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INDEX TO VOLUME LXXXVI

January 1 to June 30, 1921

	PAGES	
Jan. 6	1 to	48
Jan. 13	49 to	96
Jan. 20	97 to	144
Jan. 27	145 to	192
Feb. 3	193 to	240
Feb. 10	241 to	280
Feb. 17	281 to	322
Feb. 24	323 to	362
Mar. 3	363 to	408
Mar. 10	409 to	448
Mar. 17	449 to	490
Mar. 24	491 to	532
Mar. 31	533 to	576
Apr. 7	577 to	620
Apr. 14	621 to	662
Apr. 21	663 to	704
Apr. 28	705 to	746
May 5	747 to	794
May 12	795 to	836
May 19	837 to	878
May 26	879 to	920
June 2	921 to	974
June 9	975 to	1016
June 16	1017 to	1058
June 23	1059 to	1100
June 30	1101 to	1142

A

Accidents, see Failures, Engineering.
Railway, derailment on curves ..e1018, 1024
Activated sludge, see Sewage Treatment.
Adams, Prof. C. A., leaves Research Council n1095
Adams, R. M., on bunk houses built in sections *800
On mess and bunk houses on wheels..h*1006
Adams, W. H., and H. H. Esselstyn, on redesign of Belle Isle Bridge, Detroit e451, *452, n484
Adobe building, Germany returns to.... 823
Advice, gratuitous professional 330
Aeronautics, airplanes and forest fire control 329
Landing fields and air ports (book review) 476
Mails, Hayti-Santo Domingo, carried by airplane 596
Seaplanes, landing for, of precast slabs on concrete piles *984
Agricultural engineering, business in 541
Air blowers unload light commodities ... 857
Akron, Ohio, Ohio Canal bed for highway.n1136
Akron, Ohio, sewage-works studies to be made n609
Alabama highways, and Federal aid.... e706
(W. S. Keller) letter, with editorial comment, 909.
Alameda naval base rejected.....n277, n1094
(see also Naval Bases)
Alaska, engineering conditions 58
Forest reserves, new district 209
Highway development (Maj. J. A. Steese) a346
Alaska R.R. location surveys (T. W. Secrist) *632
Alaska Ry., Alaskans ask for new commission n1052
Alberta, rainmaker's contract with farmers (K. T Roberts) ....letter 1090
Albertson, W. B., on slip scraper for unloading rock and sand h*86
Albrecht, E. C., on reconstruction of upper (K. T. Roberts) ....letter 1090
Alcohol from wood waste 268
Aldrich, S. W., on pouring culvert below freezing h*137
Alexandria, Va., Washington's town plan..1085
Algæ, removed from basin walls by use of copper sulphate 223
Allen, Governor, of Kansas, for state-made cement 266
Allen, K., on prediction of probable rainfall intensities.....*588 (L. S. Hall and K. Allen) letters 825.
Allied Business Metal Industries reopen shops n362
Alpha and Cement Securities Co. plan consolidation n321
Alum, see Water Treatment, Filters.
America, fortunate e976

AMER. ASSN. OF ENGINEERS

Aud Federation co-operation n1007
Boston chapter forms section n278
Conference with Amer. Engineering Council n1094
Convention n784, e837, n870, e881
Decentralization e881
Employment service (E. B. Miller) 66
Federal Council, reclassification report n1139
Federal department, engineers discuss status n526
Great Northern Section, educational plan. 563
(see also n612)
Membership, 24,026, on Jan. 13.....n396
New York State Assembly organized...n609
Presidential candidates n656
Progress in 1920, etc. 64
Publicity conference.....n316, e364, n395
Questionnaire on education 80
Railroad conference n570
Services and fees, committee report on.. 671
Southern Pacific Section before Railway Labor Board, on engineers' pay.....n1094

Page
Tennessee chapters approve licensing bill n93
Amer. Automobile Assn., G. C. Diehl president n965
Amer. Concrete Institute, committee report on plant layout e491, *505
Meeting e324, a348, n355
Amer. Engineering Council, see Federated Amer. Engineering Societies.
Amer. Engineering Standards Committee begins work on terminal marking for electrical apparatus n141
More standards submitted to n318, 572
Report 729
Amer. Fed. Labor, see Labor.
Amer. Highway Educational Bureau to produce film n612
Amer. Inst. of Electrical Engineers, convention n43
McClellan, Dr. William, president ...n1010
Amer. Inst. of Mining and Metallurgical Engineers, Stoughton resigns secretaryship n1052
Amer. Iron and Steel Institute meeting....n403
Amer. Pub. Health Assn. moves to New York n915
Meeting n1095
Amer. Railway Assn. elects officers n93
Amer. Railway Engineering Assn., officers nominated n142
Convention n396, e409, 515, n524
L. A. Downs, new president n*526
Amer. Road Builders' Assn. convention.... n91, n315, e324, a345
Good Roads Congress e193, n235
Amer. Soc. for Testing Materials, convention report and abstracts.....e1103, 1126
Joint Committee report.....e1101

AMER. SOCIETY OF CIVIL ENGINEERS

Activities e3, e4
Annual convention...n43, n139, e146, n188
Harmony at e747, n782
Board of direction endorses completion of U. S. maps n1094
Supports Federation employment bureau n1096
Chandler, E. M., acting sec. n784
Classification and compensation committee report n912
Committee chairmanships (A. T. North) .....letter 232, (L. Metcalf) letter 310.
Committee on corporation practice of engineering n963
Committees, new n189
Constitution:
Amendments, all defeated n442
New, likely by fall.....e747, n782
New, when would it begin to function? (P. H. Norcross and Parker & Aaron)).....letters 693.
New proposed e578
Revised 559
Directors' annual report n187
Discusses New York-New Jersey port report n482
Machinery, construction, society's neglect of e879
Membership 770
New York Section discusses heat, light, power n317
Discusses Hudson River crossing n870, e880
Meetings n44, n142, n189
Organization, etc. e5
Officers, Biographies of, etc.
n*317, n*357, n*397, n*443
Proceedings, technical life of society revived e747, n782
Secretary, none elected n446
Secretary, salary fixed at $10,000 for 1921 439
Student chapters 520
Webster, G. S., new president n*139
Wellington transportation prize, society accepts, and conditions n189

Amer. Soc. of Mechanical Engineers, discusses road-building machinery....n1011
Kimball, D. S., nominated for president.n1094
Spring meeting n484, n1010
Amer. Specification Institute plans maturing n318, 572
Amer. Surety Co. information service for contractors n703
Am. Water Works Assn., Illinois and Iowa Sections meet n569
Convention n1049
New York Section meeting n559
Problems and practice, abstracts of convention papers (A. Wolman and others) a1039
Standardization, committees on.....n1049
Amer. Wood Preservers' Assn., abstracts
Analysis of double footing pressures (F. R. Eshing) .....letter 232
Anderson, A. P., on 1920 motor vehicle statistics 683
Anderson Cottonwood Irrigation District, Cal., inverted riser ends in riser on bridge pier.....*562 (E. H. Tashjian) letter *780
Anderson, G. T., biography.....n*443
Antioch, Cal., wins brackish water suit..*513

Page
Antioch plan of education (A. E. Morgan) .....e99, 108, (E. S. Closson) letter 233, (C. A. Plumley and R. L. Morrison) letters 349, (C. R. Young, A. E. Morgan and L. S. Le Tellier) letters 480, (S. Sims) letter 651, (A. E. Morgan) letter 779
Ants, white, see white ants.

APPLIANCES

Auger, earth, attached to motor truck (M. Garlinger) h*655
Chipper tool, pneumatic, salvages brick. h*655
Slip scraper with A-frame for unloading rock and sand (W. B. Albertson).h*86
Support, simple, for trestle legs while replacing footings (D. G. Coombs)..h*42

Aqueduct, Sudbury River, changes in cleanness coefficient (F. I. Winslow).....*1132
Architects, "Handbook of Architectural Practice," book review 475
School for, advocated by Wisconsin Engineering Soc. n398
Area in acres, computation (H. N. Bradstreet) 804
Arizona highways, bid 65 per cent of estimate n786
Arkansas highways, construction in cypress bottoms (D. A. MacCrea) *196
Highway financing disclosures .....e577, n611, n699, e706, (W. S. Keller) letter, with editorial comment, 909, n1052, e1060
State seeks highway engineer.....n1092
Arlington Sanitary District, Va., water and sewers for n914

ARMY, U. S.

Construction Division, reunion n189
Engineer Corps, examinations n443
Engineer colonels, five new n1093
Officers go to Rensselaer.....n1095
Vacancies e449
Will get 7% of West Point graduates.n914
Work of (F. G. Jonah) .....letter 88
Engineers demobilized in 1920 19
Engineers, shall arm be recognized in promotions?.....e365, (Col. J. H. Graham) letter 439
First Engineers decorated n610
Motor equipment needed for State roads n277, n318
Thirteenth Engineers organized 58
Ash, C., and others on highway bridges .. 214
Ashland, Ky., cost-plus contract gives low cost on filters (L. R. Howson)..... 388
Asphalt Assn. convention n744
"Assembly" planned by Council n697
Assoc. Engineering Societies of St. Louis formed n142

ASSOCIATED GEN. CONTRACTORS

And New York building scandal e3
Committee on building problems n701
Convention n47, e97, e194, n*235, e838
Denver contractors to join n47
Ethics, proposed code e241, 257
Executive board to meet n743
Meeting discusses new plan for contracting e838
Nominations n94
Seek income tax data n790
Spokane branch formed n746

Associations, trade, see Trade Associations.
Atlanta, Ga., new viaduct location.....n1136
Atlanta votes for water-works, etc. n530
Atlanta, Birmingham & Atlantic, valuation report 686
Atlantic-Gulf canal survey recommended .n277
Atlantic City, N. J., groundwater pumping and hydraulic excavation for hotel foundation *52
Atlas Co. statement on cement prices.....n703
Auger, earth, attached to motor truck (M. Garlinger) e*655
Australian contract awarded here.....n970
Australian steam-electric plant to use 50c. coal 296
Automatic recorder for stream discharge, see Recorder.
Automobiles, see Motor Vehicles.
Automotive Engineers, Soc. of, announces highway session n45
Organizes research department n570
Avery, H. T., on diagram for vertical curves *1004

B

B. Welchii tests, see Water Supply, Tests.
Bagdad Ry. international problem.. e411, *423
Baker, P. S., on filling high viaducts on Phila. & Reading.....*1020
Bald Eagle Creek, Pa., bridge, failure....n525
Baltimore, garbage feeding contract given up n237
Garbage and refuse plant.....n698
Baltimore & Ohio bridge at Pittsburgh, see Pittsburgh, Bridges.
Bank investigation by Lockwood committee denied n362

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

Banker on financing highway construction (H. F. Beebe) 16
Banker's analysis of business outlook (F. H. Scisson) 204
Banks, many buildings being erected.....n877
Barba, W. P., review of "Making, Shaping and Treating of Steel" (Camp and Francis) 130
Barge Canal, New York State, see Canals.
Bark beetle, getting rid of (J. A. Kitts), letter 522
Barker, H., review of "Financial Engineering" 127
Barnes, F. E., on labor costs in building construction e889
Barney, W. J., on union schedules and building operations 886
Barranquilla, Colombia, water supply, etc. (G. C. Bunker) *10, e706, 732
Barrett Mfg. Co., Frankford, Pa., fire-resisting concrete building e747, *760
Barry, P. J., on combined methods in topographical surveying *801
Batchelder, A. G., killed n1010
Beaman stadia arc reduction table for (W. S. Dix) *78

BEAMS

Concrete, repeated reversal stress tests.. 504
Concrete, T-beam designed as truss (J. B. Hutchings, Jr.) .....letter 135, *233
Concrete, of uniform live load, moments for (H. M. Gibb) *807
Continuous, of uniform live load, moments for (H. M. Gibb) *807
Diagram for effect of flange holes (H. Kercher) *799
Diagrams for design of reinforced concrete and timber beams 807
I-beams of crane girders, properties of (J. H. Sawkins) *13
Beebe, H. F., on financing road construction, a banker's viewpoint 16
Beetle, bark (J. A. Kitts).....letter 522
Bekay, A. V., on special light gypsum blocks in floor construction *544
Belgium, standard specification for structural steelwork.....71, (R. Fleming) letter 478
Belle Isle Bridge, see Detroit.
Benn, E. J. P., on economic disturbances in England e1060, a1069
Bennett, C. J., and others, on highway bridges 214
And others, on motor vehicle law..... 722, see also e665 and *666.
On traffic problems of state highway department 935
Review of "Location, Grading and Drainage of Highways" (Harger).....1045
Bennett, C. S., on concrete monuments, Miami District *806
Bergen County, N. J., to have own road material plant n698
Besselievre, E., on engineering problems in bubonic plague control *113
Bessemer Limestone & Cement Co., Youngstown, Ohio, electric haulage *956
Besson, Maj. F. S., on further study in economics of garbage reduction 258
Best, B. G., on shaft sinking by bucket and trolley h*962
Bethlehem Steel Co. reduces wages..n46, n362
Big Chute, Ont., power plant, horizontal diaphragm increases surge tank capacity *67
Biles, G. H., on snow removal and drift prevention on highways *230
Billings, L. C., on tastes and odors from chlorination a1041
Biographies, little known, of engineers... 863
Birmingham, Ala., carpenters cut own wages n530
Water contract extended..... 636
Black Canyon Dam to cost $1,200,000....n878
Blaeser, A. A., on wing walls of concrete arch held by tie rods *721
Board of Surveys and Maps names officers..n571
Bohland, C. P., on freezing water distorts steel column and base *935
Boiler-stack support, timber for temporary set-ups (G. W. McAlpin) h*523
Boilers, feed water for filtered through hay.....h*869, (L. L. Tribus) letter 1047
Treated, precipitation from 458
Bolling, C. E., becomes city consultant after 48 years' service *955
Bonding operating expenses, Chicago e364
Bonneville Irrigation District, return water pumped 300 ft. 887

BOOKS

"Activated Sludge Process of Sewage Treatment" (Porter) 865
"American Business Methods" (Parsons) 691
"American Industry in the War" (Baruch) 691
"American Rural Highways" (Agg)... 476
"Building Estimator's Reference Book" (Walker) 1046
"Community Health Problem" (Burnham) 476
"Concrete Roads and Their Construction" 476
"Concrete Work" (Hatt and Voss)... 475
"Conservation of Nitrogen, With Special Reference to Activated Sludge" (Fowler) 865
"Criticism of the Nile Projects" 689
"Discovery of Electromagnetism in 1820 (Oersted) 131
"Earthwork and Its Cost" comment on (C. P. Dunn) .....letter 125
"Factory Administration and Cost Accounts" (Elbourne) 691
"Financial Engineering" (Sabin), review by H. Barker 127
"Handbook of Architectural Practice".. 475
"Handbook of Building Construction" (Boyd) 686
"Handbuch des Wasserbaues" (Engels).
review by A. Hazen.....1044
"Herbert Hoover" (Kellogg) 476
"Housing Famine; How to End It" 307
"Human Engineering" (Wera) 865
"Hydraulics of the Miami Flood Control Project" (Woodward), review by R. E. Horton 690
"Hydraulics With Working Tables" (Bellasis), review by R. E. Horton) 128
"James Nasmyth, Engineer: An Autobiography," review by E. A. Van Deusen 474
"Labor's Crisis" (Mendelsohn) 308
"Landscape Gardening" (Simonds)..... 865
"Layout of Small Water Mains" (Hellin), review by R. E. Horton 864
"Lehrbuch der Eisen-und Stahlgiesserei" (Osann) 307
"Location, Grading and Drainage of Highways" (Harger), review by C. J. Bennett 1045
"Maintenance of Way Cyclopedia" 863
"Making, Shaping and Treating of Steel" (Camp and Francis), review by W. P. Barba 130
"Manual of Gas Distribution" 475
"Masonry Structures" (Spalding) 691
"Modern Road Construction and Maintenance," Hong Kong (Goldsmith).... 475
"Municipal Landing Fields and Air Parts" 476
"Naval Consulting Board of U. S." (Scott) 131
"New York State Barge Canal"..... 865
"Power Situation During the War" (Keller) 864
"Practice of Railway Surveying and Permanent Way Work" (Perrott and Badger) 865
"Public Health and Hygiene" 690
"Rainfall and Runoff in Miami Valley" (Houk), review by R. E. Horton...1044
"Red-Lead and How to Use It in Paint" (Sabin) 864
"Reminiscences of a Municipal Engineer" (Boulnois) 128
"Report of the Nile Project Commission" 689
"Report on the San Francisco Bay Marine Piling Survey" 308
"Silvanus Philipps Thompson" 308
"Trank Construction" (Beck) 864
"White Lead" (Sabin) 126
Books, text, see Textbooks.
Borers, marine, see Teredos.
Boring machine, thrust (W. H. Shields) letter 393

BOSTON

Building trade strike.....n191, n530, n615
Garbage contract still in force n356
Gas rates increased 955
John Hancock building, pile load based on penetration in redriving (J. F. Mullen) *344
Labor enters contracting field n489
Molasses tank collapses, trial resumed..n569
Water supply, cleanness of Sudbury River aqueduct (F. I. Winslow).....*1132
Boston Soc. of Civil Engineers interesting young men in society work e837, 848
Boulnois, H. P., reminiscences 128
Bowen, E. R., on failure of steel truss support wrecks concrete dome.....e281, *294, (J. T. N. Hoyt) letter 479, (F. A. Johnson and H. W. Bolin) letter 479.
Boycott, secondary, held illegal e49
Brackenridge Borough, Penn., injunction against impure water n483
Brackish water suit won by Antioch, Cal..*513
Bradstreet, H. N., on computation of areas in acres 804
Brattleboro, Vt., bridge failure.....n1095
Brazil, railway construction in 1921.....1068
Breed, H. E., on motor trucks and industrial railway on road job *289

BRICK

Common conditions in industry..... n448, n834, n1013
Concrete, made without forms *148
Conference, Philadelphia n1014
Manufacturers and Government bureau to study n530
Manufacturers' convention; building costs, etc., discussed n279, e281
Salvaged with pneumatic chipper tool..h*655
Sand-lime, qualities 425
Surplus on hand over orders n46
Bricklayers, British, output of.....n745
Chicago, demand pay increases..... n94
Efficiency commended by employers....n322

BRIDGES

Allegheny River at Pittsburgh, B. & O. R.R. bridge, see Pittsburgh, Bridges.
Arch, are they permanent? e283
Arches and girder spans for bridges.... 291
Bald Eagle Creek, Pa., failure.....n525
Bascule, repaired by electric welding..*727
Belle Isle, Detroit, see Detroit.
Bethlehem, Pa., bids soon n969
Bids soon on two bridges n969
Bills before Congress n316
Camden, see Bridges, Philadelphia-Camden.
Chicago, work stopped n829
Chinese $10,000,000 bridge, Dr. Waddell on commission n785
Colorado River, in Grand Canyon, building.....*254, (G. E. Goodwin) letter 352.
Columbia River, plan to bridge.....n484
Concrete:
Arches and girder spans 291
Long arch bridge built of slag concrete (W. C. Fry, Jr.).....*840, (J. L. Campbell) letter 1005.
New arch survives washout of centers (C. L. Wood) *809
•Pile bridge fails from slipping foundations (E. E. East) *334
Sidewalk separation, Spokane *153
Tempe, repair after damage by pier settlement and floor expansion (M. Butler) e663, *675
Truss spans erected without falsework h*608
Two record-breaking bridges 851
Wing walls held by tie rods (A. A. Blaeser) *721
Dayton, Ohio, pier failure wrecks two spans of concrete arch bridge..... n187, e193, *264, (J. T. N. Hoyt) letter, with editorial comment, 351, 511.
Dayton, Ohio, another in danger.....n524
Delaware River, see Bridges, Philadelphia-Camden.
Design, review of column formulas for (Engineer of Bridges) e410, *431
Detroit, Belle Isle, see Detroit, Belle Isle Bridge.
Eads, reconstruction of upper deck of approach (E. C. Albrecht) *412
Evansville, Ind., see Bridges, Ohio River.
Failures, see Failures, Engineering.
Feather River, Cal., contract lower than estimate n575
Floors, asphalted, edge waterproofing for (W. H. Tiedeman) .....letter *950
Floors, expansion *153
Flooring, new, reduces sway h*523
Floors, reconstruction Eads Bridge approach (E. C. Albrecht) *412
Footbridge, suspension, worth study (C. H. Blackman) .....letter *1005
Georges Creek, Md., resistance of railway bridge to impact under train wreck (C. B. Pyle).....e98, *100, e450, (A. W. Buel) 463.
Gulf Coast, ordered rebuilt n142
Gulf Coast, L. & N. R.R., order to rebuild opposed n610
High Bridge, New York, to remain n236
Highway:
Arches and girder spans for bridges..291
Conditions and requirements, a symposium (C. L. Hussey and others). 214
Edge waterproofing for asphalted floors (W. H. Tiedeman)....letter *960
Falsework failure wrecks large bridge, Connecticut River, Brattleboro, Vt.n1095
Impact, roughness, analysis of (W. Whited) *582
Impact under high-speed traffic (W. D. Uhler) 583
Indiana, large plans.....n1055
Kansas conditions 208
Load limitation by county upheld in Ohio n398
New Jersey bridges inadequate..... 223
New Jersey, density in 258
Old, assuring safety in (M. W. Torkelson).....e50, 61, 214, (M. Goodkind), letter *311
Railing, strong 253
Roughness impact, analysis of (W. Whited) *582
Strengthening, to carry heavy traffic e579, 580, *582, 583
Timber combination 387
Truss spans, concrete, erected without falsework h*608
Hudson River, Association to be incorporated n656
Planning for *900
Relative merits of bridge and tunnels 430
Intercounty, New Jersey, state board suggested n141
Kenova, measurement of secondary stresses (Prof. C. T. Morris)..letter 86
Lake Worth, Fla., bids soon.....n965
Load limitation by county upheld in Ohio n398
Lehigh Valley, Bethlehem, Pa., bids soon n969
Louisville & Nashville, see Bridges, Gulf Coast.
Maintenance, joint, subject to commission control, Pennsylvania n913
Mississippi River, at St. Paul, bonds approved n913
Ohio River, Evansville, Ind., legislation for n91, n571
Permanent e283
Philadelphia-Camden:
Engineering studies for.....*1086
Foundation borings begun n142
Report approved by commission....n1136
Report expected by early summer..n571
Site, commission holds hearings on..n1092
To be suspension.....e1018, n*1049
To have 135-ft. clearance.....n740
Pier settlement, see Bridges, Concrete.
Pins, higher stresses for (D. B. Steinman).....e492, *504, (A. W. Carpenter) letter 651, (D. B. Steinman) letter 735.
Platte River, construction of substructure (J. H. Merriam) *1078
Railway:
B. & O., over Allegheny River, at Pittsburgh, reconstructed at new grade *284
Corrosion by locomotive gases, bridge reinforced 959
Gulf Coast, ordered rebuilt n142

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page
Louisville & Nashville opposes order to rebuild n610
Piers, maximum compression on (F. K. Eshing) ....letter 232
Repairing bridge damaged by train wreck (C. B. Pyle)....e98, *100, e450, (A. W. Buel) 463
Strength in (C. B. Pyle)....e98, *100, e450, (A. W. Buel) 463, (F. H. Frankland) letter 566
Susitna, Alaska R.R., opened n358
Turntable girders, old, used for bridge h*137
Repairs, bids drop 50 per cent in nine months n1141
Research, structural, in Switzerland....1113
San Francisco Bay, to cost $25,000,000, proposed n1053
Schuylkill River, Philadelphia, to be rebuilt n1138
Stresses, secondary, measurement of (Prof. C. T. Morris) ....letter 88
Stresses, secondary, resistance to, saves bridge with member missing (J. W. Peare) ....letter *234
Substructure for Platte River bridge, construction (J. H. Merriam)....*1078
Suspension, footbridge worth study (C. H. Blackman) ....letter *1005
Sway reduced by new flooring....n523
Swing bridge calculations, short method (Prof. C. A. Ellis) *981
Swiss builders' structural research board, work of 1113
Tempe, see Bridges, Concrete.
Troy, N. Y., new bascule span....n829
Brightwood, Pa., ash-handling plant, Pittsburgh & Lake Erie R.R....*172
Brindell, R. P., refused change of venue....n46; convicted, n279; begins term, n615
Brindell, R. P., aids get prison terms....n1098
British Institute of Transport growing. 313
Bronx River Parkway Drive, specialized use of mechanical equipment (W. F. Welsh) *205
Brooklyn-Staten Island tunnel, act for....n874
Brown, B. L., biography n397
Brown Hoisting Machinery Co. new small crane n*490
Brush wire scratch, used to clean building stone n1016
Bubonic plague control, engineering problems in (E. Besselievre) *113
Buck, W. V., on superelevation of curves at cross-roads *858
Bucket-loader converted into crane h*781
Buel, A. W., on Georges Creek accident and ruggedness in bridges....e450, 463, (see also e98, *100), (F. H. Frankland) letter 566
Buetow, W. C., on Wisconsin day-labor road construction 1070
Buffalo, N. Y., commission government, attack on n745
Water supply, filtration proposed....n525
Buffalo Springfield Roller Co. accused of unfair competition n322

BUILDERS (see also CONSTRUCTION; BUILDINGS; NEW YORK CITY, BUILDING SCANDAL)

And labor leaders indicted, Chicago n191
Builder opposes wage cut n190
Announce wage cuts n575
New Jersey, bill to license n530
New York City, registration proposed. n444
Building, see Construction.
Building and loan associations, statistics. .n969
Building Officials' Conference n530, 775
Building Trades Employers Assn., N. Y. City, under fire n46, n94

BUILDINGS

"Building Estimator's Reference Book," book review....1046
Concrete, fire-resisting e747, *760
Conference on occupancy and standardization 775
Construction, handbook (book review)....688
Contracts awarded on 57 per cent of permits issued n322
General motors Detroit, construction details (J. Matte, Jr.)....*624
Large, moved in Pittsburgh....n745, (E. Dauenhauer) *904
Reinforced-concrete, six stories added to (W. H. Wheeler)....*585, (R. E. W. Hagarty) letter 825, (W. H. Wheeler) letter 1005, (V. D. Fixen), letter 1133
Reinforced-concrete, special light gypsum blocks in floor construction (A. V. Bekay) *544
Steel, higher working stresses in frames suggested 112
Street traffic tremor, effect on buildings e282, n315
Work active....n1057
Bulkhead, wood, holds fill on soft bottom h*1048
Bump, M. R., new N. E. L. A. president. .n1093
Bunker, G. C., on Baranquilla, Colombia *10, e705, 732
Bunker, cost of, saved by storing materials in surge chamber h*440
Bunk houses built in sections (R. M. Adams) *800
On wheels (R. M. Adams) h*1006
Burch, G. F., and others, on highway bridges 214
Bureau of Foreign and Domestic Commerce, Hoover plans divisions n789
Bureau of Public Roads, report on motor truck impact tests e534, *553
Wear tests of paving materials....*1121
Bureau of Standards, Hoover asks $50,000 for n789
Plastering code undertaken 11
Tests:
Bond resistance 512
Concrete beams, repeated reversal stress tests 504
Sand-lime brick 425

BUSINESS

And Government, co-ordinating....e664, (book review) 691.
Conditions in relation to cosntruction..e2, 14
Information, value of....e922, n968, n1014
Methods (book review) 691
Outlook (F. H. Sisson) 204
Prophecy, economists better than business men (R. E. White)....letter 1090
Reducing overhead costs n787
Situation viewed from three special angles (A. I. Findley and others)....n400
Statistics needed e749, n787
What of business? e281
Butler, A. D., on road guard rail timbers mounted on concrete pipe *499
Butler, M., on repair of Tempe concrete arch bridge e663, *675

C

Cables, Channel, see Channel Cables.
Cadle, C. L., appointed supt. of public works, N. Y. State n43
Calcutta dock, work begun 892
Calder, Senator W. M., urges trade schools. n190
Calder committee reports on reconstruction n574

CALIFORNIA

Highways:
Bonds, rate raised to 5¼%...n277, e493
Concrete pavement on saturated adobe foundation (T. E. Stanton) *217
Danger of losing Federal aid denied..n441
Gasoline tax proposed n569, n657
Investigated by Federal Bureau....*469
Oil insulation of subgrades used in experiments n1135
Policy criticised in report 207, e242, 268, 340, n1138
Practice 59
Precast slabs vs. monolithic concrete for repairs 156
Irrigated area 386
Irrigation plan (Marshall, all-California plan), (G. S. Nickerson and others) ....letter 273, n277 (G. B. Ashcroft) letter 606, e977, *904
Northern California Power Co. valuation case 1125
Power contracts, preferential, subject to regulation, California 370
Sacramento Valley, clam-shell dredges, large size, used *978
Water power, development by cities discussed n1011
Filings on 1116
Program, enormous 85
California R.R. Commission decision in Northern California Power Co. valuation case 1125
Calumet harbor for Chicago 673
Calumet sewer, see Chicago Sanitary District.
Cambridge, Mass., mechanical water filtration n569
Camp commissary h42
Campbell, J. L., on leakage from machine banded wood pipe 124
On water-hammer prevention in long railway force main 951
Camps, bunk and mess houses built in sections (R. M. Adams) ....*800, on wheels, h*1006

CANADA

Engineering legislation (F. S. Keith)... 21
Government takes Grand Trunk..n830, n914
Oil fields, rail routes sought 1038
Public works construction asked as unemployment relief n190
Railways, Govt., $179,000,000 for....n488
Railways, Lord Shaughnessy's proposal..e837
Railways, reductions, 10 per cent in rates n1136
Railways, routes to oil fields sought....1038
Three provinces lack licensing laws.... 31
Canadian Pacific Ry., lining Selkirk tunnel, plant and equipment (Staff of S. E Junkins Co., Ltd.) *418

CANALS

Atlantic-Gulf, survey recommended ...n277
Cape Cod, purchase favored n1094
Lake Washington ship canal, widening urged n277
Lining, concrete, special joints for....*902
Moss in, eradicating 103
New York Barge Canal, association to further use n574
Back to state control e449, n185
Bids for equipment rejected n702
"Book of plans" issued....e705, (review) 865
Concrete barges on 107
Engineer to run e49
Equipment bought by syndicate n1095
First 1,500 ton barge delivered n1137
Service extended n874
Store-door delivery from n738
Ocean ship, Army engineers report against n236
Ohio Canal bed for highway....n1136
Panama, see Panama, Canal.
Sault, 1920 traffic 958
Suez (see Suez).
Traffic records at St. Mary's Falls and Panama 779
Canton, Ohio, reservoir roof, flat-slab, collapses n569
Canvas carpet keeps truck body clean 370
Capen, C. H., Jr., on licensing water purification plant operators in New Jersey a1041
Car dumpers for quick unloading at grain elevator e491, *508
Car loading, December, makes record n395
Caribou plant, see Great Western Power Co.
Carpenter, A. W., review of "White Lead" 126

CEMENT

And base metals lead in value 63
Bulk, no special plant needed for handling h*86
Chemical analyses as indicators of behavior *637
Companies, indictment in New York ....e410, (S. M. Green and Atlas Co.) letters 736, (S. M. Green) letter 909.
Companies plan consolidation....n321
Compared with structural shapes for 21 years n*487
Inquiry....n46, e145, 155, n403, e975, n1014, e145, 155, n321, n403, e410, n703, 736, 909, e975, n1014, n1099
Manufacturers indicted n403
Maricopa County, Ariz., considers building plant n918
Nevada commission opposes state plant n489
Pennsylvania may tax n609
Ontario to build plant n834
Plant, municipal, Detroit to vote on...n529
Price drops n46
Prices, Atlas Co. statement n703
Prices before and since war....n743
Production 100,000,000 bbl. in 1920..n321
Setting time, modified Vicat apparatus used for study (O. L. Moore)....*70
State-made, advocated by Governor Allen of Kansas 266
Tests, chemical *637
Tilting measuring box h*86
Cement gun, coats steel trash racks....*1003
Long concrete piles built up with....*420
Used in interlining reservoir (B. A. Greene) *958
Cement Securities Co. and Alpha Co. plan consolidation n321
Census, traffic, see Highways, Traffic.
Chamber of Commerce, International, see International, etc.
Chamber of Commerce, U. S., conference on housing n94
Analyses construction....n1099
Construction industry, bulletin on....e1101
Government employment policy, revision urged by Chamber n1137
Meeting, annual n94
Report on housing n787
Unified rail operation, committee favors. n914
Urges cheaper building materials....n239
Chandler, E. M., acting sec., Am. Soc. C. E. n784, n829
Channel cables, electrified, pilot ships.... 590
Channels, diagram of effect of flange holes (H. Kercher) *799
Chatham, Ont., poor water pressure due to unopened valve 203
Chauny, France, competition for sewerage plan n699
Chestnut wood from blighted trees better than healthy wood (E. A. Weimer) letter 312

CHICAGO

Bonding operating expenses e363
Bridge tenders' houses, Michigan Ave. bascule bridge, gifts for n610
Bridges, work stopped n829
Building inquiry n191, n574, n614, n790, n1013
Building trades vote continuance of $1.25 scale n191
Calumet harbor for Chicago.... 673
City bridge engineer reinstated....n914, 1043
Engineers protest against appointment ....n740, personal note 572.
Expert Builders formed n447
Garage, long-span concrete roof arches..*167
Garbage reduction plant shows poor results 856
Harbor, Army engineers propose new location *120, n526, 673
Progress convention n657
Railway terminals, commission changes. n446
Proposed improvement *845
Snow-loading machine *176
Stockyards, waste disposal, final report on *815
Street railways, municipal ownership for n398
Terminal problems 1077
Unemployment n279
Water supply, why it is not filtered....e707
Chicago Assn. of Consulting Engineers formed n484
Chicago Expert Builders formed n447
Chicago Sanitary District, alternative outlets for sewage pumping station *65
Calumet region sewage treatment plant (L. Pearse) *986
Chimneys, reinforced-concrete, diagrams for (F. E. Hertel) *803
Loose anchor bolts and chimney theory (W. W. Christie) ....letter 1047
Smelter contract for tile concrete stack let n1141

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts.

Page

Stresses in (F. S. Bailey)....letter 393, (E. A. Dockstader and E. S. Martin) letters 363
Steel, lined with concrete, felled...*855, (Lukens Steel Co. and Walworth Mfg. Co.) letters 1099
China, primitive wheel-and-bucket pumps (O. Sherven).....letters *134, (D. C. Washburn) letter 273.
Tidal power plant (J. H. West).....*378
Yellow River $10,000,000 bridge Dr Waddell on commission.....n785
Chipping hammer, pneumatic, cleans bricks n*655

Chlorine and chlorination, see Water Supply.
Church, J. E., Jr., on snow surveying for forecasting stream flow *241 *300
Chutes, drop, with gravity plant pours steel building floors n962
Saving rope in hanging (C. W. Garrison) h*1091
Zigzag concreting (V. K. Woods) e747, *752, correction 935.

CITIES

And unemployed e241
Atlanta votes for waterworks, etc. n530
Bond decisions slow up street work, Columbus, Ohio n834
Bonding operating expenses e364
Brick and cement plants, city, authorized by Detroit voters n703
Buffalo, N. Y., commission government, attack on n745
California, discuss municipal water-power development n1011
Cleveland, neighborhood group plan.... 66
Widening and arcading Euclid Ave....*715
Columbus, Ohio, planning commission, engineers on n1009
Curbing, header, replaced *729
Duluth, Minn., to have sanitary survey..n570
Engineers:
Broad powers, Sacramento, Cal. 895
Cranford, N. J., pays city engineer $1 for each inhabitant 683
In city government.....e706, (A. L. Dabney) letter 734, (W. E. Brown) letter 909.
Move to take Pennsylvania city engineers out of civil service 161
To advise on new charter for Nashville, Tenn. n44
Finances in relation to improvements .....e6, (E. H. Foster) letter, with editorial comment, 133.
Statistics 668
Fire danger in parked automobiles 213
Fire hydrant, thawing device n745
Garbage and refuse disposal, see Garbage.
Gas rate increased, Boston 955
Health officers need not be physicians..e663
Housing project, Olean, N. Y. (J. Nolen) *80
Improvements, municipal dilemma.....e6, (E. H. Foster) letter, with editorial comment, 133.
Jersey City, N. J., plans for port terminals, etc. *177
Lethbridge, Alta., to have manager.... n44
Manager plan authorized by three states 1002
Manager plan, New Haven rejects, New London adopts n1138
Manager plan proposed for Cleveland, Ohio n698
Milk plant, municipal, at Jamestown, N. Y., delayed 253
Montreal retains mayor-and-council charter 934
Municipal engineering, Pres. Webster on n782
Municipal ownership, for Chicago street railways n398
Water-works, Clinton, Ia., rejects....n446
Municipal supply scheme in London...n917
Neighborhood group plan for Cleveland.. 66
Pasadena adopts city manager form...n1009
Pavement rule in London..... 764
Paving contract, Gary, Ind., 83 per cent of estimate n745
Planning:
Alexandria, Va., Washington's plan...1085
And subdivision plans 510
Commission, Columbus, Ohio, engineers on n1009
Conference, zoning principal subject... n740, n870
For small towns *1025
Housing project, Olean, N. Y. (J. Nolen) *80
Lake Charles, La. 176
Tribute to L'Enfant 649
Univ. of Colorado course n658
Rated by water supplies, Indiana..... e663, 686.
Sacramento, Cal., city manager appointed n965
Seattle to vote on bond issue.....n316
Water dept. shows profit n658
Sewers, see Sewers.
Smoke abatement study and plans, Salt Lake City 74
Street cleaning and related work, Philadelphia (J. W. Follin) 166
Phila. plan for contract killed.....n874
Street traffic tremor and buildings..e282, n315
Streets:
Pavement, stone block ripped up by grader h*911
Pavements, maintenance by street railway companies (A. Swartz) *1118
Resurfacing brick and cobble (W. H. Eagle) *798
Rubber paving London 1120
Thoroughfare plan and program, Cleveland (R. H. Whitten).....*382, *715
Traffic control, engineering problem.... e51

Page

Traffic control, uniform signs, etc., needed e1059, e1060
Traffic regulation, principles of (W. P. Eno) 996
Traffic, elevated sidewalks for congestion (F. W. Harris).....letter *606.
Traffic, streets fenced for safety?....e796
Traffic, London, bill for regulation...n1137
Trailers in municipal service (H. W. Perry) *374
Utility bonds, city-owned outside debt limit 175
Water-supply, see Water Supply and Water-Works.
Zoning, Minnesota cities n740

Civic Federation meeting.....n188
Civil Service examinations 94, 572, 1096
Clay, investigation by department..e975, n1014
Cleaning arch form with air hose prevents raveling concrete h869
Cleaning building stone, wire scratch brush used n1016
Cleary, A. J., on California rock tunneling practice *1082
Clemmer, H. F., on testing cylinders for Illinois experimental road *1116

CLEVELAND, OHIO

City manager proposed n698
City sues to void bond issue for viaduct n398
Clearwater basin suit e535, 549
Fisher Body Ohio Co. plant (automobile bodies) e49, *82
Neighborhood group plan 66
Reservoir, low bid n917
Thoroughfare plan and program (R. H. Whitten) *382, *715
Fifty-cent, to be used by Australian steam-electric plant 296
Mines under cities, maps must be filed..n401
Strike, British, see Labor Strikes.
World production, 1920..... 903
Cofferdam in swift water held by anchor dam and timber spuds (G. W. McAlpin) n*481
Colleges, see Education, also Universities.
Colombia engineering in (J. L. Crane).... 907

COLORADO

Floods ..e975, n1008, e1019, n1049, n*1051
Free employment bureau for engineers- 381
License law revised n698
Colorado Fuel & Iron Co. employs 1,000 more men n488
Colorado River, building bridge across, in Grand Canyon...*254, (G. E. Goodwin) letter 352
Compact proposed n1096
Floods threaten Imperial Valley.....n1093
Power site surveyed n1096
Problems 862
Colorado River, Cal., power project filed on n93
Columbia Basin costs found low by board.. 733
Surveys continue n1136
Columbia River, jetties, properly constructed 138
Plan to bridge n484
Columbus, Ohio, bond decisions slow up street work n834
City planning commission, engineers on..n1009
Garbage reduction economics (Maj. F. S. Besson) 258
Water-works, dam named for J. O'Shaughnessy 349
Columns, formulas for bridge design, review of (Engineer of Bridges)....e410, *431
Steel, and base, distorted by freezing water (C. P. Bohland) *935
Commerce Chamber, U. S., see U. S. Chamber of Commerce.
Commercial association and engineering.... 124
Commissary camp h42
Committee on Elimination of Waste in Industry work of e491
Compressed-air tunnels, "sand hog" to reappear (D. J. Price) e622 *634
Compressors, steam simply converted to electric drive (D. G. Coombs)..... h87

CONCRETE (MATERIAL) see also CONCRETE ARCH, ETC.

Aggregate, sand in bulking noted years ago by Feret (A. E. W. King)..... letter, with editorial comment, 136, (G. M. Williams) letter 312.
Slag, see Concrete, Slag.
Amer. Concrete Institute, meeting..... e324, a348, n355
Chutes, see Chutes.
Cold weather concreting, see Concreting.
Colorings, effect on strength 721
"Concrete Work," book review..... 475
Flowability, see Concrete, Mixing.
Forms, air vent in form for tunnel lining h*1134
Forms, wall, job-fabricated wire ties for (D. G. Coombs) h*138
Fusing temperatures 694

Page

Mixing:
Delays reduced by careful maintenance h*1134
Flowability and the minute mix.....*705
Loader, mechanical, helps in paving..*170
Mixer, test of a349
Plant, on motor truck h*394
Portable belt-conveyors handle cement to elevated mixers h*827
Oil-proof, nonporous, for oil reservoir (E. E. Halmos) *260
Oil tanks, permeability tests.....a349
Plant, design a348
Studying e491 *505
Proportioning on job by exact methods (R. B. Young and T. V. McCarthy) .....e450, *456, (Prof. G. M. Williams and R. G. Young) letters 867.
Tests made in various laboratories..a1131
Raveling prevented by use of air hose..h869
Reinforced:
Bond resistance, new tests..... 512
Effect of excessive heat on mild steel and concrete (E. A. Cross)..... letter 353.
Electrolysis, protection against 552
Hooped column formula, new.....a348
In sea water.....e97, *121, (T. B. Shertzer) letter 392, (L. Ravier) letter 566, (F. J. Littler) with editorial comment, 652, (B. deAlzugaray) letter 910, e1018, 1032
Rods vs. expanded metal for slabs..417, 518
Steel from slag concrete shows little corrosion *212
T-beams designed as truss (J. B. Hutchings, Jr.) .....letter *233
Sea-water, concrete in.....e1018, 1032
Sea water test pieces, effect of water content (D. Patch) *373
Ship, see Ships, Concrete.
Slag, long arch bridge built of (W. C. Fry, Jr.) *840, (J. L. Campbell) letter 1005.
Some things to be learned..... 415
Spalling under frost *947
Strength, see Concrete, Proportioning.
Stucco, cracking a348
Surfaces, unsightly (A. S. Harrison).. letter 40
Tests:
Hydrated lime test specimen very lean mix (T. B. Shertzer) .....letter 392
Rods vs. expanded metal for slabs... 417, 518
Tests made in various laboratories..a1131
Water content affects wear of test pieces (D. Patch) *373
Wear tests a1130
Truss forms supported by large timber frame (R. C. Mitchell) *380
Water important in surface conditions (A. S. Harrison) .....letter 40
Winter concreting, see Concreting.
Concrete and steel construction, mixed.... *585, 825, 1005, 1133

Concrete arch, wing walls held by tie rods (A. A. Blaeser) *721
Concrete beams, see Beams, concrete.
Concrete bricks made without forms.....*148
Concrete bridges, see Bridges, Concrete.
Concrete buildings, fire-resisting.....e747
Concrete footings replaced: simple support for trestle legs (D. G. Coombs) h*42
Concrete Institute, see Amer. Concrete Institute.
Concrete lining for canals, special joints.*902
Concrete piers, etc., construction of Platte River bridge substructure (J. H. Merriam) *1078
Concrete piles, see Piles, concrete.
Concrete pipe for mounting of road guard rail timbers (A. D. Butler) *498
Concrete sea wall, see Sea wall.
Concrete ships, see Ships, concrete.
Concrete structures, new stop-water for joints *681
Concrete surface roller patent upheld....n610
Concrete surfaces, unsightly (A. S. Harrison) .....letter 40
Concrete tower built to support revolving crane *1043
Concrete truss spans erected without falsework h*608
Concrete wireless tower 672 ft. high.....*847
Concreting, cold weather *167
Pouring culvert below freezing (S. W. Aldrich) h*137
Quebec power development, winter work on *1122
Concreting plant, design a348
Graphic wattmeter checks gravity plant operation *1067
Gravity, with drop chute pours steel building floors h962
Layout studied by Concrete Institute Committee e491, *505
On motor truck h394
On traveler, for pouring sea wall.....*896
Studying e491, *505
Concreting, watertight in wet gravel....h*394
Conference of State Sanitary Engineers organized n1009
Conferences e241
Congressional Library, contents 305
Connecticut, highways:
State plans increase in motor vehicle license tax n44
Traffic problems (C. J. Bennett).... 935
Connecticut River bridge, Brattleboro, Vt., failure n1095
Consoer, A. W., on concrete road building delays in Illinois 644

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

CONSTRUCTION

Activities n1013
Activities, Federal Reserve Board report 253
Analyzed by Commerce Chamber n1099
Analysis of situation, in questionnaire..n1140
And housing bureau, Federal, proposed.. n47
Bidding shows activity n403
Boston Chamber of Commerce report...n701
Boston, strike, arbitration blocked....n615
British, ex-service men in n919
British, cheaper n614, n790
British, crisis expected n615
Business conditions e2, 14
Calder Committee reports on n574
Cardinal principles, eight....n968
Chicago trades vote continuance of $1.25 scale n191
Companies' incomes analyzed....n403
Concrete and steel mixed 585, 825, 1005, 1133
Conditions and labor supply, New York State n789
Conferences, Philadelphia, and others, e325, n361, 447, n877, n1014
Congress organizes New York branch...n239
Nominating Committee.......n322, n703
Costs, see also Construction, Materials.
Costs, studying....e1017
Costs, time, of building work (F. E. Barnes) e880, 888
Deferred, extensive....n919
English, see Construction, British.
Harrisburg, Pa., mechanics ask increase.n530
Homebuilding, increase in n529
House costs for small houses compared for 1914, 1920, 1921.... 389
Illinois investigation....n574
Increases reported....n661, n833
Indiana, close to $2,000,000....n877
Industry, present and future....n917
Industry, importance of....e1101
International statistical bureau proposed n1140
Jurisdictional awards to be published..n530
Labor, see Labor;
Machinery, A.S.M.E. and Am. Soc. C.E., attention to....e879
Machinery output, 1919, $186,000,000 n1141

Materials:
Cheaper, urged by U. S. Chamber of Commerce n239
Cost, 6-year comparison (H. E. Keyes) ....n•446
Costs and wholesale prices. ....n•833
Costs in 1920 and 1921.... 646
Foreign, appear in local markets....n322
Freight rates....n876
Interests watched by Justice Department n660
Monthly prices....n616
Prices and supply of....e2, 14
Prices before and since the war.... n743
Prices, deflation urged by construction conference n447, n877
Prices and supply 15
Prices in 1920 and 1921.... 646
Prices, monthly....n616
Prices, inquiry planned by St. Louis building trades n190
Prices no indication of market conditions n403
Prices since 1913....n402, e976
Prices, situation.... e409
Prices wholesale costs construction and living ....n•833
Prices, wholesale, decrease in March..n704
Prices, wholesale, fall....n918
Road and building, lower rail rates sought n1015
Storage in surge chamber saves cost of bunker .... •440
Transported tonnage 32
Miscellaneous lead in active week n448
National conference board proposed n917
Natl. Congress of Building and Construction Industries studies costs e1017
New Jersey investigation authorized n574
New York City's, increase in February n704
New York City, stimulated by tax exemption n786
Only at reasonable costs (R. E. Newton) .... letter 350
Open-price associations e922, n968, n1014
Open-shop plan gains n1015
Outlook e2
Philadelphia trades eager to improve status n919
Plant oversize, demonstrates value..e49, •82
Problem to be discussed in London n701
Project, large co-operative, New York City, abandoned n16
Quantity, surveys and estimate payments 903
Rammed earth as "masonry" (T. C. Young).. •267 ("Former Lieut. Col. A.E.F.") letter 652
Record new.... n790
Residential construction decline marked in 1920 .... [illegible]
Responsibilities .... [illegible]
San Francisco lower wages .... [illegible]
School construction leads .... [illegible]
Second heaviest week .... [illegible]
Situation better than in 1920 .... [illegible]
Situation viewed by Federal Reserve banks.... [illegible]
Strikes follow proposed wage cut .... [illegible]
Unemployment, British, lead in building trades .... [illegible]
Union labor a tax on construction .... e[illegible], 991
Union schedules and [illegible] (W. J. Barney) .... [illegible]
Wage adjustments, see Labor.
Youngstown, Ohio, builders [illegible] cut .... [illegible]

Construction Corps, Division, Service, see Army, Construction Division.
Construction railroad built over flume to save excavation....h•440
Consulting engineers, see Engineers, consulting.

CONTRACTORS, see also CONTRACTS

Assoc. Gen. Contractors, see Assoc. Gen. Contractors.
Boston labor enters contracting field....n489
Concrete road building requires best contracting skill.... 981
Ethics, proposed code....e241, 257
General contractor, the.... 928
Highway, Indiana, loses bond suit....n744
Highway, New York, cannot obtain reimbursement for war losses....n322
Income tax data sought....n790
Information service by Amer. Surety Co.n703
Organized, and New York building scandal e3
Personnel board for field forces (M. A. Darville) ....•860
Portable power plant, Austrian....n•1141
Relief for contractors operating under Supervising Architect....n322
St. Paul labor bodies plan to enter contracting n574

CONTRACTS, see also CONTRACTORS

April exceeds $105,000,000....n786
Awarded in January, 1920, and January, 1921 ....n279, e281
Cleveland clearwater basin suit, important points decided....e535, 549
Cost-plus, gives low cost on Ashland, Ky., filters (L. R. Howson).... 388
Successful on Georgia road work (W. R. Neel).... 224
Sacramento, Cal., adopts cost-plus plan on water-filter work (C. G. Gillespie) 77
Emergency contract, new 507
February's exceed January's. n403
For 1920 and 1921 compared....n•701
Form safe is sought 430, n487
Highway construction, contractual relations (W. A. Rogers) a345, 346
June 8%, over June 1920 .... n1100
New plan for contracting....e838
Quantity, surveys and estimate payments 903
Record week n703, n1016
Reported n661
Risks, engineer's, relation to....227, e242
Risks, minimizing (W. B. King).... 227
Three large, in total of $35,000,000....n835
Coombs, D. G., on hot-water tank makes grout machine for repairing Chilean dam ....n•481
On job-fabricated wire ties for wall forms .... h•138
On simple support for trestle legs while replacing footings....h•42
On steam compressors simply converted to electric drive.... h87
Copeland, W. R., on colloid chemistry in sludge pressing....a1042
Copper sulphate for cleaning basin walls... 223
Cornell Univ., engineering colleges to combine n398
Corporations holding may be barred from Louisiana n576
Corporations, practice by, see Engineers, licensing.
Corps of Engineers, U. S. Army, see Army.
Corpus Christi causeway, contract to rebuild n530
Cost, service, planning for minimum cost.. 127
Cost-plus contracts, see Contracts, cost-plus.
Cotten, S. M., beam design diagrams.... 807
Coulumb's formula, earth-pressure curves by (A. W. Bedell) .... letter •392
Crandell, J. S., on wood-block paving in St. Louis .... •376
Crane, J. L., on engineering in Venezuela and Columbia 907
Crane, J. L., Jr., and F. Gannett on high-head centrifugal pumps, Shenandoah, Pa. .... •983
Cranes, crawling tread, O. S. dependable n•1015
Heavy motor crane combines mobility and flexibility .... n•189
Made from bucket loader .... n•781
New small-capacity .... n•490
Revolving concrete tower built to support .... •1013
Cranford, N. J., pays city engineer $1 for each inhabitant 683
[illegible] 899
Creosote, see Wood Preservation.
[illegible] experiments with R. G. Smith .... [illegible]
Cubic equations, see Equations.
Culvert [illegible] poured below freezing (S. W. [illegible]) .... n•137
[illegible] .... n[illegible]
[illegible] .... •[illegible]
Curbing, header, replacing ....
Curves, [illegible] railway, see Highway [illegible] and Railway Curves.
[illegible] F. D. [illegible] 270
[illegible]

D

[illegible] M. [illegible] Supreme [illegible] .... n[illegible]

DAMS

[illegible]

Earth-fill, hydraulic fill practice on Terrace Reservoir dam (J. E. Field).....•597
Foundation, shale, concrete dam built on ....•750
Germantown, see Miami Flood Protection Works.
Hydraulic fill, Germantown, method of capping ....•248
Sheerboards used in building.... 291
Hydraulic-jump pools effective....•764
Irrigation, earth fill; with novel details (C. V. Mann) ....•1030
Loading, how much?....e1017
Muscle Shoals, appropriation held up.... n47
Construction and plant....e533, •536
Mysore, India, power and irrigation dam (E. W. T. Slater) ....•1107
Repairing, hot-water tank makes grout machine (D. G. Coombs)....h•481
Rimrock, work to be resumed....n701
San Joaquin River, Cal., plans for...n141
Temporary, formed of water-filled hose.h•911
Terrace Reservoir, hydraulic fill practice (J. E. Field) ....•597
Uji River, Japan, American to design machinery n47
Wilson, see Dams, Muscle Shoals.
Yellowstone River, opposed n1095
Danielson, F. D., on test of large water meters in place with pitometer, Glencoe, Ill. ....•64
Darrow, F. T., biography....n•443
Darville, M. A., on personnel board for contractor's field forces....•860
Dauenhauer, E., on moving 8-story building on rollers ....•904
Davis, J. A. W., on permanent record of field changes in highway construction.. •32
Davis, J. C., named as Director General of Railroads n569
Dawes, C. G., testimony before war investigation committee e241
Dayton, Ohio, bridge failures, see Failures, Engineering.
Death rates from typhoid and other diseases in 1919 212
Decatur, Ill., water company, financing....n525
Delaware, highways, practice.... 153
Delivery, store-door, see Freight.
Denver, contractors to join A. G. C.... n47
Six stories added to reinforced-concrete building (W. H. Wheeler)....•585, (R. E. W. Hagarty) letter 825, (W. H. Wheeler) letter 1005.
Water supply, bonds not voted....n1092
Water-works, rehabilitation 859
Denver Civic and Commercial Assn. and engineering 124
Dept. of Commerce, appropriations....e880
Studies housing n874, n914
Department of Mines proposed n1094

DEPT. OF PUBLIC WORKS

Analysis of proposal (M. O. Leighton), letter 88
Army engineers and (F. G. Jonah).letter 88
Coming, says Hays....n785
Harding, President, omits department from message e663
Natl. association's final report.... n91
Postoffices principal work of Supervising Architect (J. A. Cliff) .... letter 186
Departments, see Government;
Derrick falls Irvington, N. J....n703
Design, structural, some unsettled points (R. Fleming) 336

DETROIT

Belle Isle bridge, action on bids postponed n92
And status of engineer (J. W. Pearl and W. B. Newhall) .... letters 734
Bids again rejected, new bids asked...n830
Companies organized n1010
Contract let on new bids....n1008
Engineers want board named to pass on plans n396
Modified plans approved and advertised n609
New design .... n190 (H. H. Esselstyn) 273 (J. T. N. Hoyt) letter with editorial comment 273, n359, (H. H. Esselstyn and W. H. Adams) e451, •452, a484, n782
Steel superstructure suggested n442
Cement and brick plants authorized by voters n529, n703
General Motors Building construction details (J. Mattie, Jr.) ....•624
Grade separation progress 306
Port bill fails n831
Street railway buildings, bids soon....n1057
Street railways work begun on 42 miles of track n488
Traffic development in Wayne County 29 (F. N. Hines) a345
Detroit & Ironton to build short line n915
Detroit Steel Products Co. questionnaire on [illegible] n1140
[illegible] beam design 807
Diaphragm, horizontal, increases surge tank capacity ....•67
[illegible] water-borne, B. Welch test e921, e922, 920, 998
[illegible] G. C., president Amer. Automobile Assn. n965
Digging ditch by auger attached to motor truck (M. Garlinger) .... n•655
Dikes, river, see Rivers.
Ditch cleaner for silt prevention 647
[illegible] S. H., on temper of bidding public n401
[illegible] dynamite [illegible] 1134

Page

Dix, W. S., on reduction table for stadia arc *78
Dock stringers tests (Prof. M. O. Fuller) *928
Dome, concrete (Long Beach Cal.) wrecked by failure of steel truss support (E. R. Bowen)......e281, *294, (A. T. N. Hoyt) letter 479, (F. A. Johnson and H. W. Bolin) letter 479
Don Pedro dam to be built by day labor n609
Donnelly law, New York, called unconstitutional n488
Don't *write* it—*say* it.................... 436
Douglas fir paving blocks a298
Dowell bill, see Highways, Federal-aid.
Downs, L. A., pres. Amer. Ry. Engineering Assn n*526
Drafting strips protect tracings (H. G. Fay) *807
Dragline excavator also drives piles in reclamation work (A. W. Walker) .. h*354
At Englewood dam (H. S. R. McCurdy). *603
Used for closed-drain excavation (J. D. Hays) h*523

DRAINAGE

Conference to be held.................. n45
Development an open field for engineering societies e282
Ditch design for silt prevention........ 647
Ditching, dynamite for 1134
Federal aid proposed 340
Illinois, work in 33
Indiana laws to be codified............n571
Indiana, State engineer wanted........ n45
Interstate case in Supreme Court.n187, n830
Oregon association meeting............ 347
Southeast, development in............ 36
Tile drains, flow in 902

Drawings, curled, how to straighten (R. R. Randell) h962
Mucilage instead of thumb tacks (F. A. McCurdy) 1077
Dredges, clam-shell, large, in Sacramento Valley *978
Digs narrow canal h*827
Pump efficiency, effect of worn runners on (I. E. Houk) *169
Pump operation for hydraulic fill, tests (I. E. Houk)....................*1034
Seagoing, economical loading (G. S. Phelps) *30
Siam record in (A. W. Robinson) letter 1133
Velocity tests in pipe (I. E. Houk). *18, *169
Drill, new, for breaking pavement........n970
Drill steel, hollow reclaimed (J. C. Lamon) h*607
Dry dock, Esquimalt (J. B. Hunter)......*670
Dry rot of timbers....................... 206
Rapidly destroys timber floor (W. F. Smith) *390
Dryland, A., on English bituminous road practice 894
Duluth, Minn., sanitary survey to be made.n570
To make zone rules..................n740
Dump cars, cable haulage for...........h*737
Dumpers, car, see Cars.
du Pont, C. (Gen.) on immigration.... e50, 57
Dust explosions (D. J. Price)......e621, *634
Dynamite for drainage ditching..........1134

E

Eads Bridge, see Bridges.
Eads, J. B., in Hall of Fame............ 306
Eagle, W. H., on resurfacing of brick and cobble pavements *798
Earth as an elastic solid (E. G. Haines) ......letter 89, (J. C. Meems) letter 185, (L. White) letter 439.
Earth fills, see Fills, Earth.
Earth pressure, see Fills, Earth.
Earth, rammed, as "masonry" in building construction (T. C. Young)......*267, ("Former Lieut. Col. A.E.F.") letter 652
Earth slides, held by inclined wall braced by struts *906
Earthquake causes surge in sewer........ *60
Earthwork cost data (C. P. Dunn)..letter 125
East, E. E., on concrete pile bridge fails from slipping foundations *334
East Chicago, Ill., water supply, tuning up filters 520
East Walker River, Cal., water for power or irrigation? n914
Eastern Terra Cotta Assn. under fire...... n46

ECONOMICS (see also LABOR, BUSINESS)

America, fortunate e976
English and American situation (E. J. P. Benn) e1060, a1069
Kansas Industrial Court decision........ e49
Living cost and wage reductions......e1061
Price associations, see Trade Associations:
Price deflation urged by construction conference n447, n877
Price situation e409
Production decreases as working week shortens n362
Readjustment delay in n743
Taking up slack in industry (H. C. Hoover) e324, 342
Wage reductions, see Labor, Wage Reductions.
Wages and cost of living...........n*1055
World economics address by F. H. Sisson e145
Editors, technical, confer with Hoover....n661

EDUCATION

Administrative engineering course, new, at Union College n610
A. A. E. questionnaire 80
Antioch plan (A. E. Morgan) .... e99, 108, (E. S. Closson) letter 233, (C. A. Plumley and R. L. Morrison) letters 349, (C. R. Young, A. E. Morgan and L. S. Le Tellier) letters 480.
College registration shows 1% gain *1104
Cornell Univ. engineering colleges to combine n398
English, good, for engineering (H. C. Hodgkins) ....letter 90
First engineering course 349, 605
Graduation thesis, request for material e880
Great Northern and Illinois Central Ry. plan 563, n612
Harvard, engineering education at...... 594
Highway engineers, see Highways, Engineers.
Norwich Univ, first engineering course (C. A. Plumley)......letter 349, (T. M. Belden) letter 605.
Public service in engineering courses....n612
Rensselaer Poly. Inst. first engineering course (T. M. Belden) ...... letter 605
Scholarship, good, and engineering eminence 679
Size vs. specialization in colleges.......e451
Soc. for Promotion of Engineering Education meeting n1093
Trade schools urged by Senator Calder...n190
Edwards, Gov., New Jersey, opposed port treaty with New York.................n441
Eel River dam, see Dams.
Electrical apparatus, standardization of terminal marking initiated n141
Electric haulage, remote-control, in quarry. *956
Electric railways, see Railways, Electric.
Electric welding repairs bascule bridge...*727
Electrolysis, protection for reinforced concrete a552
"Electromagnetism, Discovery in 1820" (Oersted). ....book review 131
Elevated sidewalk for traffic congestion (F. W. Harris) ....letter *606
Elevator, grain, see Grain Elevator.
Ellis, Prof. C. A., on short method for swing bridge calculations *981
Ellison, J. T., and others, on highway bridges 214
Ellms, J. W., on coagulation and sedimentation with chemicals.................a1041
On rate of solution of sulphate of alumnum a1039
On sanitary survey of Lake Erie......a1039
On tastes and odors, Cleveland water supply a1039
Ely, J. S., on alterations on Queen Lane water filters, Phila...................*942
Emley, W. E., on plastic gypsum by new method 1023
Emmett Irrigation District dam to cost $1,200,000 .... n878
Employment bureau, Federation n1096
Engineer Corps, U. S. Army, see Army.
Engineer of Bridges on column formulas for bridge design e410, *431

ENGINEERING

Advancing the profession............ 885
Agricultural, business in 541
Canada, legislation in (F. S. Keith)..... 21
Corporations and partnerships, see Engineers, Licensing.
Denver commercial association and engineering 124
Emphasis, engineering, change in.......e976
Failures, see Failures, Engineering.
Financial, book on (Sabin), review by H. Barker 127
Human (book review) 865
Libraries, special, needed (K. C. Walker). letter 392
Log-flume engineering (V. K. Woods) ......e747, *768, correction 935.
Municipal engineering, Pres. Webster on.n782
Nineteen-twenty an uneventful year..... e1
Practice, operating costs *542
Publicity e364, n395
Reports, see Reports.
Structural, research problems.......... 859
Transport is leading engineering question e976
"Engineering Assembly" planned by Amer. Engineering Council n697
Engineering Council activities transferred to Amer. Engineering Council............ n43
Salary committee, final report.......... 81
Salary scale approved by 13 societies... 36
Engineering Institute of Canada annual meeting; election of J. M. R. Fairbairn.n*275

ENGINEERING NEWS-RECORD

Average engineer, number for, May 12..e795
History and editorial staff.............. 1
Railway engineers, issue for March 10.
Road-building issue, Feb. 3.
Water-works issue, June 2.
Wellington transportation prize, conditions n189
Engineering Standards Committee, see Amer. Engineering Standards Committee.

ENGINEERS

Advice, gratuitous professional......... 330
And Governmental inefficiency e491
And physician needed to control yellow fever (C. G. Wigley)............... 372
Army, see Army.
Autobiographies, and that of Nasmyth.. 474
Average, issue for, May 12............e795
Biographies little known (J. K. Costello) 863
City, see Cities, Engineers.
Consulting, Chicago, form association...n484
Consulting, educate employees 808
Consulting, how one consulting engineer got job (E. E. Seelye) *940
Contracting engineer's part in minimizing risk in (W. B. King)............ 227
Definition sought by Institution of Civil Engineers n658
Electric see Amer. Institute of Elec. Engineers.
Employment bureau, free, for Colorado engineers 381
Engineer—key man of industry....e324, 342
Ethics, see Ethics.
Federal reclassification report n1137
Fees, see Engineers, Pay.
Foreign trade, engineer in (R. S. MacElwee) 959
Government, discuss status n526
Highway, see Highways, Engineers.
In the Cabinet e363
Incomes, compared with doctors', etc...*387
"Let engineers be heard".............. 480
Licensing:
Am. Soc. C. E. committee on practice by corporations and partnerships n963
Bills progress n525
British, bill deferred..............n1138
Canada, legislation (F. S. Keith) .. 21
Canada three provinces lack laws..... 31
Colorado law revised...............n698
Corporations and partnerships, practice by—New York law, etc......n358, e492, 518, (W. J. Wilgus) letter 521, n524, e577, (L. E. Buff), letter, with editorial comment, 650, n696, 724, e796, n963, n1007, 1109
Corporations, practice by, ethical and practical consideration 1109
Idaho examination Sept. 13 ......n1093
Indiana bill becomes law...n484, n571, 604
Massachusetts defers action n611
Minnesota bill introduced............n142
Minnesota law weak n783
New York law, see above, Engineers, Licensing, Corporations and Partnerships.
North Carolina bill passed...........n395
North Carolina board meets........n1093
Not effective (S. M. Green Co.)...... letter 565, (G. L. Bean) letter 650.
Ontario engineers take steps......... n93
Partnerships see above, Engineers, Licensing, Corporations.
Pennsylvania law signed...........n1007
Progress, etc., in 1920............. e5
Reasons against laws (J. C. Trautwine, Jr.). ....letter 650
Tennessee bill n45, n237
Tennessee bill approved by A. A. E. chapters n93
West Virginia bill n275, n879
Mission to England n738
Navy wants engineers n658
Opinions, differences in e282
Pay
Am. Soc. C. E. committee report n912
Average, as reported in *Professional Engineer* 64
City engineer's salary $1 for each inhabitant 683
Engineering Council committee report. 81
Engineering Council scale approved by 13 societies 36
Fees, structural engineers', Illinois.... 379
Incomes compared with doctors'......*387
Railway engineers', hearing on.....n1094
Services and fees, A. A. E. committee report 671
Structural, fee schedule, Illinois 379
Practice by corporations and partnerships see Engineers, Licensing.
Railway, educational plan on Great Northern, etc. 563, n612
Railway, issue for, March 10.
Railway, pay, hearing on n1094
Registration, see Engineers, Licensing.
Relation to contract risks........227, e242
Services and fees, A. A. E. committee report on 671
Spanish, organize society n612
Structural, Illinois, fee schedule........ 379
Unemployed n610
Engineers' Exchange, Inc., Chicago, formed n484
England, see Great Britain.
Englewood dam, see Miami.
English, good, for engineers (H. C. Hodgkins) ....letter 90
Eno, Prof. F. H., on road drainage problems a*347
Eno, W. P., on city traffic regulation..... 996
Epps, F. W., on dry masonry laid as riprap h*1091
On gravity conveyor helps lay brick in road work h*87
On stepped riprap of large stone retains highway fill h*138
Equations, cubic, another nomogram for (Cusec) ....letter *90
Erie, Lake, see Lake Erie.
Erie shovel, see Shovels, steam.
Esch, J. J., new I. C. C. member.........n739
Esquimalt dry dock, building (J. B. Hunter) *670
Esselstyn, H. H., and W. H. Adams, on redesign of Belle Isle Bridge, Detroit. e451, *452, n484
Ethics, code of (A. G. Christie).....letter 274
Gratuitous professional advice 330
Of dual allegiance, ruling on 991
Proposed code for contractors....e241, 257
Europe, civic tour to n484

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

EXCAVATION

Cable haulage for dump cars h*737
Closed-drain, done by dragline (J. D. Hays) h*523
Dragline operations at Englewood dam (H. S. R. McCurdy) *603
Hydraulic, for hotel foundation, Atlantic City *52
Rock excavated by improvised derrick fixed to stiff-leg derrick (P. P. Suiter), letter 314
Trenching machines n359, n532
Explosion, dust, Chicago grain elevator. n531, *560
Explosives, production in 1919 118
Exports, see Trade, Foreign.
Expressways, elevated proposed for N. Y. City traffic congestion . . . . 547, e577, (C. W. Leavitt and Col. W. J. Wilgus) letters 780, (C. W. Leavitt) letter 910, (C. F. Dingman) letter 1047

F

Factories, administration and cost accounts (book review) 691
Moist, treated lumber for insulating roofs (F. J. Hoxie) a297
Steel shops of Samson Tractor Co., Janesville, Wis. *716

FAILURES, ENGINEERING

Bald Eagle Creek, Pa., bridge n525
Boston molasses tank collapse, trial resumed n569
Bridge foundation failures e193
Bridge, Imperial Valley, failure (D. E. East) *334
Concrete arch bridges, New Jersey 291
Concrete building failure shows monolithic nature of frame (W. H. Wheeler) . . . . *585 (R. E. W. Hagarty) letter 825, (W. H. Wheeler) letter 1005
Concrete pile bridge fails from slipping foundations (E. E. East) *334
Dams, how strong should they be? e1017
Dayton, Ohio, pier failure wrecks two spans of concrete arch bridge . . . . n187, e193, *264, (J. T. N. Hoyt) letter, with editorial comment.. 351; proposed repair, 511
Derrick fall, Irvington, N. J. n703
Dome, concrete, wrecked by failure of steel truss support, Long Beach, Cal. (E. R. Bowen) . . . . e281, *294, (J. T. N. Hoyt) letter 479, (H. W. Bolin) letter 479, (S. M. Green Co.) letter 565
Dust explosion, Chicago grain elevator *560
Falsework failure wrecks large highway bridge, Brattleboro, Vt. n1095
Georges Creek accident and ruggedness in bridges (A. W. Buel) . . . . e450, 463, (see also e98, *100), (F. H. Frankland) letter 566.
Herkimer, N. Y., bridge, new concrete arch survives washout of centers (C. L. Wood) *809
Planning for the inexpected . . e450, 463, 566 (see also e98, *450)
Railway, derailment on curves . . . e1018, 1024
Reservoir roof, Canton, Ohio, collapses . . n569
Strathmore building collapse, New York . . e282, n315
Tempe Bridge, repair of concrete arch after settlement and floor expansion (M. Butler) e663, *675
Trestle collapse due to freshet n1095
Wall, overloaded, buckles n483
Fairbairn, J. M. R., new pres. Engineering Inst. of Canada n*276
Falsework, not used in erection of concrete truss spans h*608
Patents, Luten suit dismissed n830
Fame, Hall of, J. B. Eads in 306
Fay, H. G., on strips to protect tracings . . *807
Federal Council see Amer. Assn. of Engineers.
Federal Highway Council, new members executive committee n657
Plans study of subgrades (H. G. Shirley) a306
Works on transportation problems n188
Federal Power Commission, see Water Power.
Federal Reserve Board report on building activities 253

FEDERATION OF AMER. ENGINEERING SOCS.

Amer. Engineering Council:
Assumes activities of Engineering Council n43
Conference with A. A. E. n1094
Employment bureau service n1096
Government department reorganization to be studied n398
Hoover resigns as president e663, n696
Plans "Engineering Assembly" n697
Wallace, L. W., elected secretary e330, n*355
Waste survey . . . n355, 472, n1007, n1009
And A. A. E., co-operation n1007
"Assembly," planned by Council n697
Committee on New York licensing law . . n1007
Executive board to meet n658
Industrial opportunity of 728
Launching, etc. e4
Under way e323
Urges reorganization of New York State Government n482
Wallace, L. W., elected secretary n316
Discusses work n831
Washington office opened n527
Waste elimination committee. n355, 472, n1007, n1009
Feiker, F. M., appointed assistant to Hoover n*873
Fetherston, J. T., on garbage and snow removal, New York City e98, 104
Field, J. E., and others, on interstate water conflicts 755
Field, J. E., on hydraulic fill practice on Terrace Reservoir dam *597

FILLS, EARTH

Dam, irrigation, with novel details (C. V. Mann) *1030
Hydraulic, at Germantown Dam, method of capping *248
Hydraulic, at Terrace Reservoir dam (J. E. Field) *597
On soft bottom held by wood bulkhead h*1048
Tests of dredge pump operation (I. E. Houk) *1034
Pressure and pile bearing (E. G. Haines) . . . . letter 89, (J. C. Meen) letters 185 and 565
Pressure, as related to foundations (D. E. Moran) e363, *366
Pressure curves by Coulumb's formula (A. W. Bedell) . . . . letter *392
Pressure theory as affected by practical factors (G. Paaswell) *682
Sheerboard methods used to build large stadium, Seattle e323, *326
Sheerboards used in building hydraulic fill dam *291
Soil as an elastic solid (E. G. Haines) . . letter 89 (J. C. Meems) letter 185, (L. White) letter 439
Soil pressure as related to foundations (D. E. Moran) e363 *366
Stadium built by sheerboard method, Seattle e323, *326
Stepped riprap of large stone retains highway fill (F. W. Epps) h*138
Subsidence as a factor in valuation . . . e409, *434
Subsidence under railway fills, methods of investigating *437
Viaducts, high, on Reading Ry., filling (P. S. Baker) *1020
Widening, two hints e145
Filter, hay, for feed water h*869
Filters and Filtration Water, see Water Treatment, Filters.
"Financial Engineering" (Sabin) (review by H. Barker) 127
Findley, A. I., on iron and steel situation . . n400

FIRE

Combatting increase of hazards 102
Danger in parked automobiles 213
Forest, see Forest fires.
Hydrants, thawing, device for n745
Loss in terms of new construction 566
Fire-resisting concrete buildings e747, *760
First Engineers decorated n610
Fisher Body Ohio plant (automobile bodies), Cleveland e49, *82
Flange holes in beams and channels, diagram for effect of (H. Kercher) *799
Fleming, D. H., on all-steel truck for heavy-duty transfer-work h*567
Fleming, R., on lapses in textbooks . . 125, (Prof. H. Sutherland and R. Fleming) letters 352, (F. S. Bailey) letter 393, (H. S. Jacoby) letter 474, (A. S. Niles) letter 606
On some unsettled points in structural design 336

FLOODS and FLOOD PROTECTION (see also MIAMI)

Bridge foundation failures e193
Conference to be held n45
Colorado floods e975, n1008, e1019, n1049, n*1051
Engineering studies for control e1019
Imperial Valley threatened n1093
Kankakee River control n656
Nile River, allocation of waters between Egypt and Sudan . . . . 679, (book reviews) 689
Problems special (book review by R. E. Horton 690
Trestle collapse due to freshet n1095

FLOORS

Bridge, see Bridges, Floors
Construction special light gypsum blocks in (A. V. Bekay) *544
Flat slab, built without drops or capitals *672
Timber, rapidly destroyed by dry rot (W. F. Smith) *390
Flour mill case decision, Kansas e49
Flow meter see Recorder
Fluorescein traces underground waters . . 639
Flushing Bay N. Y. project approved . . n1095
Follin, J. W., on street cleaning and related work in Philadelphia 166
Food prices retail drop n1141
Footing pressures double analysis of (F. K. Esling) . . . . letter 232
Footings concrete replacing simple support for trestle legs (D. G. Coombs) h*49
Footway under street, quick construction . . h911
Ford plant in Highland Park increases working staff n362
Foreign Fields Notes From see Notes From Foreign Fields
Foreign trade see Trade Foreign
Foreman C. S. on water main cleaning Kansas City Mo. a1040
Forest fires, airplanes used in control . . . 329
Forest Products Laboratory, million-pound testing machine (L. J. Markwardt) *31
Forms, see Concrete, Forms.

FOUNDATIONS

Earth as an elastic solid (E. G. Haines) . . . . letter 89, (J. C. Meems) letter 185, (L. White) letter 439
Groundwater pumping and hydraulic excavation for hotel, Atlantic City *52
Ring girders, multiple concrete, for New York court house (C. S. Proctor) *494
Soil as an elastic solid (E. G. Haines) . . letter 89, (J. C. Meems) letter 185, (L. White) letter 439
Soil pressure as related to foundations (D. E. Moran) e363, *366
Founding iron and steel, textbook on (Osann), review by Dr. R. Moldenke. 307
Foundry, Samson Tractor Co., Janesville, Wis. *716
Fowler, A. W. and W. C. Lounsbury, on water waste prevention, Superior, Wis. . *461
Frame house construction, distortion tests of wall sections *20
France, oil pipe line abandoned n448
Railroad reconstruction 591, *592

FREIGHT

Air blowers unload bulk shipments of light goods 857
Building materials, rates on n876
Car loadings, increase and decrease n395, n490, n703, n743, n835, n919, n1057, n1098, n1140
Coal and ore movement n970
Handling, at New York e195
Methods, better, by mechanical equipment *151
Methods, better, in ports 641
Harbor terminal design e491
Motor truck transport by European railroads *954
Movement at New York e242
New York City's local problem 370
Rates, high e1102
Rates, lower, drive for n834
On construction materials, reduction sought n1015
Stationary e976
Store door deliveries, before railroad executives n396
From New York Barge Canal n738
May be resumed n964
Terminal, Nashville, Tenn. *766
Terminal problems, Chicago 1077
Tractor speeds delivery on hauling job . . *853
Tractor-trailer transfer, St. Louis, Mo. . . *852
Truck-body-container car, new, for store-door delivery e533, *557
Fritz, John, medal awarded to E. Schneider n1092
Fry, W. C., Jr., on long arch bridge built of slag concrete . . . . *840, (J. L. Campbell) letter 1005
Fuller, G. W., on existing water-works conditions and needed planning 9
Fuller, Prof. M. O., on tests of timber dock stringers *928
Garage, long-span concrete arches for roof, Chicago *167

G

Gannett, F., and J. L. Crane, Jr., on high-head centrifugal pumps, Shenandoah, Pa. *983

GARBAGE

Baltimore feeding contract given up . . . n237
Plant recommended a698
Boston contract still in force n357
Chicago reduction plant shows poor results 856
Disposal uncertainties . . . . e6, (E. H. Foster) letter, with editorial comment 133
Legislation, vicious, on garbage and sewage e705
New Bedford, Mass., buys reduction plant 859
New York City (metropolitan district) (G. A. Soper, G. C. Whipple, A. Hazen, J. F. Fetherston) e98, 104
New York City, committee report on disposal n1135
Philadelphia, street cleaning and related work (J. W. Follin) 166
Reduction further study in economics, Columbus, Ohio, and Washington, D. C. (Maj. F. S. Besson) 258
Quality reflects thrift tendency 155
San Francisco quality reflects thrift tendency 155
Rates revision 269
Garlinger, M., on earth auger attached to motor truck h*655
Garrison, C. W., on saving rope in hanging chutes h*1091
Gary, E. H., views on business situation . . e921
Gary, Ind., paving contract 83% of estimate n745
Gas distribution manual of book review . . 475
Main steel joints welded *731
Rate increased Boston 955
Gasoline tax see Highways
General Motors building Detroit construction details (J. Matte, Jr.) *624
Georgia, highways, cost-plus contract successful (W. R. Neel) 224
Germantown Dam see Miami Flood Protection Work

*Illustrated, e, editorials, h, hints, n, news notes, a, abstracts

Page

GERMANY
- Accepts reparation terms e837
- Adobe building returns 823
- Exchange of silver coin at border—a protest (Barmer Bank Verein) ....letter with editorial comment 391
- e621
- Exports from, menace of 115
- Industrial issues, dominant n740
- New Institution of Traffic Science n740
- Steel, semi-finished, price restrictions removed n969
- n702
- Steel trust dead 176
- Trade with, in 1920 .... n278
- Trade with, New York office opened n278

Gibb, H. M., on moments for continuous beams of uniform live load *807
Gibson, N. R., on testing turbine efficiency by pressure measurement a*465
Gillespie, C. G., on Sacramento adopts cost-plus plan on water filter work 77
Gin poles, pulling stumps with (H. M. Burwell) .... letter 133
Glencoe, Ill., test of large water meters in place with pitometer *64
Goethals, Maj. Gen. G. W., consulted on Ohio highways n189
- n485
- To study port of Shanghai n878
Gold imports and exports e193, n235
Good Roads Congress e193, n235

GOVERNMENT
- And business, co-ordinating ...... e664, (book review) 691
- Co-ordination, lack of e975, n1014
- Department of Mines proposed n1094
- Departments, Commerce Dept. appropriations e880
- Departments, reorganization n44, n398, e491, e707, 731, n874, e923, e1059
- Employment policy revision urged by Commerce Chamber n1137
- Engineering bureaus deficiency appropriations n964
- Engineers discuss status n526
- Reclassification report n1137
- Teamwork in e363

Governors may discuss waterway and power development n1136
Gow, Col. C. G., views on union labor in construction e976, 991
Grade crossings, see Railways, Grade Crossings.
Grader rips up stone block pavement ... h*911
Graduation thesis, request for material .. e880
Grain elevators, car dumpers for quick unloading e491, *508
- n531, *560
- Dust explosion, Chicago n531, *560
- Dust explosions in (D. J. Price) e621, *634
Grand Canyon, building bridge across Colorado River .... *254, (G. E. Goodwin) letter 353
Grand Rapids, Mich., sewage testing station *459
Grand Trunk Ry., arbiters bar cost of reproduction value n318
- Taken by Canadian Government .. n830, n914
Gravel and sand production 991

GREAT BRITAIN
- Builders' guild system n917
- Building, cheaper n614, n790
- Building, crisis expected n615
- Building trades, ex-service men in n919
- Coal production grows 25
- Coal strike, see Labor, Strikes.
- Economic situation (E. J. P. Benn) .. e1060, a1069
- n743
- Emergency act n738
- Engineer mission to n738
- Highways, bituminous (A. Dryland) .. 894
- 606, 906
  - Classification 1132
  - Concrete 67
  - Work aids unemployed 67
- Labor dilution plan for ex-service men . n1099
- Labor, wage conditions n744
- Mine strike e623
- 200
- Railways, electrification plans e324, 341
  - Proposed grouping e324, 341
  - 1920 traffic 939
  - Rate increases 186
- Unemployment least in building trades . n1014

Great Falls, see Potomac River
Great Lakes cities' water supply and filtration .... e492, (J. N. Chester) letter 736
Great Lakes-Hudson and Atlantic Waterways Assn., Inc., formed n574
Great Northern, and Illinois Central Rys., educational plan for engineers .. 563, n612
- Bond issue quickly taken n786
Great Western Power Co., Caribou hydro-electric development, Cal., methods of saving in construction h*440
- Plant in service n965
- Preferential power contracts subject to regulation 370
Greece, water supply and sanitation (W. E. Spear) *708
Green Bay & Western line may not be abandoned n912
Greene, B. A., on waterproofing reservoir with gunite *958
Greve, Prof. F. W., on calibration of circular orifices under high heads 24
Groundwater pumping and hydraulic excavation for hotel foundation, Atlantic City *52
Grouting, hot-water tank makes grout machine for repaving Chilean dam (D. G. Coombs) h*481
Grunsky, C. E., and others, on interstate water conflicts 755
Gulf-Atlantic canal survey recommended .. n277
Gulf Coast bridges ordered rebuilt n142
Gun, 4-in., travels 25 miles per hour 993
Gunite, see Cement Gun.

Gypsum plastic by new method (W. E. Emley) 1023
Gypsum blocks, light in floor construction (A. V. Bekay) *544

H

Hall of Fame, J. B. Eads in 306
Halmos, E. E., on concrete oil reservoir with flat-slab roof and floor *260
Hamilton, Ohio, water and sewerage systems not fully used 181
Hammer, water, see Water Works
Harbors, see Ports and Harbors
Harding, Pres., confers with railroad union heads n615
- Omits Public Works Dept. from message e663
- On highways e663, 687
- Tribute to the press and to business . e923
Harger, W. G., on effects of motor operation costs on highway location and design *201
Harrisburg, Pa., building mechanics ask increase n530
Harvard, engineering education at 594
Haselton, Ohio, ash-handling plant, Pittsburgh & Lake Erie R.R. *172
Hathway, N. F., on photographing road plans 422
Hatt, Prof. W. K., appointed Indiana state engineer .... n657, (W. K. Hatt) letter 825
Haulage, electric, remote-control, in quarry . *956
Hay filter for feed water h*869
Haynes, W., on chemical trade situation . n401
Hays, J. D., on closed-drain excavation in irrigation work done by dragline .. h*523
Hayti-Santo Domingo mail carried by airplane 596
Hazen, A., on water supply and sanitation in metropolitan district, New York e98, 104, *179
Hazen, A., review of Handbuch des Wasserbaues (Engels) 1044
Header curbing, replacing *729
Health officers need not be physicians . e663
Health, public, see Sanitation
Heisig, H. M., on colloid chemistry in sludge pressing a1042
Henny, D. C., on interstate water conflicts 755
Herkimer, N. Y., bridge, new concrete arch survives washout of centers (C. L. Wood) *809
Hertel, F. E., on diagrams for reinforced concrete chimneys *803
Hetch Hetchy, see San Francisco, Water Supply.
Hettrick, J. T., on trial ... n279; convicted n403
Hickories, properties of varieties compared 335
Highland Park, Mich., water purification plant *772

HIGHWAYS
- Alabama, and Federal-aid (W. S. Keller) .....letter, with editorial comment 909
  - Financing unsound .... e706, (W. S. Keller) letter, with editorial comment 909
- Alaska, deevlopment (Maj. J. A. Steese) a347
- Amer. Highway Educational Bureau to show film n612
- Amer. Road Builders' Assn. convention .. n315, e324, a345
- Arizona, bid 65% of estimate n786
- Arkansas, construction in cypress bottoms (D. A. MacCrea) *196
  - Disclosures .... e577, n611, n699, e706, (W. S. Keller) letter with editorial comment, 909, n1052, e1060
  - State seeks highway engineer n1092
- Arkansas-Louisiana Highway, construction D. A. MacCrea) *196
- Army motor equipment needed for state roads n277
- Asphaltic oils, see Highways, Oils.
- Asphalt, tea kettles better than coffee pots for repairing cracks 208
- Bergen County, N. J., to have own material plant n698
- Bids, disparities in .... e533, (C. P. Puff, Jr.) letter 693
  - Illinois n529
  - New York and Ohio, analyzed n529
- Bituminous, English practice (A. Dryland) 894
- Bonds:
  - Canvass of issues n575
  - Economical life of investment (J. E. Pennybacker) *770
  - Financing construction, a banker's views (H. F. Beebe) 16
  - For investors (H. C. Sylvester, Jr.) .. a345
  - California rate raised to 5¼% . n277, e493
  - Pennsylvania, sold at par n1142
  - Spending highway dollars e5
  - Wyoming, voted n968
- Brick, gravity conveyor speeds up laying (F. W. Epps) h*87
  - Machine tamped base required in Kansas 259
  - Monolithic, built of fine aggregate (W. M. Watson) *25, 259
- Bridges, see Bridges, Highway.
- British, bituminous 894
  - Classification 606, 907
  - Concrete 1132
  - Concrete slabs, experiments with 1118
  - 'Lighthouses' 1033
  - Work aids unemployed 67
- California:
  - Bonds, rate raised to 5¼% ... n277, e493
  - Concrete pavement on saturated adobe foundation (T. E. Stanton) *217
  - Danger of losing Federal aid denied . n441
  - Gasoline tax urged by Commission .. n657
  - Investigated by Federal Bureau *469
  - Oil insulation of subgrades used in experiments n1135
  - Policy criticized in report .. 207, e242, 268, 340
  - Practice 59
  - Precast slabs vs. monolithic concrete, for repairs 156
- Cold patches with sand unsatisfactory in Ohio maintenance (H. S. Perry ... letter 234
- Colors for routes, Eastern states 558
- Commission urged n656
- Concrete:
  - Average and maximum runs in slab placing *222, 947
  - British 1132
  - Construction (book review) 476
  - Construction requires best contracting skill 981
  - Corner failures (C. Older) .... *210, e492, *504, (C. S. Pope and C. Older) letters 693
  - Illinois, delays in building analyzed (A. W. Consoer) 644
  - Kitchen boiler makes roller for finishing h354
  - London, England 1073
  - Mix proportioned at central plant (H. T. Tuthill) *595
  - Mixer delays reduced by careful maintenance h*1134
  - Mixer drags pipes that support reinforcing h*695
  - Mixer loader, mechanical, helps operation *170
  - Night work, in Maricopa County, Cal. e1017, *1026, h*1048
  - Pavement on saturated adobe foundation (T. E. Stanton) *217
  - Paving record broken 947
  - Precast slabs vs. monolithic concrete for repairs 156
  - Reinforcement, in Illinois e492, *504, e879
  - Replacing slabs at joints 263
  - Repair, tail-gate measuring box minimizes handling h*695
  - Slabs, experiments with, in England .. 1118
  - State-made cement advocated by Kansas Governor 266
  - Stockpiles on subgrade prohibited in Iowa 248
  - Submerged gravel pumped to screens (G. E. Johnson) h*781
  - Surface roller patent upheld n610
  - Tamped-in wearing course, Iowa 728
  - Thickening edges, in Maricopa County, Ariz., and elsewhere ... e879, *882
- Connecticut, state plans increase in motor vehicle license tax n44
  - Traffic problems (C. J. Bennett) 935
- Construction:
  - Active n1057
  - Arkansas cypress bottoms, road construction in (D. A. MacCrea) *196
  - Bidding shows activity n403
  - Brick, gravity conveyor speeds up laying (F. W. Epps) h*87
  - Canvas carpet keeps truck body clean. 370
  - Concrete, demands best contracting skill 981
  - Concrete paving, average and maximum runs *222, 947
  - Contract dates and peak outputs (B. Piepmeier) e1059, *1081
  - Contractual relations in (W. A. Rogers) a345, 346
  - Day-labor construction, Wisconsin (W. C. Buetow) 1070
  - *Engineering News-Record* road-building issue, Feb. 3.
  - Field changes, permanent record (J. A. W. Davis) *32
  - Gravel plant, local, experiences with (H. T. Tuthill) 854
  - Kitchen boiler makes roller for finishing concrete pavement h354
  - Loader, mechanical, for mixer helps operation *170
  - Machinery discussed by A. S. M. E. . n1011
  - Maricopa County, Ariz., 309 miles of road, building (R. Rollins) . e879, *882
  - Mechanical equipment, specialized use of (W. F. Welsch) *205
  - Mixer delays reduced by careful maintenance h*1134
  - Motor trucks and industrial railway used on one job (H. E. Breed) *289
  - Night work on concrete roads e1017, *1026, h*1048
  - Plant, improvements needed (B. H. Piepmeier) e921, *949
  - Problems, plea for mathematical forms (J. A. Kitts) .... letter 41
  - Riprap dry masonry laid as (F. W. Epps) h*1091
  - Slabs, concrete, English experiments with 1118
  - Slip scraper with A-frame for unloading rock and sand (W. B. Albertson) h*86
  - Stepped riprap of large stones retains fill (F. W. Epps) h*138
  - Stockpiles on subgrade prohibited in Iowa 248
  - Submerged gravel pumped to screens (G. E. Johnson) h*781
- Contract dates and peak outputs (B. Piepmeier) 1059, *1081
- Contractors, New York, cannot obtain reimbursement for war losses n322
- Contracts, bids below engineers' estimates e795
  - Cost-plus, successful on Georgia work (W. R. Neel) 224
  - May 1921, exceed May, 1920 .... n968

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

Cost analysis simplified by Illinois report (I. E. Scott) .... •118
Curbing, header, replacing .... •729
Curves:
Pavement on, widened by ring method (E. H. Stelle) .... •72
Pennsylvania practice in widening •957
Plea for mathematical forms (J. A. Kitts) .... letter 41
Superelevated, Minnesota practice ... •220
Superelevation at cross-roads (W. V. Buck) .... •858
Vertical diagram for plotting (H. T. Avery) .... •1004
Cypress bottoms, Arkansas, road construction in (D. A. MacCrea) ... •196
Delaware, practice 153
Departments, politics in e622
Design, grade, and location, effect of motor operation costs (W. G. Harger) •201
Pavement on curves widened by ring method (E. H. Stelle) .... •72
Pavement, subgrade support in (C. Older) .... •210, e492, •504, (C. S. Pope and C. Older) letters 693
Superelevated curves .... •220, •858
Dirt, load limit in New Hampshire e621
Drainage, book review 1045
Drainage problems (Prof. F. H. Eno) .. a•347
Economics of improvements (H. G. McGee) .... •810
Education, committee appoints Prof. C. J. Tilden director n44
Conference n275
Michigan engineers want state aid for colleges n278
Engineers, transport and engineering courses at Purdue and Michigan n93
Equipment, Army, wanted by states ... n318
Failures, corner (C. Older) .... •210 e492, •504, (C. S. Pope and C. Older) letters 693
Federal-aid:
Act .... n44, e50, letter n236, 272, n318, n359, n395, n483, e534, n568, n699, n738, e748, n783, e797, n828, n873, n912, n963, n1007 n1050, n1093
Alabama and Federal-aid (W. S. Keller) ..... letter, with editorial comment, 909
Arkansas disclosures, see Highways, Arkansas.
California, danger of losing denied n441
Commission urged n656
Financing, unsound .... e706 (W. S. Keller) letter, with editorial comment, 909
MacDonald testifies n963
Missouri 581
Phipps bill passes house n1137
Resolution for investigation n699
Senate committee hearings begun n912
Federal Highway Council, new members executive committee n657
Financing 1052, e1060
Financing economics of improvements (H. G. McGee) .... •810
Financing, see Highways, Bond Issues.
Gasoline tax proposed, California . n569, n657
Georgia, cost-plus contract successful (W. R. Neel) 224
Good Roads Congress e193, n235
Grade design and road location effect of motor operation costs (W. G. Harger) .... •201
Grading, book review 1045
Grading methods and costs in Nebraska (G. E. Johnson) .... •251
Gravel plant, local, see Highways, Construction.
Guard rail timbers mounted on concrete pipe (A. D. Butler) .... •498
Harding President, on highways e663
Higher type or lower? .. e243, 265, n•275
Hirst, A. R., resignation as Wisconsin state highway engineer .. e243, 265, n•275
Hong Kong, practice in 475
Humps at railway crossings proposed in Tennessee .... •256
Illinois:
Bids received and rejected. n361 n448, n529 (correction)
Concrete road building delays analyzed (A. W. Consoer) 644
Contract dates and peak outputs (B. Piepmeier) .... e1059, •1081
Cost analysis simplified by report (I. E. Scott) .... •118
Legislature to investigate n569
Lincoln Highway ideal section to be built n1093
New concrete road slab design e492 •504, e879
Patented pavements permissible n444
Practice 29
Subgrade support in pavement design corner failures, etc. (C. Older) .... •210, e492, •504 (C. S. Pope and C. Older) letters 693
Testing cylinders for experimental road (H. F. Clemmer) .... •1116
Impact tests report on .... e534, •553
Indiana commission changes recommended n443
Contractor loses in bond suit n744
District maintenance engineers report blank .... •223
Internatl Assn. of Road Congresses no prospect for joining n316
Iowa concrete roads tamped in wearing course 728
No need to curtail work (A. P. Munsen) .... letter 391
Kansas machine tamped base required 259
Monolithic built of fine aggregate Reno County (W. M. Watson) •[illegible], 259

Legislation, see Highways, Federal-aid.
"Lighthouses" for British roads 1033
Lincoln Highway competely marked 380
Ideal section to be built in Indiana . n1093
Road types 499
Local road materials report 160
"Location, Grading and Drainage" (Harger), book review by C. J. Bennett ... 1045
Location and grade design, effect of motor operation cost (W. G Harger) . •201
London, Eng., concrete 1073
Machinery exports n744
Road-making, exports 501
Maintenance, district engineers' report blank, Indiana .... •223
Estimate forms, Minnesota .... •79
Patrol, lessons of, in Wisconsin 200
Malaria and mosquitoes, road work should not help 826
Maricopa County, Ariz, 309 mile road program (R. Rollins) .... e879, •882, e1017, •1026, h•1048
Materials:
Freight rates lowered in Michigan ... n786
High freight rates in Wisconsin protested n442
Local report 160
New Jersey freight rates adjusted ... n1056
Wear tests show service qualities .... •1121
Maximum service to traffic dominant idea in 1920 12
Mechanical equipment, specialized use of (W. F. Welsch) .... •205
Minnesota, maintenance estimate and progress report forms .... •79
Motor vehicle fees n964
Superelevated curve practice .... •220
Missouri, Federal-aid work in 581
State survey methods and costs .. •68, (C. M. Noble) letter 233, (C. A. Shockley) letter with editorial comment, 353
Moisture, see Highways, Subgrades.
Money for, difficulty in obtaining .... e243, 265, n•275
Motor truck impact tests, report on .. e534, •553
Overloading condemned n913
Number in U. S. e323, 330
Speed rating and body weights 1022
Moving pictures show road work . n612, n1094
Natl. Highway Traffic Assn. convention . n656
Nebraska, grading methods and costs (G. E Johnson) .... •251
Needs 723
New England Road Builders' Assn. formed n322
New Hampshire, load limit for soft roads e621
New Jersey, bridges, density of 258
Engineers urge road law amendment. e194, n237
Labor to have wages cut n93
Requirements n142
New outlook for highway thought e975
New York:
Appointment of H. S. Sisson ... e146, (E. Harrison) letter 310
Bids n316, n529, n660
Contract worth $2,900,000 let n834
Knight law unconstitutional n322
Reconstruction needed; report of Commissioner Greene 269
Nova Scotia, investigated n278
Officials, state, uncertain tenure and inadequate compensation ... e243, 265, n•275
Ohio:
Bids analyzed n529
Building awaits lower freight rates . n1014
Contracts to be let n322
Contracts let n1016
Contracts must be awarded within 10 days n1099
Semi-monthly estimates for contractors n835
Oil insulation of subgrades in California experiments n1135
Oils, asphaltic, modernized plant to handle 514
Oregon bids are 80% of estimate n745
Pavements:
And rail tremor e282, n315
Breaker for starting water-works trenches .... •937
Drill new for breaking pavement n970
Heavy traffic (E. J. Wulff) .... letter 352
Names of types (E. G. Orbert) . letter 134
On curves widened by ring method (E. H. Stelle) .... •72
Patented, permissible in Illinois n444
Paving blocks, Douglas fir a298
Paving contract, Gary, Ind., 83% of estimate n745
Pennsylvania:
Bids n322, n361, n448, n660 n661, n1014
Bonds sell at par n1142
Contracts let n743, n968
Curves, state practice in widening ... •957
Practice 102
Projects under way n1098
Replacing concrete slabs at joints .... •263
State to open bids on 90 miles n489
Permanent Internatl Assn. of Road Congresses prize to be awarded in 1922 .... n14[illegible]
Plans, photographing (N. F. Hathway) .... 1[illegible]
Policy, getting together on e531
Practice in various states 29, 59, 102, 153
Progress report forms Minnesota .... •79
Reno County, Kan, see Highways, Kansas.
Repair:
Cold patches with sand unsatisfactory in Ohio practice (H. S. Perry) letter 231
Precast slabs vs monolithic concrete 136
Tailgate measuring box minimizes [illegible]

handling .... h•695
Replacing concrete slabs at joints .. •263
Tea kettles better than coffee pots for repairing cracks 208
Research e5
Results of .... e533, •553
Work ("Highway Engineer") .. letter 133
Riprap, dry masonry laid as (F. W. Epps) .... h•1091
Roller Co. accused of unfair competition . n322
Rubber, London 1120
Rural (book review) 476
Service to traffic dominant idea in 1920. 12
Situation as seething mass of flux (T. M. Ripley) .... letter 40
Snow removal and drift prevention (G. H. Biles) .... •230
Soft, see Highways, dirt.
South Carolina, program 156
State department notes .... •726
State departments queried on policy ... n697
State officials confer on policies n696
Street pavements, resurfacing brick and cobble (W. H. Eagle) .... •798
Subgrades, effect of capillary moisture (W. W. McLaughlin) .... •1037
Intensive study planned by Highway Council a306
Oil insulation in California experiments n1135
Support in pavement design (C. Older) .... •210, e492, •504, (C. S. Pope and C. Older) letters 693
Tests of bearing power of soil and other tests .... a•1131
Under suspicion e880
Superelevated curves, see Highways, Curves.
Surveys, methods and costs in Missouri ...... •68, (C. M. Noble) letter 233, (C. A. Shockley) letter with editorial comment, 353
Tendencies in design, maintenance, etc., in 1920 12
Tests:
Oil insulation of subgrades in California experiments n1135
Testing cylinders for Illinois experimental road (H. F. Clemmer) .... e1102, •1116
Wear tests show service qualities .... e1102, •1121
Tires effect on roads .... e534, •553
Townsend bill, see Highways, Federal-aid.
Traffic:
Census, standardization of methods and results .... •338, correction 604
National conference e98, 112, n143
Problems, of state department (C. J. Bennett) 935
Regulation, conference n963, e975
Study proves two-lane widths sufficient (Prof. A. N. Johnson) .... •989
Transport needs 723
Wayne County, Mich., traffic .... 28, (E. N. Hines) a345
Wear tests show service qualities of materials .... e1102, •1121
West Va., contractors form organization n47
Widths, two-lane, sufficient (Prof. A. N. Johnson) .... •989
Wisconsin day-labor construction (W. C. Buetow) 1070
Wisconsin, high freight rates for materials protested n442
Hirst, A. R., resigns as state highway engineer .... e243, 265, n•275
Patrol maintenance 200
Wood-block paving in St. Louis (J. S. Crandell) .... •376
Wyoming, bonds voted n968

Hines, E. N., on traffic development in Wayne County, Mich. a345
Hirst, A. R., resignation as Wisconsin state highway engineer .... e243, 265, n•275
Hoboken, N. J., combination quay and pier in restricted space .... •1074
Hog Island closes e193
Hogan, J. P., biography .... n•357
Holding companies may be barred from Louisiana n576
Hole digging by auger attached to motor truck (M. Garlinger) .... h•655
Hollow tile, see Tile
Homebuilding increase n529
Hong Kong, road practice, book review . 475
Hood, W., retires as So. Pac. chief engineer .... •824

HOOVER, H. C.

Appoints F. M. Feiker assistant .... n•873
Biography (Kellogg), book review ... 476
Dinner by Phila. Engineers' Club n697
Discusses public issues e749, n787
Estimate of 514
In the Cabinet e363
Meets technical editors n661
On open price associations e922, n968 n1014
On taking up slack in industry e324, 342
Plans industrial service bureaus n789
Represents engineers on Internatl Chamber of Commerce committee n45
Resigns as president of Amer. Engineering Council e663, n696
Views on Government reorganization e707, 731

Horizontal diaphragm increases surge tank capacity .... •67
Horrocks, H. E., on creosote treatment for Douglas fir pipe staves a297
Horse Heaven Irrigation District proposed 997
Horton, R. E., review of Bellasis Hydraulics 128

•Illustrated; e, editorials; h, hints; n, news notes; a, abstracts.

Page

Review of Hydraulics of the Miami Flood Control Project 690
Review of "Layout of Small Water Mains" 864
Review of "Rainfall and Runoff, Miami Valley" 1044
Hose, water-filled, forms temporary dam.h*911
Hotel foundations, Atlantic City, see Atlantic City.
Houk, I. E., on effect of worn runners on dredge pump efficiency *169
Houk, I. E., on tests of dredge pump operation for hydraulic fill.....*1034
On velocity tests in hydraulic dredge pipe *18, *169

HOUSING

Bank and insurance co. investigation denied, New York n362
Bill revised n1098
British, building guild system n917
Bureau, Federal, proposed n47
Commerce Dept. studies.....n874, n914
Conference in Washington n142
Division in Bureau of Standards recommended n1010
Famine and how to end it, book review. 307
Legislation will not build homes.....e578
London, Eng., problem (C. H. S. Tupholme) n614
Louisiana exempts dwellings from taxation n1057
1,250,000 houses needed n47
Prague, conditions in..... 111
Project, Olean, N. Y. (J. Nolen)..... *80
Report by Chamber of Commerce.....n787
Tax exemption bill passed by New York aldermen n362, n403
Hovey, O. E., biography n*357
Howson, L. R., on cost-plus contract gives low cost on Ashland filters 388
Hoxie, F. J., on treated lumber for insulating roofs of moist factories a297
Hudson Bay Ry., no work this year.....n530

HUDSON RIVER

Bridge and tunnel discussed..430, n870, e880
Bridge, se Bridges, Hudson River.
Channel protection e193
Crossing question discussed e880
Piers, see New York City.

HUDSON RIVER VEHICULAR TUNNEL

Bids for N. J. ventilating shafts held up n575
Bids on shafts called for n448
Contracts read May 15.....562, (W. I. Aims and C. M. Holland) letters 960
Deadlock ends n1011
Engineers dismissed summarily....e795, n828, n912
Policies indorsed by transport interests.n277
Traffic policies endorsed..... 293
Slide vs. trench method.....764, e879
Tunnels and bridges, relative merits.. 430
Ventilation policies, tests....497, 602, (W. I. Aims and C. M. Holland) letters 960
Watson, Col. G. L., declines appointment n870, e880
Wrangle continues n963
Human engineering (book review)..... 865
Humphrey, R. L., biography n*397
Hunt, A. M., vice-pres. Am. Soc. C. E...n*317
Hunter, J. B., on Esquimalt dry dock.....*670
Hussey, C. L., and others, on highway bridges 214
Hydraulic excavation, see Excavation.
Hydraulic fills, see Fills, Earth.

HYDRAULICS

Calibration of circular orifices under high heads (Prof. F. W. Greve).... 24
Coefficient of discharge for vertical circular orifices (Prof. F. W. Greve).... 24
Computing waste-weir capacity and reservoir rise (Prof. W. S. Pardoe)..*114
Horizontal diaphragm increases surge tank capacity *67
"Hydraulics With Working Tables" (Bellasis), review by R. E. Horton.. 128
Investigations resumed by Reclamation Service; summary of work e145, 161
Jump, hydraulic (J. A. Wade)....letter 135, (S. M. Woodward) letter 186 (Julian Hinds) letter 272
Reclamation Service investigations resumed; summary of work.....e145, 161
Snow surveying for forecasting of stream flow (J. E. Church, Jr.)...*244, *300
Stream flow forecast by means of snow surveys (J. E. Church, Jr.)..*244, *300
Velocity tests in dredge pipe (I. E. Houk) *18, *169
Hydro-electric power, see Water Power.
Hydro-Elec. Power Commission of Ontario, proportioning concrete on job by exact methods (R. B. Young and T. V. McCarthy).....e450, *456, (Prof. G. M. Williams and R. G. Young) letters 867

I

I-beams, see Beams.
Idaho, license examination Sept. 13.....n1093
Idaho Soc. of Engineers, growth.....n358

ILLINOIS

Construction investigation n574
Drainage work 33
Highways:
Bids n361, n448, n529
Concrete road building delays analyzed (A. W. Consoer) 644

Page

Contract dates and peak outputs (B. Piepmeier) e1059 *1081
Cost analysis simplified by report (I. E. Scott)) *118
Legislature to investigate n569
New concrete slab design..492, *504, e879
Patented pavements permissible.....n444
Practice 39
Subgrade support in design; corner failures, etc. (C. Older).....*210, e492, *504, (C. S. Pope and C. Older) letters 693
Testing-cylinders for experimental road (H. F. Clemmer) *1116
Legislation, new n1138
Water supplies, small, financing of....a299
Illinois Central Ry., educational plan....n612
Illinois River, Health Service to study pollution n396
Illinois Soc. of Engineers, meeting; prizes awarded n358
Illuminating Engineering Soc. to meet....n570
Immigration, conference n703
Law, new n362, e705, n1013
Status of e50, 57
Imperial Valley, New River bridge failure (E. E. East) *334
Imperial Valley threatened by Colorado River floods n1093
Imports, see Trade, Foreign.
Income tax data sought from contractors..n790
Indicator, electrical, on London subway.. 655
India, protecting buildings against white ants 13
Mysore power and irrigation dam (E. W. T. Slater) *1107
Public works (A. W. Robinson)..letter 961

INDIANA

Building close to $2,000,000.....n877
Cities rated by water supplies.....e663, 686
Conservation Dept. gets money for engineers n570, n657
County surveyors' pay, bill fixes.....n571
County surveyor supported in court decision n915
Drainage, laws to be codified.....n571
State engineer wanted n45
Engineering department bill passed....n526
Favors interstate harbor.....n526
Highways:
Bridge plans, large.....n1055
Commission changes recommended...n443
Contractor loses in bond suit.....n744
District maintenance engineers' report blank *223
Lincoln Highway, ideal section to be built n1093
Legislation affects engineers.....n571
Licensing bill signed n484
Public Service Com. reorganized.....n914
Public utilities and waterworks..... 510
State authorizes city manager plan....1003
State engineer bill approved n443
Prof. W. K. Hatt appointed....n657, (W. K. Hatt) letter 825
Indiana Sanitary and Water Supply Assn. convention n397
Indianapolis, filters, fifteen years' operation 218
Track elevation will proceed n488
Industrial Court, Kansas, see Kansas.
Industrial railways, see Railways, Industrial.
Industrial service bureaus planned by Hoover n789
Industrial waste, see Sewage.
Industry, taking up slack in (H. C. Hoover) e324, 342
Information, business, value of....e922, n968, n1014
Institution of Civil Engineers, move to charter n658
Insurance co. investigation by Lockwood committee denied n362
Interior waters, conference on n964
Internatl. Assn. of Road Congresses, no prospect of joining n316
Internatl. Boundary Commission, Col. E. L. Jones appointed n485
Internatl. Chamber of Commerce, Hoover represents engineers on committee... n45
To hear building problem n701
Internatl. Motor Co. new crane.....n*489
International Railway Congress on pre-war basis n965
International technical meetings.....e1060

INTERSTATE COMMERCE COMMISSION

Authorizes two short lines n739
Engineer for e409
Issues four valuations n658
Esch, J. J., new member n739
May not abandon line, contended.....n912
New members confirmed n829
Nominations n484
Interstate drainage case in Supreme Court n187, n830
Interstate water conflicts and possible solution.....157, (J. C. Trautwine) letter, with editorial comment, 274, (C. E. Grunsky and others) 755
Investigations, Government.....e975, n1014
Iowa, highways, concrete, tamped-in wearing course 728
No need to curtail work (A. P. Munsen) .....letter 391
Stockpiles on subgrade prohibited..... 248
Iowa Engineering Soc. investigates engineers' incomes *387
Meeting n187
Iron and steel founding, textbook on (Osann), review by Dr. R. Moldenke.. 307
Iron and steel situation (A. I. Findley)..n400

Page

IRRIGATION

All-California plan (Marshall plan) held numerical (G. S. Nickerson and others).....letter 273, n277, (G. B. Ashcroft) 386, 556, letter 606, e977, *994
California area 386
Canal linings, freeboard allowance for (C. P. Dunn) *186
Colorado River problems 862
Columbia Basin project, board finds cost estimates low 733
Surveys continue n1136
Dam, earth fill, with novel details (C. V. Mann) *1030
Dams, sheerboards used in building hydraulic fill dam *291
Ditch design for silt prevention 647
Duty of water (J. T. Kingdon)..... 546
Excavation, closed-drain, done by dragline (J. D. Hays) h*523
Horse Heaven district, proposed..... 997
Interstate conflicts and possible solution (R. I. Meeker).....157, (J. C. Trautwine) letter with editorial comment) 274, (C. E. Grunsky and others) 755
Madera project, see Madera.
Marshall plan, see above, Irrigation, All-California plan.
Moss, eradication from canals..... 103
Mysore, India, power and irrigation dam (E. W. T. Slater) *1107
Nile River, allocation of water between Egypt and Sudan.....679, (book reviews) 689
Oregon congress n188
Pumps, increase in area served by, San Joaquin Valley 1115
Reservoirs, see Reservoirs.
Return water pumped 300 ft..... 887
Siphon, inverted, ends in riser on bridge pier .....*562, (E. H. Tashjian) letter *780
Utah storage commission appointed....n873
Water needed for, rather than for power.n914
"Wildcatting" in e977, *994

J

Jacks, pivoted, to prevent rotation of tunnel shields *892
Jacob, C. C., on reservoir capacity curves without topographic survey.....*948
Jamaica Bay plans approved by New York City n915
Jamestown, N. Y., municipal milk plant delayed 253
Japan and cities population 497
Concrete wireless tower 672 ft. high...*847
Railways in 848
Jenks, H. N., on investigation of perforated-pipe filler under-drains, Sacramento, Cal.....e145, *162, (W. Gore, H. N. Jenks and P. Hansen) letters 735
Jersey City, N. J., engineer board recommends plans for *177
Objects to early creation of port authority n395
Pennsylvania R.R. to tear down train-shed n1136
Prize fight stadium, construction..... e1102, *1112
Jetties, properly constructed 138
Johnson, Prof. A. N., on two-lane road widths *989
Johnson, E. O., on paint values, diagram for *601
Johnson, G. E., on road grading methods and costs in Nebraska.....*251
On submerged gravel pumped to screens for road work h*781
Joint Committee reports e1101
Joints in concrete structures sealed by new stop water *681
Jones, Col. E. L., on boundary commission.n485
Journal of Electricity dines Western leaders of industry n188
Enlarges scope n277
Junkins, S. E. Co., Ltd., staff of, on lining Selkirk tunnel *418

K

Kankakee River control 656
Drainage board created n398

KANSAS

Court of Industrial Relations says skilled help should be helped n47, e49
Governor Allen for state-made cement.. 266
Highways:
Brick, machine tamped base required. 259
Highway bridge conditions 208
Monolithic brick road built of fine aggregate (W. M. Watson).....*25, 259
Kansas City, Mo., city-owned utility bonds outside debt limit 175
To have new water commission.....n914
Water works, $18,000,000 extensions advised n44
Copper sulphate for cleaning walls.. 223
Main cleaning (C. S. Foreman).....a1040
Water supply, report on 499
Metered n1136
Kansas City Southern R.R., valuation report .....686, (S. W. Moore) e796, 818
Kansas Engineering Soc. annual convention n44
Keefer, C. E., and M. J. Rurak, on sanitary lateral sewers and house connections 564
Keith, F. S., on engineering legislation in Canada 21
Kenova Bridge, see Bridges.
Kentucky & Tennessee Ry. to build spur..n739
Kercher, H., on diagram for effect of flange holes in beams and channels.....*799

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

Kern River, Cal., reaction turbine in service n749
Keyes, H. E., on 6-year comparison of building material costs n*446
Kimball, D. S., nominated for president A. S. M. E. n1094
On industrial opportunity of Fed. Amer. Engineering Societies 728
King, W. B., on minimizing risk in contracting 227
Kingdon, J. T., on duty of water in irrigation 546
Kirchoffer, W. G., on air-lift removal of sludge from sewage tanks *953
Knight law, New York, unconstitutional. n322
Knott, G. L., on waterproofing vertical lift well h*607
Knott, V. P., resigns as Arkansas highway engineer n1092

L

LABOR

Aid skilled help in slack times, says Kansas court n47
"Bill of rights" by Federation of Labor. e365
Boston builders break with union employees n530
Boston labor enters contracting field.... n489
Boycott, secondary, held illegal........ e49
Bricklayers, British, output of........ n745
Chicago, demand pay increases..... n94
Efficiency commended by employers.. n322
British, see also Labor, Strikes.
British, highway work aids unemployed 67
Wage conditions n744
British, London builders initiate dilution plan n1099
Building trades:
Construction industry 225
Cost per output hour in building (F. E. Barnes) e880, 888
Harrisburg, Pa., mechanics ask increase n530
London employees agree to increase output n744
Metal sash and door work allocated by national board n575
Newark, N. J., dispute settled n322
New York State, conditions and supply n789
Open-shop plan gains in building industry n1015
Relations 225
San Francisco building disputes settled by arbitration n239
San Francisco, builders lockout unions. n970
Situation, April........ n702
Union schedules and building operations (W. J. Barney) 886
Wage adjustments n1098, n1140
Wage controversies n660, n1056
Wage differential n1098
Wage situation n702, n745, n876
Wages in various countries n1141
Wages lower in San Francisco n660
Camp commissaries h42
Colorado Fuel & Iron Co. employs 1000 more men n488
Dilution plan, English n1099
Hetch Hetchy tunnel work now open-shop n657
"Labor's Crisis" (Mendelsohn) book review 308
Leaders indicted, Chicago n191
Lumber industry, Norhwest, conditions... n575
New Jersey highway, to have wages cut n93
Packing industry, strike averted by wage cut agreement n575
Pan-American conference n94
Prevailing rate of wages ordinance, St. Louis repealed n321
Railway Board decides to abolish agreement e664
Railway, conference in wage dispute.... n489
Move to scale down wages n279
National agreements relief from.... e1101
Railway wages upsetting to industry.. e325
Track, problem of e449, e622
Unemployment n362
Unions charge neglect in research ... n740
Wage regulations, practical details ... 631
Working agreements with e281
Rates and conditions, April n615
May n789
Shop council plan, Chicago gas company n47
St. Paul bodies plan to enter contracting. n574
Steel Corporation twelve-hour day seven-day week to go n796
Wages reduced e796
Strikes
Boston building trades n191, n615
British coal mine strike.... 20, e623, e664, n743
Building trades after proposed wage cuts n835
Marine .... [illegible]
Tug strike in New York called off .... [illegible]
Unemployment
British, least in building trades .... [illegible]
Chicago union men idle n279
Canada public works [illegible] asked as relief .... [illegible]
City work for unemployed .... [illegible]
Insurance, proposed Wisconsin law .... [illegible]
Metal trades reopen shops. n362
Number decreases .... 531 [illegible]
[illegible] n1011
Now and in 1920 .... [illegible]
Toledo emergency fund ... [illegible]
Union a tax on [illegible] .... [illegible]
Wages and cost of living.... [illegible]
Wage reductions
Adjustments, [illegible] many industries.. n191
Bethlehem [illegible] .... [illegible]
Bethlehem Steel Co. n46
Birmingham [illegible] wages .... [illegible]

Builders oppose wage cut n190
Building industry
n362, n448, n575, n745, n835, n1098
Cutting wages to fit living cost e1061
Deflation in wages e533
Factory wages decrease........ n1140
Montreal building trades, wages drop 10% n489
New Jersey highway n93
Production vs. wage cutting e1061
Railway Labor Board opposes wage cut n321
Railway, move to scale down wages.. n279
Seattle announces 20% wage cut.... n321
Shipyards, due Apr. 1........ n448
Steel Corporation e796
Steel trade adjustments........ n1057
Working week shortened, production decreases n362
Youngstown, Ohio, builders plan wage cut n530
Lagging tool, a good h869
Lake Erie, sanitary survey opposite Cleveland (J. W. Ellms) a1039
Lake Michigan, water filtration near Chicago 730
Land, computation of area in acres (H. N. Bradstreet) 804
Landscape gardening (book review)..... 865
Lake Charles, La., city planning 176
Lake Washington ship canal, widening urged n277
Lamon, J. C., on reclaiming hollow drill steel h*607
Langelier, Prof. W. F., on coagulation of water with alum by prolonged agitation e921, *924
Lanterns, signal, painted to decrease theft h354
Lath, metal, tests *20
Weights, reduction in number recommended n1057
Lawrence, W. C., on tastes and odors, Cleveland water supply........ a1039
Lead, red, in paint (book review)....... 864
Lead, white, in paint 126

LEGISLATION

Army highway equipment, to go to states under Reavis bill n318
Bridge bills before Congress n316
Builders, bill to register, New York City n444
Building and housing bureau, Federal, Calder bill n47
California, gasoline tax proposed...... n569
Canada, engineering legislation (F. S. Keith) 21
Colorado River compact proposed n1096
Contractors, relief for contractors operating under Supervising Architect n322
Department of Mines proposed n1094
Garbage and sewage, vicious legislation on e705
Gasoline tax, California, proposed n569
Grade crossing bill, Pennsylvania, vetoed. n1095
Highway (see also Highways, Federal-aid) humps at railway crossings proposed in Tennessee *256
Housing, bill for study introduced.... n874, n914
Bill revised n1098
Division in Bureau of Standards recommended n1010
Illinois, new n1138
Illinois-Indiana harbor n526
Immigration, see Immigration.
Indiana, affects engineers n571
Bill fixes county surveyors' pay...... n571
Engineering department bill passed.. n526
Highway commission changes recommended n443
State engineer bill approved........ n443
Knight law, New York, unconstitutional n322
Licensing, see Engineers, Licensing.
Louisiana exempts dwellings from taxation n1057
Louisiana, may bar holding companies.. n576
Lumber, dressed, tax opposed n1057
Maine, proposed state water power control n571
Metering of Government water proposed 343
Michigan port bill fails........ n831
Michigan port district, bill passed.... n1094
Minnesota, motor vehicle fees, ... n964
Missouri franchise tax law constitutional n830
Muscle Shoals dam appropriation killed n441
New Jersey, bill to license builders.... n530
Building investigation authorized.... n574
New York Dowling law called unconstitutional n488
Water power n527, n738
New York-New Jersey Port Commission bill, see New York-New Jersey Port Commission.
Ohio River bridge at Evansville, Ind. n91
Pavement patents, permissible in Illinois n444
Potomac River, see Potomac River.
Prevailing rate of wages ordinance, St. Louis, repealed n321
Railroad, bill for partial payments of .... n364, [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

United States Civil Engineer, bill creates office n874
Unemployment insurance, proposed Wisconsin law n321
Valuation, see Railways, Valuation.
Washington, D. C., water supply, appropriation for conduit n1095
Waste elimination, commission, Federal, proposed n1094
Water power act e6
National parks excluded n442

Leixoes, see Portugal.
L'Enfant, P. C., tribute to........ 649
Lenth, G. C. D., on pneumatic hand shovels hasten tunnel excavation....... *500, see also *986.
Lethbridge, Alta., to have manager..... n44
Levee settlement causes seepage under pump house *814
Levy, A. G., on rate of solution of sulphate of aluminum a1039
Libraries, special, needed (K. C. Walker) letter 392
Library of Congress, contents 305
Licensing of engineers, see Engineers, Licensing.
"Lighthouses" for British roads........ 1033
Lincoln, Neb., sewage works for city and suburbs *221
Lincoln Highway completely marked..... 380
Road types 499
Lincoln Memorial, Washington, D. C., approaches must be underpinned........ n275
Lippincott, J. B., on interstate water conflicts 755
Lipps, W. F., new chairman Chicago terminal commission n446
Lockwood investigation, see New York City, building graft scandal.
Locomotives, see Railways, Locomotives.
Loess, sliding, held by inclined wall braced by struts *906
Log-flume engineering (V. K. Woods) ...... e747, *768, correction, 935.
Logging railroad, Pacific Coast, contracts to be let n969
Logs, see Lumber.

LONDON

Builders initiate labor dilution plan.... n1099
Building employees agree to increase output n744
Concrete roads 1073
Housing problem (C. H. S. Tupholme).. n614
Municipal supply scheme n917
Pavement rule 764
Rubber paving 1120
Subway, electrical indicator........ 655
Traffic, bill for regulating........ n1137
Water supply, large loan for extensions proposed n1137
Waterloo Station, enlarged *426
Long Beach, Cal., failure of steel truss support wrecks concrete dome (E. R. Bowen) .... e281, *294, (J. T. N. Hoyt) letter 479, (F. A. Johnson and H. W. Bolin) letter 479.

LOS ANGELES

Bond issue for sewers loses........ n1057
Building activity n835
Crowded (F. C. Wight)........ 56
Earthquake causes surge in sewer..... 60
Harbor, long concrete piles built up with cement gun *420
Hill St. Bldg., large timber frame to support concrete truss forms (R. C. Mitchell) *380
Sewage Disposal Commission, findings.. 1117
Sewers, new ocean outfall and screens *331, n484, n784
Terminal plan ordered n829
Louisiana, holding companies may be barred n576
Tax exemption for dwellings........ n1057
Louisville & Nashville R.R., Gulf Coast bridges ordered rebuilt n142
Railroad opposes order n610
Lounsbury, W. C., and A. W. Fowler, on water waste prevention in Superior, Wis. *461
Louvain reconstruction begun by American architects n531

LUMBER, see also WOOD

Consumption, per capita 546
Costs, current n1014
Exporters ask standard contract form.. n322
Loaded on trucks, simple method h*137
Log rules found inaccurate 1066
Log-flume engineering (V. K. Woods) ...... e747, *768, correction 935.
Northwest, conditions n575, 744, n786, n835, n970
Orders and shipments greater than cut .... [illegible]
Prices before and since war .... [illegible]
Production, etc., half normal .... [illegible]
[illegible] prices offered .... [illegible]
Southern pine, million-foot order closed. n748
[illegible] lumber opposed .... [illegible]
West coast production .... [illegible]
West Coast [illegible] .... [illegible]
West Coast Lumbermen's Assn. [illegible] .... [illegible]
Western, movement to Eastern ports.... n918
Luten falsework patent suit dismissed.... n830
[illegible]

M

[illegible]
[illegible]
[illegible]
[illegible]

*Illustrated; e editorials; h [illegible]; n news notes; a abstract.

Page

MacElwee, R. S., on engineer in foreign trade ... 959
Machinery, construction, attention to ... e879
 Road, exports of ... 501, n744
 Value of output, 1919, $186,000,000 .. n1141
Machines vs manual labor ... e491, *508
Mackall, J. N. and others, on highway bridges ... 214
Madera irrigation project, plans for ... n141
Madison, Wis., water tank of water-works, condition after 30 years' service (W. E. Miller) ... *548
Mails, Hayti-Santo Domingo, carried by airplane ... 596
Maine, proposed state water power control . n571
Malaria, road work should not help ... 826
Manchester, N. H., builds three schools ... n569
Manitoba railway, survey for new line begun ... n236
Mann, C. V., on earth fill irrigation dam with novel details ... *1030
Manual labor vs. machines ... e491, *508
Map, relief map of U. S., new ... 689
Mare Island Navy Yard, chance for ... e975
Maricopa County, Ariz., considers building cement plant ... n918
 309-mile road program (R. Rollins), e879, *882, e1017, *1026, h*1048
Marine borers, see Teredos.
Marine Equipment Mfrs. Assn. organized . n321
Marine strike ... n790
Markwardt, L. J., on million-pound testing machine, Forest Products Laboratory ... *31
Marshall irrigation plan, see California.
Marshall, L. A., on rate of solution of aluminum sulphate ... a1039
Maryland motor vehicle law, enforcement. e665, *666
Maryland Univ., College of Engineering reorganization ... n612
Masonry, mortar stains on, prevention ... 954
Masonry structure, large, Mysore power and irrigation dam (E. W. T. Slater) ... *1107
Masonry structures (book review) ... 691
Mass. Inst. Technology, Dr. Nichols, new president ... n739
Materials, see Construction, Materials.
Mathematical forms, plea for (J. A. Kitts) letter 41
Matte, J. Jr., on construction details, General Motors building, Detroit ... *624
Maywood, Ill., almost scored typhoid epidemic (H. F. Ferguson) ... letter 310
McAlpin, G. W., on anchored barge and timber speeds hold cofferdam in swift water ... h481
 On timber boiler-stack support for temporary set-ups ... h*523
McCarthy, T. V., and R. B. Young, on proportioning concrete on job by exact methods ... e450, *456, (Prof. G. M. Williams and R. G. Young) letter 867
McClellan, Dr. W., president A. I. E. E. .. n1010
McClintic-Marshall Construction Co., Panama lock gate claim settled ... n448
McConnell, I. W., biography ... n*357
McCurdy, F. A., on use of mucilage instead of thumb tacks ... 1077
McCurdy, H. S. R., on dragline excavator at Englewood dam ... *603
McGee, H. G., on economics of highway improvements ... *810
McLaughlin, W. W., on capillary moisture and effect on subgrades ... *1037
Medough, F. W., on excluding air from pitometer piping ... *605
Meeker, R. I., on interstate water conflicts ... 157, (J. C. Trautwine) letter, with editorial comment), 274, (C. E. Grunsky and others) 755
Mellon, Sec., suggests tax revisions ... n789
Memphis, Tenn., auditorium, work begun . n969
 City recognizes engineers ... e706, (A. L. Dabney) letter 734, (W. E. Brown) letter 909
Merriam, J. H., on construction of substructure, Platte River bridge ... *1078
Metal lath, see Lath, metal.
Metal sash and door work allocated by national board ... n575
Metals, base, lead in value, with cement .. 63
Metal trades reopen shops ... n362
Meter, flow, see Recorder.
Meters, water, see Water Supply, Meters.
Mexico, railways, life of ties and timbers ... 224
Miami Beach, Fla., recognizes engineers (W. E. Brown) ... letter 909

MIAMI FLOOD PROTECTION WORK

 Dayton arch bridge pier split and listed. *264, 511
  Another bridge in danger ... n524
 Dragline excavator at Englewood dam (H. S. R. McCurdy) ... *603
 Dredge pump efficiency, effect of worn runners (I. E. Houk) ... *169
 Dredge pump operation for hydraulic fill (I. E. Houk) ... *1034
 Hydraulic fill at Germantown Dam method of capping ... *248
 Hydraulic-pump pools ... *764
 "Hydraulics of the Project" (Woodward), review by R. E. Horton ... 690
 Monuments, concrete, for property (C. S. Bennett) ... *806
 "Rainfall and Runoff in Miami Valley" (Houk), book review by R. E. Horton 1044
 Velocity tests in hydraulic dredge pipe (I. E. Houk) ... *18, *169

Michigan, engineers want state aid for colleges ... n278
 Freight rates on road materials lowered . n786
 Port bill fails ... n831
 Port district, bill passed ... n1094
Michigan Engineering Society convention . n278
Michigan Univ., highway courses ... n93
Military Academy, see West Point.
Milk pan used for flood-light reflector ... h*137
Milk plant, municipal, at Jamestown, N. Y., delayed ... 253
Miller, E. B., on employment service of A. A. E. ... 66
Miller, Gov. N. E., New York, wants state water power control ... n483, n527
Miller, W. E., on conditions of water tank, Madison, Wis., after 30 years' service .. *548
Milwaukee, water-filtration problem .. 604, n698
 Sewage disposal plant foundation, bids received ... n1056
 Water supply, filters urged ... n1138
Mines, equipment and practice, standardization conference ... n278
 Department proposed ... n1094
 Shaft sinking by bucket and trolley (B. G. Best) ... h*962
Minneapolis to make zone rules ... n740
Minneapolis, St. Paul and Sault Ste. Marie, unusual trestle filling methods ... *123

MINNESOTA

 Highways:
  Maintenance estimate and progress report forms ... *79
  Motor vehicle fees ... n964
  Superelevated curve practice ... *220
 Licensing bill ... n142, n783
 Societies form federation ... n482
Minnesota-Dakota drainage case in Supreme Court ... n187, n830
Minnesota Valley Drainage and Conservancy District formed ... n831
Mississippi River bridge at St Paul, bonds approved ... n913
Mississippi Valley Assn. conference on drainage, etc. ... n45
Missouri franchise tax law constitutional . n830
Missouri, highways, Federal-aid ... 581
 State survey methods and costs .. *68, (C. M. Noble) letter 233, (C. A. Shockley) letter, with editorial comment, 353
 State authorizes city manager plan ... 1003
Mitchell, R. C., on large timber frame to support concrete truss forms ... *380
Molasses tank collapse, Boston, see Boston.
Moldenke, Dr. R., review of "Lehrbuch der Eisen- und Stahlgiesserei" ... 307
Montreal building trades, wages drop 10% . n489
 City retains mayor-annd-council charter. 934
Monuments, concrete, Miami District (C. S. Bennett) ... *806
Moore, E. H., protest against appointment. ... n740, personal note 572
Moore, L. E., on strengthening highway bridges ... e580
Moore, O. L., on modified Vicat apparatus for study of setting time of cement ... *70
Moore, S. W., on analysis of Kansas City Southern valuation ... e796, 818
Moran, D. E., on distribution of soil pressure as related to foundations ... e363, *366
Moran, J., prison term ... n1098
Morse, R. B., and A. Wolman, on meeting water-supply and sewerage costs ... e921, 944
Morgan, A. E., see Antioch plan.
Morse, R. B., on state vs. local viewpoint on filter plant control ... a1040
Mortar stains on masonry, prevention ... 954
Mosquitoes, road work should not help .. 826

MOTOR VEHICLES

 And industrial railway on road job (H. E. Breed) ... *289
 Auto body building plant, oversize construction ... e49, *82
 Autos, parked, fire danger in ... 213
 Auto shipments, April, 1920 and 1921 .. n917
 Bus successful on short line railroad ... *648
 Concrete mixing plant on motor truck . h*394
 Connecticut plans increase in license tax n44
 Drivers, safety lessons for ... 272
 Fees, Minnesota ... n964
 Freight transfer by trucks on European railroads ... *954
 Gasoline tax ... 685
 Impact on roads, report on ... e534, *553
 Load limit for soft roads, New Hampshire ... e621
 Operation costs, effect on highway location and grade design (W. G. Harger) *201
 Overloading condemned ... n913
 Radio signals, transcontinental, in moving autos ... 643
 Registration ... e323, 330
 Regulatory law, enforcement in Maryland ... e665, *666, (C. J. Benlett and others) 722
 Research department organized by Soc. of Automotive Engineers ... n570
 Statistics for 1920 (A. P. Anderson) ... 683
 Tax higher favored (J. H. Wilkes) letter 41
 Train two-yard subgrade truck ... n1015
 Tractor carries 4-in. gun 25 miles per hour ... 993
 Tractor speeds delivery on hauling job .. *853
 Tractor-trailer freight transfer, St. Louis, Mo. ... *852
 Trailers in municipal service (H. W. Perry) ... *374
 Truck, all-steel, for heavy-duty transfer work (D. H. Fleming) ... h*567
 Truck body kept clean by use of canvas carpet ... 370
  Truck speed rating and standard body weight allowances ... 1022
Moving, building, see Buildings.
Moving pictures show road work ... n612, n1094
Muck cars, "home-made" foot brake for . h*1134
Mud balls in filters, piping rearrangement as cure (H. W. Blaisdell) ... *234
Mullen, J. F., on pile load based on penetration in redriving ... *344
Municipal government, ownership, etc., see Cities.
Muscle Shoals, Wilson Dam appropriation held up ... n47, approved by Senate, n275; killed, n441
  Monthly suppers stimulate spirit ... h567
  Plant and construction ... e533, *536

N

Narrows, New York City, borings for tunnel ... n316
Nashville, Tenn., engineers to advise on new Rail and water terminal ... *766
Nashua, N. H., Mfg. Co., Jackson Mills, rebuilding water-power plant (E. H. Swett) ... *1062
 city charter ... n44
Nashville, Chattanooga and St. Louis Ry. proposes highway humps at crossings ... *256
Nasmyth, J., autobiography ... 474
Natl. Academy of Sciences, Washington, to have new home ... 220
Natl. Assn. of Purchasing Agents seeks safe contract form ... n487
Natl. Assn. of Railroad Tie Producers adopt standards ... n318
Natl. Board of Jurisdictional Awards Allocates metal sash and door work ... n575
Natl. Building and Construction Congress, New York branch organized ... n239, nominating committee named, n322, n703
Natl. Civic Federation meeting ... n188
Natl. Conference on City Planning ... n872
Natl. Congress of Building and Construction Industries studies costs ... e1017
Natl. Construction Conference urges price deflation ... n447, n877
Natl. Drainage Congress, conference to be held ... n45
Natl. Elec. Light Assn., Bump, M. R., new president ... n1093
Natl. Highway Traffic Assn. convention ... n656
Natl. Municipal League, engineer becomes president ... n738
National Municipal Review enlarges scope .. 476
National Parks, see Parks, National.
Natl. Public Works Assn., see Dept. of Public Works.
Natl. Research Council, Washington, to have new home ... 220
Naval bases, Pacific ... n277, e975, n1094
"Naval Consulting Board," book review ... 131
Navy, U. S., civil engineers wanted ... n658
Nebraska, highways, grading methods and costs (G. E. Johnson) ... *251
Neel, W. R., on cost-plus contract successful on Georgia road work ... 224
Neighborhood group plan for Cleveland ... 66
Nevada commission against state making cement ... n489
Newark, N. J., building trade dispute settled ... n322
 Overloaded wall buckles ... n483
New Bedford, Mass., buys garbage plant .. 859
New England Road Builders' Assn. formed n322
New Hampshire, highways, load limit for soft roads ... e621
New Haven rejects manager plan ... n1138

NEW JERSEY

 Building investigation authorized ... n574
 Highways:
  Bridges, density of ... 258
  Bridges inadequate ... 223
  Bridges, intercounty, state board suggested ... n141
  Engineers urge road law amendments e194, n237
  Freight rates on materials adjusted .. n1056
  Labor to have wages cut ... n93
  Licensing water purification plant operators (C. H. Capen, Jr.) ... a1041
  Requirements ... n142
 Watersheds, study of ... n1009
 Waterpower and waterway development n1136
 Water supply, cities discuss shortage ... n527
New Jersey Sewage Works Assn. meeting .. n398
New Jersey State Assn. of County Engineers meet ... e194, e237
New London adopts manager plan ... n1138
Newton, Kan., sewage treatment plant (I. S. Siegrist) ... *249
N. Y. Central R.R., new truck-body-container car for store-door delivery ... e533, *557

NEW YORK CITY

 Broadway made one-way street ... *256
 Brooklyn-Staten Island tunnel act for .. n874
 Builders, bill to register ... n444, n530
 Building graft scandal (see also Chicago and St. Louis):
  And organized contracting ... e3
  Bank and insurance co. investigation denied ... n362
  Brindell, R. P., refused change of venue ... n46
  Brindell found guilty ... n279
  Brindell begins term ... n615
  Brindell aids get prison terms ... n1098
  Builders paid high for loans ... n1013
  Cement inquiry ... n46, e145, 155, (410 (S. M. Greer and Atlas Co.) letters 736 (S. M. Greer) letter 909
  Cut stone contractors indicted ... n322
  District court to take up probe ... n1055
  Hettrick, J. T., on trial ... n279
  Hettrick convicted ... n403
  Investigation ends ... e922, n969
  Jail term asked for material dealers .. n835

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

Lockwood committee broader powers for ... n94
Lockwood committee denied increased powers ... n239
Lockwood inquiry, change in plan ... e922
Lockwood committee resumes ... n786
Mason building material dealers fined n876
Plumbers indicted ... n190
Plumbers get jail terms ... n531
Prison sentences to be asked ... n403
Sand dealers indicted ... n46
Sand dealers plead not guilty ... n94
Sand and gravel men fined ... n191
Special counsel provided ... n94
Stadtmuller, P., convicted of extortion n968
Stadtmuller and Moran get prison terms ... n1098
Trade associations advised to correct codes ... n94
Trade associations, regulation of ... e1102
Trade associations to be investigated by Government ... n1140
Water meter makers on grill ... e748, n784
Building, plans, increase in 1920 ... n93
Project, large co-operative, (Park-Madison Bldg.) abandoned ... n46
Report of Manhattan for February ... n447
Stimulated by tax exemption ... n488, n786
Contractors' claims, city will not pay ... n919
Court house, foundation of multiple ring concrete girders (C. S. Proctor) ... *494
Elevated trafficways proposed ... n525
Ferry to Staten Island, new, proposed ... n657
Ferry to Weehawken, dock commission would replace with piers ... n657
Freight handling at New York ... e195
Freight movement ... e242
Freight problem, local ... 370
Garbage disposal, in metropolitan district (G. A. Soper, G. C. Whipple, A. Hazen, J. T. Fetherston, e98, 104 (see also n1135)
Harbor, see New York-New Jersey Port Commission.
High Bridge to remain ... n236
Hudson River piers, further extension denied ... 250
Port (see also New York-New Jersey Port Commission)
Flushing Bay project approved ... n1095
Jamaica Bay plans approved by city ... n915
Rainfall intensities, probable, from Central Park records (K. Allen) ... *588
(L. S. Hall and K. Allen) letters 825
Schools, program cost $52,387,000 ... n615
Public, how one consulting engineer got job (E. E. Seelye) ... *940
Sewers (G. A. Soper, G. C. Whipple, A. Hazen, J. T. Fetherston) ... e98, 104
Snow removal, in metropolitan district (G. A. Soper, G. C. Whipple, A. Hazen, J. T. Fetherston) ... e98, 104
Machines ... e355, e411, *415
Strathmore building collapse ... e282, n315
Tax exemption bill passed by aldermen ... n362, n403
Traffic congestion, elevated expressways proposed ... 547, e577 (Col. W. J. Wilgus and C. W. Leavitt) letters 780, (C. W. Leavitt) letter 910
Traffic survey ... 304
Transit commission engineers ... n829
Contractors' claims, city will not pay ... n919
Growth ... n92
Lines to have "business" valuation ... n873
Narrows tunnel, borings ... n316
Problems, looking ahead on ... e795
Waste disposal, committee report on ... n1135
Water supply and sanitation in metropolitan district (G. A. Soper, G. C. Whipple and A. Hazen, J. T. Fetherston) ... e98, 104, *179

NEW YORK-NEW JERSEY PORT COMMISSION (see also NEW YORK CITY, PORT)

Belt-line plan to make New York a railroad port ... *182, e242, *271, n482
Bills:
Bills in Congress authorize compact ... n1007
Bills passed ... n524
Bill passes New York legislature ... n570, signed n611
Gov. Edwards of New Jersey [illegible] treaty with New York ... n441
Hudson River channel protected ... e193
Hudson River piers, further extension denied ... [illegible]
Hudson River tunnels and bridge, relative merits ... [illegible]
Injunction refused, pact signed ... n785
Jersey City objects to early creation of port authority ... [illegible]
New York City opposes treaty ... [illegible]
Plan difficulties in (T. K. [illegible]) ... [illegible]
Plans recommended by engineer board ... *177
Plan indorsed by Gov. M[illegible] ... [illegible]
Port, immediate relief for port ... e242
Port methods [illegible] Miller ... [illegible]
Port authority [illegible] ... [illegible]
Members [illegible] ... [illegible]
Step toward ... [illegible]
Railroad committee [illegible] authority ... [illegible]
State control of harbor ... [illegible] also n657)
Report ... [illegible]

New York Section, Am. Soc. C. E., see Am. Soc. C. E.
New York State [illegible]

NEW YORK STATE

Board of Estimate [illegible]
Building [illegible]
Building in New [illegible] February ... [illegible]
Engineer [illegible]

Engineering offices, Governor Miller would consolidate ... e49, n92, n482
Highways:
Bids analyzed ... n529
Bids opened ... n660
Commissioner, appointment of H. S. Sisson ... e146, (E. Harrison), letter 310
Contract worth $2,900,000 let ... n834
Contractors cannot obtain reimbursement for war losses ... n322
Knight law unconstitutional ... n322
Reconstruction needed; report of Commissioner Greene ... 269
Spirited bidding on work ... n316
Transit, valuation of lines to be made ... n871
port authority ... n396
Water power bill ... n483, n527, n738
Waterpower and waterway development, to be discussed ... n1136
New York State Assn. of Builders convention ... n46
Niagara Falls power, first license issued ... n398
Further development ... 1120
Turbine efficiency tested by pressure measurement (N. R. Gibson) ... *465
Use of more power not to be considered n278
Nicaragua, tunnel building in (H. L. Thackwell) ... *821
Nichols, Dr. E. F., new president M. I. T. ... n739
Nile River, allocation of waters between Egypt and Sudan ... 679, (book reviews) 689
Nineteen twenty, year, benefits of ... 1
Nitrogen and activated sludge (book review) 865
Nolen, J., on housing project, Olean, N. Y. *80
Nomogram, another, for cubic equations (Cusec) ... letter *90
Non-Partisan League experiments ... e281
Noonan, E. J., new member Chicago terminal commission ... n446
North Bay, Ont., wants town engineer ... n189
North Carolina, license bill passed ... n395
Licensing board meets ... n1093
North Dakota, Non-Partisan League experiments ... e281
North Platte River, see Bridges, Platte River.
Northern California Power Co., valuation case ... 1125
Northern Pacific bond issue quickly taken ... n786
Northwestern Assn. of Gen. Contractors' meeting ... n276
Norwich Univ., first engineering course (C. A. Plumley) ... letter 349 (T. M. Belden) letter 605
Notes From Foreign Fields, Barranquilla, Colombia (G. C. Bunker) ... e706, 732
Colombia and Venezuela, engineering in (J. L. Crane) ... 907
Nova Scotia highways investigated ... n278

O

OBITUARIES

Armstrong, J. F., 1012; Arp, J. P., 400
Barnard, E. C., *320; Blake, E. M., 192; Bloomshield, J. H., 742; Brenton, W. H., 486; Bullen, R., 96; correction 240; Bumstead, Dr. H. A., 144
Campbell, C., 48; Clapp, H. A., 742; Clarke, E. C., 875; Clarke, Col. T. C., 967; Cogswell, W. B., 1054
Daggett, F. W., 916; Davisson, W. H., 916; Draper, E. S., 360
Fisher, J. F., 320; Folsom, E., 192; Foust, S. M., 144; French, L. G., 742
Graham, E. M., 1012; Greene, Maj.-Gen. F. V., 875; Gunsaulus, Dr. F. W., 573
Hennebique, F., 528; Holt, B., 48; Humphreys, D. C., 144
Jarvis, C. M., 967
Kennedy, J. E., 96
Lane, F. K., 916; Leach, A. O., 1012; Lederle, E. J., 528; Ledyard, H. B., 1054; Lucas, Col. E. W. Van C., 486
MacKenzie, Maj. Gen. A., *445; Marsh, H. L., 144; McDonough, Col. M. J., 445; Mieron, F. C., 400; Moore, J. W., 788
O'Shaughnessy, J., 240
Payne, Capt. D. W., 528; Pearl, F. C., 400; Perkins, F. T., *967; Pierce, E. I., 144; Porter, H. K., 742
R[illegible], J. C., 400; R[illegible], K. G., 1012; Root, C. W., 573; Rosa, Dr. E. B., 916
S[illegible], R. C., [illegible]; S[illegible], Dr. W. T., 240, *288; Shepperd, F. W., 320; Smith, C. E., 144; Smith, F. N., 360; Smith, M. E., 192; Smith, T. L., 916
T[illegible], Col. H. [illegible]; Tinkham, S. [illegible], C., 486; Tomlinson, A. T., [illegible] W. C., 1007
W[illegible], T. H., [illegible] J. S., 192; White, A. T., 240; Wilkins, W. [illegible] A. H., [illegible]
[illegible]
Yates, F. K., 788
Observations on the Pacific Coast, Los Angeles [illegible]
[illegible]
Ocean structures, concrete for, at New York [illegible]
[illegible]

OHIO

[illegible]
[illegible] contracts let ... [illegible]
Contr[illegible] ... n1099

Goethals consulted ... n189
Semi-monthly estimates for contractors ... n835
Ohio Canal bed for highway ... n1136
Ohio River, locating soundings on (C. R. Andrew) ... letter *135
Oil, pipe line, French, abandoned ... n448
Reservoir, concrete, with flat-slab roof and floor (E. E. Halmos) ... *260
Tanks, concrete, permeability tests ... a349
Oklahoma City, sewage disposal project ... n877
Older, C., on subgrade support in pavement design ... *210, e492, *504, (C. S. Pope and C. Older) letters 693
Olean, N. Y., housing project (J. Nolen) ... *80
Ontario, engineers take steps for registration ... n93
To build cement plant ... n834
Open price associations, see Trade Assocaions.
Operating costs of engineering practice ... *542
Oporto, see Portugal.
Ore and coal movement ... n970
Oregon, highways, bids are 80% of estimate ... n745
Oregon Drainage Assn. meeting ... 347
Oregon Irrigation Congress ... n188
Orton & Steinbrenner Dependable crane n*1015
Osgood Co., shovel with continuous tread trucks ... n*1057
O'Shaughnessy, J., dam named for, Columbus, Ohio ... 349
Owens, R. G., leaves Lakewood Eng. Co. n*965
Oxyacetylene, see Welding.

P

Paaswell, G., on effect of practical factors on earth-pressure theories ... *682
Pacific Gas & Elec. Co., plans work ... n661
To build railroad for power development ... n831
Pacific Northwest Contractors' joint convention ... n531
Packing industry, strike averted by wage cut agreement ... n575
Paint, costs compared (A. H. Sabin) ... h42
Painting, steel surfaces prepared for ... a1130
Red-lead in (book review) ... 864
Values, diagram for computing (E. O. Johnson) ... *601
White lead in ... 126

PANAMA CANAL

Panama Canal, another, favored by Secretary Baker ... n91
Dredging operations for slides ... 299
Engineers recognized in inquiry ... e975, n1009
Lock gate claim settled ... n448
Slides quiescent ... 670
Traffic compared with St. Mary's Falls Canal ... 779
Traffic highest in 1920 ... 263
Pan-Amer. Labor Conference ... n94
Pardoe, Prof. W. S., on computing waste-weir capacity and reservoir rise ... *114
Park-Madison Bldg., New York City, abandoned ... n46
Parks, national, excluded from provisions of water-power act ... n442
Water, use of, controversy over ... e49, 777
Parmelee, J. H., on railway maintenance in 1920 ... 33
Partnerships, practice by, see Engineers, Licensing.
Pasadena, Cal., adopts city manager form n1009
City to have large stadium ... n873
Passaic Valley sewage may enter New York Bay ... n785, e839, 849
New Yorkers continue to fight ... n1050
Patch, D., on water content affects wear of concrete test pieces ... *373

PATENTS

Concrete surface roller upheld ... n610
Luten falsework suit dismissed ... n830
Pavements patented, permissible in Illinois ... n444
Stop water for joints in concrete structures ... *681
Pavements, see Highways, Pavements.
Penn. lead construction plants ... e49, *82
Pearse, L., on sewage plant, Calumet region, Chicago ... *986

PENNSYLVANIA

Bridges, joint maintenance subject to commission control ... n913
[illegible] city engineers [illegible] third class cities ... 161
[illegible] n1095
H[illegible]
[illegible] ... [illegible] e361, e448, e489
[illegible] e660, e661, e1011
[illegible] ... n1112
[illegible] ... n743, e968
[illegible] ... [illegible]
[illegible] ... [illegible]
[illegible] ... e1098
Replacing concrete slabs at joints ... *263
W[illegible] ... n1136
[illegible] ... [illegible]
Pennsylvania R.R. maintenance costs ... 849
W[illegible] ... n1136
P[illegible], J. J. [illegible] ... [illegible]
P[illegible] Light & [illegible] Co. [illegible] ... [illegible]
P[illegible] Assn. of Road Con[illegible] ... 316
[illegible] 19[illegible] ... 142
[illegible] W. [illegible] ... *354

*Illustrated; [illegible]

Page
Personnel board for contractors' field forces (M. A. Darville) *860
Personnel research federation organized...n612
Peru, centennial, American exhibit for...n488
Phelps, G. S. on economical loading of scagoing dredges *530

PHILADELPHIA

Bridge to Camden, see Bridges, Philadelphia-Camden.
Building trades eager to improve status.n919
Port terminal, appearance from air ... *107
Sewer work planned n1142
Societies hold hydro-electric symposium.n189
Street cleaning and related work (J. W. Follin) 166
Street cleaning, plan for contract killed.n874
Water-works filters Queen Lane alterations to (J. S. Ely) *942
Phila. Engineers' Club gives dinner to Hoover n697
Phila. & Reading R.R., coaling station for city engine terminal *673
Phosphoric acid, etc., in water softening. 81, 208
Phosphorus and sulphur in steel, study of. 601
Photographing road plans (N. F. Hathway) 422
Physician and engineer needed to control yellow fever (C. G. Wigley) 372
Pieperoier, B., on highway contract dates and peak outputs e1059, *1081
Piers, brick, mortar tests in 1111
Pier and quay, combination, in restricted space, Hoboken, N. J. *1074
Piers, railway, maximum compression on (F. K. Esling) ..... letter 232
Pihlfeldt, T. G., Chicago bridge engineer reinstated n914, 1043

PILES

Bearing and soil pressure (E. G. Hames) ..... letter 89, (J. C. Meem) letters 185 and 565
Concrete, effect of sea water on..... e97, *121 (T. B. Shertzer) letter 392, (L. Ravier) letter 566, (F. J. Litter) letter, with editorial comment, 652, (B. de Alzugaray) letter 910
Long, built up with cement gun, Los Angeles *420
Submerged, support precast slabs ..*984
Substructure of Platte River bridge (J. H. Merriam) *1078
Dragline excavator also drives piles in reclamation work (A. W. Walker)..n*354
Load based on penetration in redriving (J. F. Mullen) *344
Mechanical protection for 471
Piloting ships by electrified channel cables 590
Pine output 70% normal n702
Pine, Southern, see Southern Pine.

PIPE

Concrete, device for testing *887
Concrete, precast, tested with encased steel diaphragm *645
Pressure, water jacketing 943
Wood, creosoted, in use 28 years..... 304
Machine banded, leakage from (J. L. Campbell) 124
Staves, Douglas fir, creosote treatment (H. E. Hodges) a297
Pipe line for oil, see Oil.
Pipe lines, air-inlet valves for, formulas wanted (H. L. Thackwell) ..... *76, (A. Hazen) letter 134, (C. P. Dunn and H. L. Thackwell) letters 478
Pirnie, M., on filter underdrains, sand bed and wash water experience 371
Pit River, Cal., power development, railroad to be built n831
Pitometer piping excluding air from (F. W. Medlouch) *605
Tests large water meters in place (F. D. Danielson) *64
Pittsburg, Cal., typhoid epidemic, city faces suits, etc ..... 605 (R. Hitscher) letter, with editorial comment, 605

PITTSBURGH

Bridges, B. & O., over Allegheny River, reconstructed at new grade *284
City takes in Chartiers Township..... 77
Engineering bureaus shaken up by mayor n568
Point Bridge should be rebuilt 217
Reppert, C. M., appointed city engineer.n697
Slide, council committee report..... n610
Pittsburgh & Lake Erie R.R., ash-handling plants *172
Plague, bubonic, see Bubonic plague.
Planning, city, see Cities.
Plaster, gypsum, plastic, by new method (W. E. Emley) 1023
Plaster, tests, in frame house construction *90
Plastering code to be written..... 11
Platte River, see Bridges, Platte River.
Plumbers get jail terms, New York City..n531
Plumbers, New York, indicted for conspiracy n190
Poles, wooden, perforating to obtain better non-pressure treatment a298
"Pollas," concrete ship, winter halts salvage efforts n13
Politics in highway departments e.622
Portland, Ore., public utility plans extensions n877
Terminal changes under negotiation.... n871

PORTS AND HARBORS

Chicago, Army engineers propose new location *120, n526, 673
Flushing Bay, N. Y. project approved.n1099
Freight methods better 641
Harbor towers of concrete and steel in England 85
Illinois-Indiana, favored by Indiana....n526
Jersey City, engineer board recommendations *177
Los Angeles, long concrete piles built up with cement gun *420
Michigan bill fails n831
Michigan district, bill passes n1094
New York, see New York-New Jersey Port Commission, also New York City. Port.
Pier and quay built in restricted space, Hoboken, N. J. *1074
Portugal, foreign firms invited to bid.. n46
San Francisco Bay survey for deeper channel n740
Waterfront still under State control..n831
Shanghai to be studied by Goethals.... n485
State control e621, 649, n657, n831
Terminal, appearance from air, Phila...*107
Terminal design e491
Towers, English, of concrete and steel.. 85
Wolf Lake, Ind., bill for survey..... n571
Portugal, port improvement, foreign firms invited to bid n46
Post offices principal work of supervising architect (J. A. Cliff) ..... letter 186
Potomac River power project, appropriation for beginning work rejected n1095
Approved by Army engineers..... n92
Favored by commission 388
Power Commission, Federal, see Water Power, Commission.
Power, see Water Power.
Power plant, portable, for contractors..n*1141
Power situation during war (book review) 864
Practice by corporations and partnerships, see Engineers, Licensing.
Prague, housing conditions 111
Preparedness for war..... e664, (book review) 691
Pressure, earth, see Fills.
Price, D. J., on dust explosions ... e621, *634
Price associations, see Trade Associations.
Prices, see Materials.
Prize fight stadium, Jersey City, construction e1102, *1112
Proctor, C. S., on foundation of multiple concrete ring girders, New York court house *494
Production decreases as working week shortens n362
Production vs. wage cutting..... e1061
Pronoun, use of, in writing (C. T. Brady, Jr.) ..... letter 125, (Prof. P. B. McDonald) letter 307, (W. H. Breithaupt) letter 474.
Providence, R. I., dam contract let..... n835
Water works, resumes chemical precipitation 953
Public health, see Sanitation.
Public Health Assn. moves to New York..n915
Public Health Service to study Illinois River pollution n396
Public service, in engineering courses.... n612
Public service, integrity of e748
Public utilities, publicity a necessity.... 776
Public works, mismanaged construction. e533, 549
Public works planning, economy in..e451, (H. H. Esselstyn and W. H. Adams) *452, n484.
Public Works Dept., see Dept. of Public Works.
Publicity, congress n316
Publicity, engineering e364, n395
Publicity man, definition of..... 775
Publicity necessary to utilities..... 776
Pueblo, Colo., flood, see Floods Colorado.
Pump house, levee settlement causes seepage under *814
Pumping, groundwater and hydraulic excavation for hotel foundation, Atlantic City *52

PUMPS

Centrifugal, high-head, Shenandoah, Pa. (Gannett and Crane) *983
In Baltimore, sets new record *938
New method of determining efficiency (A. F. Sherzer) *1114
Dredge, effect of worn runners on efficiency (I. E. Houk) *169
Dredge, operation for hydraulic fill, tests (I. E. Houk) *1034
Irrigation, increase in area served by pumps 1115
Wheel-and-bucket, primitive, in China (O. Sherven) ..... letter *134, (D. C. Washburn) letter 273
Purdue Univ., highway courses n93
Pyle, C. E., on repairing railway bridge damage by train wreck..... e98, *100, e450, (A. W. Bull) 463

Q

Quarry, remote-control electric haulage..*956
Shale, railroad-type shovel swung end for end in h87
Quay and pier, combination, built in restricted space, Hoboken, N. J. *1074
Quebec, water-power development, winter work on *1122

R

Radio signals, transcontinental, in moving autos 643

RAILWAYS

Accidents, derailment on curves..e1018, 1024
Alaska, location surveys (T. W. Secrist)*632
Susitna Bridge opened n558
Ash handling plants, large, of two types.*172
Bagdad, international problem....e411, *423
Ballast and ballasting methods a497
Baltimore & Ohio, Bridge over Allegheny, at Pittsburgh, see Pittsburgh, Bridges.
Bond issue of $230,000,000 quickly taken n786
Brazil, construction in 1921 1068
Bridges, see Bridges, Railway.
British, proposed grouping..... e324, 341
Traffic in 1920 939
Canadian Govt., $179,000,000 for..... n488
Lord Shaughnessy's proposal e837
Reduction, 10 per cent in rates..... n1136
Canadian Pacific, lining Selkirk tunnel (Staff of S. E. Junkins Co., Ltd.)..*418
Car dumpers for quick unloading at grain elevator e491, *508
Car stop, sliding, for yard tracks..... *952
Cars.
Coal cars of 120-ton capacity for Virginian Ry. *304
Repair shops, design a512
Record surplus reported n661
Chicago, terminal problems..... 1077
Coaling station for city engine terminal, P. & R. *673
Conference, A. A. E., in Chicago..... n570
Construction:
Mileage in 1920 501
Pending confined to current needs... 37
Railroad built over flume to save excavation h*440
Revival in e2
Control, embargoing credit e97
Relief for railways..... e364, n396
Costs and rates e242
Credit, embargoing e97
Curves of 10° reduced to 1½ 263
Vertical, diagram for plotting (H. T. Avery) *1004
Cuts, large, drainage of a509
Delays in traffic, elimination 120
Detroit & Ironton to build short line..n915
Director general, R. C. Davis named...n569
Electric, heavy traction: is there a best system? e147
Electrification:
And location a674
Cost data (F. T. Howes)..... letter 351
Heavy traction studies n358
Location as affected by electrification.a674
Plans in England 200
Engineering research, neglect charged by unions n740
Engineers, professional, see Engineers, Railway.
European, motor truck transport of freight *954
Facilities, better co-ordination planned..n527
Fills, see Fills, Earth.
Financial situation and effect on improvement policies (T. D. Cuyler)..... 7
France, reconstruction 591, *592
Standard rails and splice bars *473
Freight, see Freight.
Grade crossings, Detroit, progress at... 306
Highway humps proposed in Tennessee *256
Indianapolis track elevation will proceed n488
Pennsylvania bill vetoed..... n1095
Syracuse takes state canal lands for..n142
Grading computations, mass diagram in (H. J. Saunders) ..... letter 134
Grand Trunk, arbiters bar costs of reproduction value n318
Taken by Canadian Government.... n830, n914
Great Northern bond issue quickly taken n786
Educational plan for engineers..563, see also n612
Green Bay & Western line may not be abandoned n912
Grouping, systems e324
Hudson Bay, no work this year..... n530
Illinois Central educational plan..... n612
Improvement policies as affected by financial situation (T. D. Cuyler).... 7
Industrial, and motor trucks on road job (H. E. Breed) *289
International Congress on pre-war basis.n965
I. C. C. has no authority to abandon line, contended n912
Investigation, Senate n739, n831
Japan 848
Kansas City Southern, valuation (S. W. Moore) e796, 818
Kentucky & Tennessee to build spur..n739
Labor, see Labor, Railways.
Location as affected by electrification..a674
Locomotives, large foreign order..... n835
London & Southwestern, London, Eng., enlargement *426
Louisville & Nashville, Gulf Coast bridges ordered rebuilt n142
Maintenance, costs, Pennsylvania R.R... 849
In 1920 (J. H. Parmelee)..... 33
Maintenance of way cyclopedia (book review) 863
Manitoba, survey for new line begun..n236
Mileage in 1920 503
Minneapolis, St. Paul and Sault Ste. Marie, unusual trestle filling methods.*123
Motor bus succeeds on short line road..*648
Nashville, Chattanooga and St. Louis, proposes highway humps at crossings.*256
National agreements, Pres. Harding confers with union heads n615
N. Y. Central, new truck-body-container car for store-door delivery e533, *557
Northern Pacific bond issue quickly taken n786
Operating costs e838, e879, 893
Pennsylvania R.R., maintenance costs.. 849

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page
Will tear down Jersey City transhed ... n1136
Pittsburgh & Lake Erie, ash-handling plants ... *172
Piers, maximum compression on (F. K. Esling) ... letter 232
Phila. & Reading, coaling station for city engine terminal ... *673
Rails and splice bars, standard, on French railways ... *473
Fissured rails ... 1069
Rate increases in England ... 186
Rates and costs ... e242
Reproduction, cost of ... e364
Roadway (book review) ... 865
San Diego-Arizona again in service ... n93
Security Owners' Assn. appoints engineer board ... n1010
Senate interstate commerce committee begins hearings ... n831
Soo, see Minneapolis, St. Paul and Sault Ste. Marie.
South African, bids until July 5 ... n877
Southern Pacific, curves of 10° reduced to 1½° ... 263
Speeds, train and track maintenance costs ... a507
Splice bars and rails, standard, on French railways ... *473
Spring work planned ... n489
Stations, Waterloo, London, Eng. ... *426
Street, maintenance of paving by companies (A. Swartz) ... *1118
Street, rail traffic vibration ... e282, n315
Surveying (book review) ... 865
Cross-sectioning and good judgment (A. A. Royce) ... letter 391
Simple method of resurvey for line adjustment (P. Vassalo) ... *798
Switches, remote control ... *1043
Terminal problems, Chicago ... 1077
Terminals, design for harbors ... e491
Plan to make New York a railhead port ... *182, e242, *271, n482
Unified operation ... e879, a893
Texas midland to build spur ... n739
Ties:
And timbers, life of, in Mexico ... 224
Machine "perforates" timber for preservative treatment ... 730
Producers adopt standards ... n318
Records from test tracks ... 461
Service test methods and record ... 584
Steel and wood, in England ... 985
Track (book review) ... 865
Anchors, new ... n576
Curve traverse chart for lining (J G. Wetherell) ... *719
Maintenance by piece work ... 455
Maintenance costs, effect of train speeds on increasing ... a507
Sliding car stops ... *952
Work, all-year-round ... e622
Train speeds, see Railways, speeds.
Trans-Andine line begun ... 824
Trestle legs, simple support for, while replacing footings (D. G. Coombs) ... h*42
Trestle collapse due to freshet ... n1095
Trestles, unusual filling methods on Soo line ... *123
Tunnels, see Tunnels
Uintah Ry. Co. to build short line ... n915
Unified operation favored by Commerce Chamber committee ... n914
Valuation:
Additional $1,000,000 for ... n396
Arbiters bar costs of reproduction value ... n318
Bill to amend act opposed by carriers. e1059 n1092
"Business" valuation of New York transit lines to be made ... n873
Commission issues four supplemental tentative valuations ... n658
Cost of reproduction ... e364
"Final" reports on four properties. e665, 686
Method not yet fixed (S. W. Moore). e796, 818
Subsidence of earth fills as a factor. e409 *434
Viaducts, high, on Reading Ry., filling (P. S. Baker) ... *1020
Virginian, coal cars of 120-ton capacity ... *304
Water supply, cleaning main ... *949
Preventing water hammer in long force main (J. L. Campbell) ... 951
Winchester & Western, motor bus successful on ... *648
Railway Labor Board opposes wage cut ... n321
Rainfall and stream flow, early measurements ... 379
Experiments (book review) ... 1044
Gage, a large, and heavy rainfall (B. F. Rush) ... 463
Intensities, probable prediction of (K Allen) ... *588 (L. S. Hall and K Allen) letters [illegible]
"Rainfall and Runoff in Miami Valley" (Houk), book review ... 1044
Rainmaker's contract with Alberta farmers (K. T. Roberts) ... letter 1090
Rammed earth, see Earth, rammed
Randell, R. R., on taking [illegible] out of drawings ... h96[illegible]
Rats, elimination in [illegible] control (E. Besselievre) ... *113
Reading, Pa., long [illegible] of [illegible] concrete (W. C. Fr[illegible]) *849 (J. L. Campbell) letter 1[illegible]
Readjustment, delay in ... n743

RECLAMATION SERVICE

Achievements to June 30, 1920 ... 213
Appropriation enlarged ... n41
Bill progresses ... n1095

Page
Hydraulic investigations resumed, summary of work ... e145, 161
Library in Washington, D. C. ... 131
Projects ... 85
Program must be curtailed ... n569
Recorder, automatic, for stream discharge (F. W. Hanna, G. H. Moore and J. C. Stevens) ... letters 521, (Prof. F. W. Greve) letter 779
Water-level, and flow meter combined ... n*531
Red lead in paint (book review) ... 864
Redding, Cal., see Northern California Power Co.
Reese, R. C., on stairways, laying out rise and run ... *805
Reflector for flood light, milk pan used ... h*137
Refuse disposal, see Garbage.
Registration of engineers, see Engineers, Licensing.
Reinforced concrete, see Concrete, Reinforced.
Reno County, Kan., monolithic brick road built of fine aggregate (M. W. Watson). *25, 259
Rensselaer Poly. Inst., first engineering school in America (T. M. Belden) ... letter 605
Rensselaer Polytechnic, Army officers go to ... n1095
Reports, engineering, writing of (H. C. Hodgkins) ... letter 90
Reppert, C. M., appointed Pittsburgh city engineer ... n697
Research problems, structural engineering. 859

RESERVOIRS

Capacity curves without topographic survey (C. C. Jacob) ... *948
Oil, see Oil, reservoir.
Roof, flat-slab, Canton, Ohio, collapses ... n569
Rise, computing (Prof W. S. Pardoe) ... *114
Waterproofing by gunite interlining (B. A. Greene) ... *958
Residual aluminum compounds in filter effluents ... 844
Retaining walls, earth-pressure curves by Coulumb's formula (A. W. Bedell) ... letter *392
Earth-pressure theory as affected by practical factors (G. Paaswell) ... *682
Inclined braced by struts ... 906
Weak (N. F. Hopkins) ... letter 90
Review of 1920 ... e1
Riensch-Wurl screen, see Sewage Treatment.
Ridgway, R., chief engineer, N. Y. transit commission ... n829
Dinner for ... n913, n1052
Rimrock Dam, work to be resumed ... n701

RIVERS

Columbia, properly constructed jetties ... 138
Conference to be held ... n45
Illinois, Public Health Service to study pollution ... n396
Jetties, properly constructed ... 138
Protection with spur dikes (E. Ramirez) ... letter *909
Red River, Louisiana, banks protected by spur dams (C. P. Chester) ... letter *1047
San Joaquin, Cal., irrigation system planned ... n141
Soundings, locating (C. R. Andrew) ... letter *135
Spur dikes protect banks (C. P. Chester) ... letter *1047
Rivers and harbors bill ... n278, n395, n485
Rivers and harbors work allotted ... n570
Roads, see Highways.
Rochester, N. Y., Engineering Soc. "engo-luncher's weekly" ... n*571
Rock excavated by improvised digger fixed to stiff-leg derrick (P. P. Suiter) ... letter 314
Rogers, W. A., on contractual relations in highway construction ... a345, 346
Roller, concrete surface, patent upheld ... n610
Roller Co. accused of unfair competition ... n322
Rollers guide cable on steep freight incline ... h*869
Rollins, R. on Maricopa County, Ariz., 309-mile road program ... e879 *882
Roofs, long-span concrete arches for Chicago garage ... *167
Of moist factories, treated lumber for insulating (F. J. Hoxie) ... a297
Rubber paving, London ... 1120
Rusk, M. J., and C. E. Keefer on sanitary lateral sewers and house connections ... 561
Rush, B. F., on large rain gage and heavy rainfall ... 463
Russian industrial conditions ... 333
Russian Engineering Society (A. Pazdzersky) ... letter 89

S

Sabin, A. H., on comparing paint costs ... h4[illegible]
Sacramento, Cal., city adopts cost-plus plan on [illegible] filter [illegible] (C. C. Gillespie) ... [illegible]
City engineer [illegible] for ... [illegible]
Investigation of perforated pipe filter [illegible] (H. N. Jenks) ... [illegible]
(W. [illegible] H. N. Jenks and [illegible]) ... letters 735
C. L. Seavey [illegible] manager ... n96[illegible]
Water [illegible] filtration [illegible] ... n9[illegible]
[illegible] ... *978
[illegible] (T. E. Stanton) ... *[illegible]
Safety [illegible] ... [illegible]
Salt Lake City smoke abatement [illegible] plans ... 71

Page
Samson Tractor Co., Janesville, Wis., steel shops ... *716
Sand and gravel production ... 991
Bulking of (G. M. Williams) ... letter 312
Dealers indicted, etc. ... n46; n94; fined n191
In concrete, see Concrete, aggregate.
"Sand hog" to reappear ... e622
San Diego-Arizona Ry. again in service ... n93

SAN FRANCISCO

Builders lockout unions ... n970
Building disputes settled by arbitration n239
Building, lower wages ... n660
Contractors fined; three more indictments n530
Garbage quality reflects thrift tendency ... 155
Garbage rates revision ... 269
Greater city, plans for ... 754
Harbor control, etc. ... e621, (see also 649), n657, n740, n831, e975
Observations (F. C. Wight) ... 27
Ocean beach improvement planned ... n698
Rincon Hill regrading ... n526
Water supply:
Hetch Hetchy dam, ready to pour concrete ... n1135
Hetch Hetchy mountain division, progress ... 270
Hetch Hetchy, strike ends ... n1015
Hetch Hetchy tunnel contract relinquished ... n701
Hetch Hetchy tunnel work now open-shop ... n657
Spring Valley, company asks rate increase to extend works ... n525
Spring Valley Water Co. purchase recommended ... 305; fails, n483
Spring Valley, J. Waldo Smith advises board ... n43
Spring Valley, vote on purchase ... n239
San Francisco Bay, bridge to cost $25,000,000 proposed ... n1053
Eastern engineers to advise on ... n1096
San Francisco Bay, naval base site ... e975
San Francisco Bay, survey for deeper channel ... n740
Sanitary Engineers, state, organize ... n1009

SANITATION (see also TYPHOID; WATER SUPPLY, etc.)

Amer. Public Health Assn., meeting ... n1095
Moves to New York ... n915
Bubonic plague control, engineering problems in (E Besselievre) ... *113
"Community Health Problem" (Burnham), book review ... 476
Conference of State sanitary engineers ... n870
Death rates from typhoid and other diseases in 1919 ... 212
Duluth, Minn., to have sanitary survey n570
Engineering aspects (J. A. Tobey) e663, *668
Greece (W. E. Spear) ... *708
Health officers, need not be physicians ... e663
Injunction against impure water ... n483
Metropolitan district, New York (G. A. Soper, G. C. Whipple, A. Hazen, J. T. Fetherston) ... e98, 104, *179
"Modern medicine and the Public Health" (Sedgwick) ... 308
Physician and engineer needed to control yellow fever (C. G. Wigley) ... 372
"Public Health and Hygiene" (book review) ... 690
Public Health Service to study Illinois River pollution ... n396
Tennessee department of sanitary engineering, in bill ... n45
San Joaquin River, Cal., irrigation project and dam ... n141
Increase in irrigated area served by pumps ... 1115
San Pablo tunnel, circular forms and tamped concrete hold ground ... h*737
San Pedro, Los Angeles & Salt Lake R.R., valuation report ... 686
Santa Barbara, Cal., Riensch-Wurl plant (O. A. Stone) ... *719
Sault Canals, 1920 traffic ... 958
Saville, Prof. T., on formula for settling periods in basins or tanks ... 647
Sawkins, J. H., on properties of crane girder sections ... *13
Saying vs. writing ... 436
Schneider, C. P. E., John Fritz medal awarded to ... n1092
Schneider, Dean H., credit due for co-operative courses (A. E. Morgan) ... letter 779
Scholarship, good, and engineering eminence 679
School buildings, see New York City.
School construction leads ... n615
Schuylkill River bridge, Philadelphia, to be rebuilt ... n1138
Scott, I. E., on highway cost analysis simplified by Illinois reports ... *118
Seaplanes, see Aeronautics.

SEATTLE

Announces 20% wage cut ... n321
Motor boulevard ... 779
Skagit River project, bidders on equipment asked to take bonds ... n[illegible]
First unit soon complete ... n956
Stadium construction [illegible] ... [illegible]
Street program more than $3,000,000 ... n*1099
To vote on bond issue ... n316
Water dept. shows profit ... n[illegible]
Water supply, plans for addition go forward ... [illegible]
Waterworks, construction of reservoir forbidden ... n47
Seavey, C. L., city manager, Sacramento, Cal. ... n965
Sea wall concrete, poured in sections by tremie ... *896
Sea water concrete, see Concrete

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

Secerist, T. W., on Alaska RR. location surveys *632
Sedgwick, Prof. W. T., address on "Modern Medicine and Public Health" 308
Obituaries 240, *388
Seelye, E. E., on how consulting engineer got job *940
Selkirk tunnel, plant and equipment for lining (Staff of S. E. Junkins Co., Ltd.) *418
Service cost, minimum, planning for 127
Service, public, see Public Service.
Settling periods in basins or tanks, see Sewage Treatment.

SEWAGE DISPOSAL, see also SEWAGE TREATMENT, and SEWERS

Chicago stockyards, final report on *815
Legislation, vicious, on garbage and sewage e705
Los Angeles plans n784
Commission's findings 1117
Removal outruns disposal e449
Waste, industrial, prevents self-purification of water courses 36

SEWAGE TREATMENT

Activated sludge:
Air-lift removal (W. G. Kirchoffer) .. *953
Bibliography (book review) 865
Colloid chemistry, application to sludge pressing (J. A. Wilson and others) a1042
Dorr-Peck modification tested at Univ. of Illinois 378
Nitrogen in (book review) 865
Process a905
Shanghai, plant for 648
Trent plant, Turlock, Cal 153
Chemical precipitation, Providence resumes 953
Dorr Clarifier, Grand Rapids, Mich. *459
Dortmund tank rebuilt into Dorr Clarifier, Grand Rapids, Mich. *459
Grand Rapids, Mich., testing station *459
Newton, Kan., plant (L. S. Siegrist, Jr.) *249
Nitrogen and activated sludge (book review) 865
Riensch-Wurl screening plant, Santa Barbara, Cal. (O. A. Stone) *719
Settling periods in basins or tanks, formula for (Prof. T. Saville) 647
Sludge, see above, Activated Sludge.
Tank troubles feature of New Jersey meeting n398
Testing station, Grand Rapids, Mich. .. *459
Testing station, Univ. of Illinois 378

SEWERS and SEWAGE WORKS, see also SEWAGE TREATMENT

Akron, Ohio, to be studied n609
Calumet region plant, Chicago Sanitary District (L. Pearse) *986
Chauny, France, competition for plan .. n699
Costs, plan for meeting (R. B. Morse and A. Wolman) e921, 944
Earthquake causes surge (Los Angeles) 60
Hamilton, Ohio, system not fully used .. 181
Lateral, sanitary, and house connections (M. J. Rurak and C. E. Keefer) 564
Lincoln, Neb., and suburbs *221
Los Angeles, bond issue loses n1057
Los Angeles, new ocean outfall and screens *331, n484, n7846
Milwaukee disposal plant, foundation, bids received n1056
New York City (metropolitan district) G. A. Soper, G. C. Whipple, A. Hazen, J. T. Fetherston) e98, 104
Passaic Valley sewage may enter New York Bay n785, e839, 849
Passaic Valley, New Yorkers continue to fight n1050
Philadelphia, work planned n1142
Pumping station, alternative outlets for *65
Wisconsin, water supplies, sewerage and wastes 567
Shaft sinking, see Mines.
Shale quarry, see Quarry.
Shanghai, activated-sludge plant for 648
Port to be studied by Goethals n485
Shapes, structural, see Steel.
Sheerboard method used to build large earth-fill Stadium, Seattle e323, *326
Shenandoah, Pa., high-head centrifugal pumps (Gannett and Crane) *983
Sherrill, Col. C. O., made President's military aide n*568
Sherzer, A. F., on determining efficiency of centrifugal pumps, new method *1114

SHIPS AND SHIPBUILDING

Changes in world's shipbuilding 232
Concrete:
Barges, concrete, on New York State Canals 107
British tests of concrete for ships .. 901
Government, status of a348
"Polias," efforts to salvage halted by winter n43
Current shipbuilding 654
Hog Island closes e193
Piloted by electrified channel cables 590
Steel shipbuilding in U. S. 39
Wage reductions in shipyards due Apr. 1 n448
Shirley, H. G., on study of subgrades a306
Shovel, Osgood, with continuous tread trucks n1057
Shovels, pneumatic hand, hasten tunnel excavation (G. C. D. Lenth) *500, see also *986
Erie, lubrication of creeper mounting is feature n1099
Railroad type, swing end for end in shale quarry h87
Siam, dredging record (A. W. Robinson) letter 1133

Page

Sidewalk, elevated, for traffic congestion (F. W. Harris) ..... letter *606
Silt prevention, ditch design for 647
Siphon, inverted, ends in riser on bridge pier. *562, E. H. Tashjian) letter *780
Sisson, F. H., address on world economics e145
On business outlook 204
Sisson, H. S., appointment as New York highway commissioner criticized ... e146.
(E. Harrison) letter 310
Siegrist, I. S., on sewage treatment plant, Newton, Kan. *249
Skagit River project, see Seattle.
Slabs, floor and roof, moments for beams of uniform live load (H. M. Gibb) .. *807
Precast, set on submerged concrete piles *984
Slater, E. W. T., on Mysore, India, power and irrigation dam *1107
Slides, earth, inclined wall braced by struts. *906
Slip scraper with A-frame for unloading rock and sand (W. B. Albertson) h*86
Sludge, activated see Sewage Treatment.
Smelter stack, tile-concrete, contract let .. n1141
Smith, F. B., invents stopwater for joints in concrete structures *681
Smith, J. Waldo, advises San Francisco water board n43
Smith, R. G., on cresoil 297
Smith, W. F., on timber floor rapidly destroyed by dry rot *390
Smoke abatement study and plans, Salt Lake City 74
Lake

SNOW AND SNOW REMOVAL

Loading machine, Chicago *176
New York City, metropolitan district (G. A. Soper, G. C. Whipple, A. Hazen, J. T. Fetherston) e98, 104
Machines used in removal .e355, e411, *415
Removal and drift prevention on highways (G. H. Biles) *230
Surveying, for forecasting stream flow (J. E. Church, Jr.) *244, *300
For water power from Spokane River *209
Wisconsin survey begun 181

SOCIETIES (see also names of individual societies)

Activities in connection with public service e748
And drainage development e282
Experiment in management, decentralization e881
International technical meetings e1060, n1092
Local societies, strengthening e323
Publicity man, definition of 775
Rochester, N. Y., society's engo-luncher's weekly n571
Young men interested in society work e837, 848
Soc. for Promotion of Engineering Education meeting n1093
Soc. of Automotive Engineers, see Automotive Engineers.
Soil and soil pressure, see Fills, Earth.
Solid partition best sound insulator 591
Soo Line, see Minneapolis, St. Paul and Sault Ste. Marie.
Soper, G. A., on water supply and sanitation in metropolitan district, New York .. e98, 104, *179
Sound insulator, thin solid partition best .. 591
Soundings, locating on Ohio River (C. R. Andrew) ..... letter *135
South Africa asks American bids n489
Railway, bids until July 5 ..... n877
South America, Barranquilla, Colombia, water supply (G. T. Bunker) *10
Brazil, railway construction in 1921 1068
Colombia and Venezuela, engineering in (J. L. Crane) 907
Trans-Andine line begun 834
South Bend, Ind., track-elevation legislation for n571
South Carolina, highways, program 156
South West Water Works Assn. meeting .. n913
Southeast, drainage development in 36
Southern California, see California, Southern.
Southern California Edison Co. files on Colorado River project n93
Development program n278
(See also Kern River)
Southern pine, Assn. meeting n575
Orders and production n94, n746, n834, n835, n877, n1013
Shipments exceed production n1099
Spain, engineers organize society n612
Spear, W. E., on water supply and sanitation in Greece *708
Specifications, more, submitted to standards association n318, 572
Plans for institute maturing n318, 572
Sperry, W. A., on tastes and odors from chlorination a1041
Spokane, Wash., Millwood bridge separation of sidewalk on concrete bridge *153
Spokane River, snow survey for water power *209
Spring Valley Water Co., see San Francisco, Water Supply.
Springfield, Mass., pays water bonds 70
Spur dikes, see Rivers.

ST. LOUIS

Building trades plan price inquiry n190
City-owned utility bonds outside debt limit 175
Eads Bridge approach, reconstruction of upper deck (E. C. Albrecht) *412
Engineering societies affiliate n142
Prevailing rate of wages ordinance repealed n321

Page

Wood-block paving in (J. S. Crandell) .. *376
St. Mary's Falls Canal, traffic, compared with Panama 779
St. Paul, Minn., labor bodies plan to enter contracting n574
Mississippi River bridge, bonds approved n913
To make zone rules n740
St. Paul Engineers' Soc. tells public about engineering problems n612
Stacks, see Chimneys.
Stadium, prize fight, Jersey City, construction e1102, *1112
Stadiums, new way o build 323, *326
Stadtmuller, P., convicted of extortion n968
Prison term n1098
Stairways, laying out rise and run (R. C. Reese) *805
Standard Oil Co of California, valuation .. n527
Standards, Bureau of, see Bureau of Standards.
International, conference on e1060, n1092
Standards Committee, see Amer. Engineering Standards Committee.
Stanton, T. E., on concrete pavement on saturated adobe foundation *217
State harbor control e921, 649, n657, n740, n831, e957
States—Why?—(J. C. Trautwine, Jr.) .... letter, with editorial comment 273
Statistics about business needed e749, n787
Statler Hotel, Buffalo, higher stresses in steel framework authorized 891
Steam-electric plant, Australia, to use 50c. coal 296

STEEL

And iron founding, textbook on (Osann), review by Dr. R. Moldeneke 307
Drill, see Drills.
From slag concrete shows little corrosion *212
German, semi-finished price restrictions removed n969
Manufacturers plan international association n403
"Making, Shaping and Treating" (Camp and Francis), review by W. P. Barba. 130
Mild steel, effect of excessive heat on mild steel and concrete (E. A. Cross) letter 353
Prices before and since war n743
Shapes, structural, and cement compared for 21 years n*487
Shops, Samson Tractor Co., Janesville, Wis. *716
Stresses, higher, authorized in Buffalo hotel framework 891
In building frames; higher working stresses suggested 112
Structural, diagram for effect of flange holes (H. Kercher) *799
Tests:
Effect of excessive heat on mild steel and concrete (E. A. Cross) ..letter 353
For toughness e410
Sulphur and phosphorous study 601
Wage adjustments in trade n1057
Steel and concrete construction, mixed ... *585, 825, 1005, 1133
Steel Corporation, case against, base-plus price involved n787
Cuts prices n660
Judge Gary's views on business situation e921
Twelve-hour day and seven-day week to go e796
Wages reduced e796
Steel surfaces prepared for painting a1130
Steel trust, German, dead n702
Steelwork, structural, Belgian standard specification ..71, (R. Fleming) letter. 478
Steese, Maj. J. A., on highway development, Alaska a346
Steinman, D. B., on higher stresses for bridge pins e492, *502
(A. W. Carpenter) ..... letter 651
(D. B. Steinman) ..... letter 735
Stelle, E. H., on widening pavement curves by ring method *72
Stench warns underground workers n394
Stevens, J. C., and others, on interstate water conflicts 755
Stiles, O. W., on better freight handling by mechanical equipment *151
Stockyards, Chicago, final report on waste disposal *815
Stone cleaned by wire scratch brush n1016
Stone, A. O., on Riensch-Wurl plant, Santa Barbara, Cal. *719
Stop-water, new, for joints in concrete structures *681
Store-door delivery, see Freight.
Stoughton, B., resigns as secretary, A. I. M. and M. E. n1052
Strathmore building collapse, New York City e282, n315
Stream flow, and rainfall, early measurements 379
Forecasting by means of snow surveys (J. E. Church, Jr.) *244, *309
Gaging, state co-operation in 996
Recorder, see Recorder, automatic.
Street cleaning, see Cities.
Streets, Pavements, etc., see Cities.
Stresses, bridge, see Bridges.
Stresses in chimneys, see Chimneys.
Stresses, steel, see Steel, stresses.
Strikes, see Labor, Strikes.
Stringers, dock, tests of (Prof. M. O. Fuller) *928
Structural design, some unsettled points (R. Fleming) 336
Structural effects of vibration e282, n315
Structural engineering, research problems 859

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

Page

Structural materials transported, tonnage.. 32
Structural shapes, see Steel.
Structural Engineers' Assn. of Illinois, fee schedule 379
Stucco, cracking a348
Tests, in frame house *20
Stumps pulled with ginpoles (H. M. Burwell) ....letter 133
Subway, London, electrical indicator 655
Sudbury River aqueduct, changes in cleanness coefficient (F. I. Winslow)......*1132
Suez Canal, notes on (A. W. Robinson)... letter 961
Suiter, P. P., on rock excavated by improvised digger fixed to stiff-leg derrick...h*314
Sulphate of aluminum, see Water Supply.
Sulphur and phosphorous in steel, study of 601
Superior, Wis., water waste prevention (W. C. Lounsbury and A. W. Fowler) *461
Supervising Architect, postoffices principal work of (J. A. Cliff) ....letter 186
Suppers, monthly, stimulate spirit, Wilson Dam h567
Surge Tank, see Tank, surge.

SURVEYS

Alaska R.R. location (T. W. Secrist)...*632
County surveyors, Indiana bill fixes pay.. n571
Cross-sectioning and good judgment (A. A. Royce) ....letter 391
Land, computation of areas in acres (H. N. Bradstreet) 804
Railways, see Railways, Surveys.
Stadia arc, reduction table for (W. S. Dix) *78
Surveyors, notable Americans as surveyors 114
Topographic, of U. S., bill for completion endorsed by Am. Soc. C. E.........n1094
Topographical, combined methods in (P. J. Barry) *801
Useful dodges in, comment on H. L. Thackwell's article of Dec. 16, 1920 (J. P. Hogan) 41, (L. B. Roberts) 88, (G. D. Whitmore and L. B. Roberts) 653, (R. Hering) 735
Sustina Bridge, Alaska, opened n358
Swartz, A., on maintenance of paving by street railway companies *1118
Swett, E. H., on rebuilding old New England water-power plant *1062
Switches, see Railways, Switches.
Switzerland, bridge builders' structural research board, work..................1113
Technical notes 856
Sydney, N. S. W., harbor bridge project renewed n441
Sylvester, H. C., Jr., on highway bonds for investors a345
Syracuse, N. Y., takes state canal lands for grade crossing elimination n142

T

T-beams, concrete, designed as truss (J. B. Hutchings, Jr.) *233
Tanks, construction, British (book review) 864
Oil, see Oil.
Surge, horizontal diaphragm increases capacity *67
Water, condition after 30 years' service, Madison Wis. (W. E. Miller).......*548
Tarentum Borough, Penn. injunction against impure water n483
Tax revisions suggested by Sec. Mellon..n789
Technical meetings, international..e1060, n1092
Teichman, F., to design machinery for Japanese dam n47
Tempe bridge, see Bridges, Concrete.
Tennesse, licensing bill n45 n237
Sanitary engineering department, in bill. n45
Tennessee River power possibilities...26. 224
Teredos, in piling, book review 308
Mechanical protection for piles....... 471
Terminal design for harbors . ..e491
Terminals, railroad, see Railways, Terminals.
Termites, see White ants.
Terra cotta producers under fire n46
Terrace Reservoir dam see Dam
Terre Haute, Ind., basis for extension of water mains 458
Testing machine, million pound [illegible] Products Laboratory (L. J. Markwardt) *31
Tests, see Concrete, Tests; Steel, Tests, etc.
Texas Midland Ry. to build [illegible] .. n739
Text books, lapses in (R. Fleming) 125 (Prof. H. Sutherland and R. Fleming) letters 352, (F. S. B[illegible]) letter 393 (H. S. Jacoby) letter 4[illegible] (A. S. Niles) letter 606
Thackwell H. L. on formulas wanted for design of air-inlet valves *76, (A. Hazen) letter 134, (C. P. Dunn and H. L. Thackwell) letters 478
On tunnel building in [illegible] *821
On useful dodges in surveying, see Surveys.
Thames River (England) tunnel proposed 983
Thawing fire hydrants, device for n745
Thirteenth Engineers [illegible] 58
Thompson, Silvanus P. [illegible] book review 308
Three Rivers, Que., concrete [illegible] reservoir (E. E. Halmos) .. *260
Thrift week e97
Thrust boring machine (W. H. Shields) letter 393
*378
Tidal power plant Chinese
Old New England (D. C. Davis) letter *89
Ties, see Railways, Ties
n46
Tile, hollow price drops 902
Tide drains, flow in ...
Tilden Prof. C. J., appointed highway education director . n44
Timber, see also Wood also Lumber

Timber construction, Jersey City prize fight stadium *1112
Timber framing, heavy, for transit shed, Seattle *509
Timbers, dry rot 206
Tires, effect on roads e534, *553
Titan Truck Co., two-yard, subgrade truck. n1015
Tobey, J. A., on engineering aspects of public health e663, *668
Toledo, Ohio, maintenance of paving by street railway companies (A. Swartz)..*1118
Toledo, Ohio, emergency unemployment fund n279
Topeka flour mill case decision e49
Torkelson, M. W., on assuring safety in old highway bridges......e50, 61, 214, (M. Goodkind) letter *311
Tower, circular, built to support revolving crane *1043
Tower, wireless, of concrete, 672 ft. high.*847
Towers, harbor, of concrete and steel, England 85
Towns, planning, etc., see Cities.
Townsend bill, see Highways, Federal-aid.
Tracings protected by strips (H. G. Fay).*807
Tractors, see Motor Vehicles.
Trade associations advised to correct practice codes, etc. n94, e922, n968, n1014
Government to test legality n1014
Investigation by Government n1140
Regulation recommended by Untermyer e1102

TRADE, FOREIGN

Colombia, opportunity in (C. J. Bunker) e705, 732
Effect of e409
Engineer in (R. S. MacElwee) 959
Germany, exportations, menace of.....e621
Germany, trade with, in 1920 176
Germany, trade with, New York office opened n278
Imports and exports n1142
Imports and exports in 1920 256
January imports and exports show decline n448
Lumber exporters ask standard contract form n322
Machinery, road-making, exports....... 501
Road machinery exports n744
Trade schools, Senator Calder urges....n190
Traffic Science, Institution of, Cologne, Germany n740
Trafficways, elevated, for New York City. ....547, e577, (C. W. Leavitt and Col. W. J. Wilgus) letters 780, (C. W. Leavitt) letter 910, (C. F. Dingman) letter 1047
Trailers, see Motor Vehicles.
Trans-Andine line begun 824
Transit shed, heavy timber framing, Seattle *509
Transport is leading engineering question.e976
Transportation prize, Wellington..........n189
Transportation problems before Federal Highway Council n188
Transportation, water (book review).....1044
Trash racks, steel coated by cement gun..*1003
Trees, getting rid of bark beetle (J. A. Kitts) ....letter 522
Trenching machine, new type n532
Use shown to water works men n359
Trestles, see Railways, Trestles.
Trident meter, gear train protected in new type n444
Troy N. Y. new bascule span n829
Trucks, see Motor Vehicles.
True, A. O., on water-closet flush tanks and water waste 951
Trusses, concrete T-beam designed as truss (J. B. Hutchings, Jr.) ....letter 135
Spans, concrete, erected without falsework h*608
Trusts, Donnelly law, New York, called unconstitutional n488
Tug strike in New York called off........n574

TUNNELS

California rock tunneling practice (A. J. Cleary) *1082
Construction, circular forms and tamped concrete hold swelling ground.......h*737
Excavation hastened by pneumatic hand shovels (G. C. D. Lenth)..*500, see also *986
Experimental, for ventilation tests . n395
"Home made" foot brace for muckers h*1134
Hudson River, see Hudson River Vehicular Tunnel.
Lining, [illegible] arch forms with air hose prevents [illegible] . h869
Air vent in form h*1134
Cost of [illegible] saved by [illegible] materials in [illegible] lumber h*440
Selkirk tunnel, plant and equipment (S. E. Junkins Co., Ltd., staff of).*418
Muck [illegible], power operated scraper shortens haul . h*1091
Narrows, New York City, borings . n316
Nicaragua, tunnel building in (H. L. Thackwell) *821
Protective [illegible] Patents [illegible], England *1108
Shields, rotation prevented by [illegible] jacks . *892
Slide vs. trench method, Hudson River tunnel 764, e879
Thames tunnel proposed .. . 983
Ventilation policies, vehicular tunnel. n395, 407, 602, (W. I. Aims and C. M. Holland) letter 960
Tupholme C. H. S. on [illegible] n614
Turbines on old water (H. M. Wood) letter 393

Efficiency tested by pressure measurement (N. R. Gibson) *465
Reaction, largest head at Kern River, Cal. n740
Specific speed, diagram for (E. A. Van Deusen) ....*806, (L. Perry) letter 960
Turlock, Cal., Trent activated-sludge plant 153
Turner, D. L., consulting engineer, N. Y. transit commission n829
Turner Const. Co., N. Y., personnel board (M. A. Darville) *860
Tuthill, H. T., on concrete road mix proportioned at central plant *595
On local gravel plant in road building.. 854

TYPHOID

Death rate, in 1919 212
Indianapolis, reduction in 15 years.... 218
Injunction against impure water......n483
Maywood, Ill., almost scored epidemic (H. F. Ferguson) ....letter 310
Pittsburg, Cal., city faces suits, etc... 605, (R. Hilscher) letter, with editorial comment, 605.

U

Uhler, W. D. on impact under high-speed traffic on highway bridges......... 583
And others, on highway bridges...... 214
Uintah Ry. Co. to build short line.......n915
Uje River dam, Japan, American to design machinery n47
Ullrich, C. J., and others, on interstate water conflicts 755
Underground workers warned by stench...h394
Unemployment, see Labor.
Union College first non-sectarian college (E. S. Closson) ....letter 233
New administrative engineering course.n610
Unloading rock and sand with A-frame slip scraper (W. B. Albertson)...........h*86
United States Civil Engineer, bill creates office n874
Universities, Colorado course in municipal design n658
Michigan, highway courses n93
Purdue, highway courses n93
Utah, water storage commission appointed.n873
Organized n1096

V

Valuation, "value for rate base" and "value for compensation" 1125
Valuation, railway, see Railways, Valuation.
Valves, air-inlet, for pipe lines, formulas wanted (H. L. Thackwell)... ..*76, (A. Hazen) letter 134, (C. P. Dunn and H. L. Thackwell) letters 478
Van Deusen, E. A., on diagram for turbine speed ....*806, (L. Perry) letter 960
Review of Nasmyth's autobiography... 474
Vassalo, P., on simple method of resurvey for line adjustment *798
Venezuela, engineering in (J. L. Crane).. 907
Vibration, structural effects of....e282, n315
Vicat apparatus, see Cement.
Virginian Ry., coal cars of 120-ton capacity *304

W

Waddell, Dr. J. A. L., on Chinese $10,000,000 bridge commission n785
Wage adjustments, etc., see Labor.
Waite, Col. H. M., elected president Natl. Municipal League n738
Wall, E. E., vice-pres. Am. Soc. C. E.....n*317
Wall plaster, see Gypsum.
Walla Walla, Wash., may take water from Oregon 373
Wallace L. W. elected secretary Fed. Amer. Eng. Societies....n316, e323, *355
On Federation's work n831
Wall, overloaded, buckles..............n483
Sections, exterior, results of tests for distortion *20
Walker A. W. on dragline excavator also drives piles in reclamation work..h*354
Wanaque Dam, contract review refused ...n321
War exploitation, partisan e241
Preparedness for.......e664, (book review) 691
War Industries Board, final report..e664, (book review) 691
Warehouse Assn. to meet...............n1010
Washington D. C., garbage reduction economics (Maj. F. S. Besson)..... 258
Science and research bodies to have new home . . 220
Water supply, new conduit, appropriation for . .. n1095
Washington, George, Alexandria, Va., town plan 1085
Washington State city may take water from Oregon 373
New administrative code 847
Waste, elimination of...n355, n441, n472, e491 n1007 n1009 n1094
Commission Federal proposed n1094
Water, boiler, precipitation from treated water 458
Freezing, distorts steel column and base (C. P. Bohland) ... *935
Underground, traced by fluorescein.... 639
Water-closet flush tanks and water waste. 951
Water courses, industrial waste prevents self purification 36

WATER POWER

California, development by cities......n1011
Figures on 1116
Program enormous 85
Contracts subject to regulation .. 370
Colorado River sites surveyed n1096

*Illustrated; e, editorial; h, hints; n, news note; a, abstract.

Page

Colorado River, Cal., huge project filed on ... n93
Problems ... 862
Commission
Act for ... e6
Considers other water rights ... n914
Issues first license, to Niagara Falls Power Co. ... n398
Issues licenses ... n441
Issues new rules ... n569, n1010
Conference to be held ... n45
Eastern superpower plan ... n912
Governors to discuss ... n1136
Horizontal diaphragm increases surge tank capacity ... *67
Maine, proposed state control ... n571
Mysore, India, power and irrigation dam (E. W. T. Slater) ... *1107
National parks, water power in ... e49, 777
Niagara, see Niagara.
New York State, law ... n483, n527, n738
Pacific Gas & Elec. Co. Pit River development, railroad to be built ... n831
Parks, national, excluded from provisions of act ... n442
Philadelphia symposium ... n93, n189
Potomac River project approved by Army engineers ... n92
Favored by commission ... 388
Quebec development, winter work on ... *1122
Rebuilding old New England plant (E. H. Swett) ... *1062
Situation during war (book review) ... 864
Snow survey for water power from Spokane River ... *209
Tennessee River possibilities ... 26, 224
Tidal, Chinese plant ... *378
Old New England (D. C. Davis) ... letter *89
Turbine, efficiency tested by pressure measurement (N. R. Gibson) ... *465
Reaction, largest head at Kern River ... n740

WATER SUPPLY and WATER WORKS, see also WATER TREATMENT

Antioch, Cal., wins brackish water suit ... *513
Barranquilla, Colombia (G. C. Bunkere) ... *10
Birmingham, Ala., contract extended ... 636
Boston; cleanness coefficient of Sudbury River aqueduct (F. I. Winslow) ... *1132
Buffalo, N. Y., filtration proposed ... n525
Chatham, Ont., poor pressure due to unopened valve ... 203
Chicago, why not filtered ... e707
Cities rated by, Indiana ... e663, 686
City in Washington may take water from Oregon ... 373
Cleaning railway water main ... *949
Cleveland, Ohio, clearwater basin suit, important contracting points decided ... e535, 549
Baldwin reservoir contract let ... n1056
Problems treated (J. W. Ellms and others) ... a1039, a1041
Clinton, Ia., rejects ownership ... n446
Conditions and needed planning (G. W. Fuller) ... 9
Costs, plan for meeting (R. B. Morse and A. Wolman) ... e921, 944
Czecho-Slovakia has few supplies ... 270
Decatur, Ill., water company, financing ... n525
Denver, rehabilitation of works ... 859
Engineering News-Record, waterworks issue, June 2
Greece (W. E. Spear) ... *708
Hamilton, Ohio, system not fully used ... 181
Illinois, small, financing of ... a299
Injunction against impure water ... n483
Kansas City, copper sulphate for cleaning walls ... 223
Kansas City, Mo., main cleaning (C. S. Foreman) ... a1040
Metered ... n1136
Report on ... 499
$18,000,000 extensions advised ... n44
London, large loan for extensions ... n1137
Madison, Wis., tank, condition after 30 years' service (W. E. Miller) ... *548
Mains, extensions, basis for, Terre Haute 458
Mains, small, lay-out of (Hellins) (book review by R. E. Horton) ... 864
Management and operation almost a sacred occupation ... 393
Materials and methods to be standardized ... n1049
Meters:
Gear train protected in new type ... n444
Government water may be metered ... 343
Large, tested in place with pitometer (F. D. Danielson) ... *64
Manufacturers grilled in New York inquiry ... e748, n784
Slippage in small meters ... 160
New Jersey, cities discuss shortage ... n527
New York (metropolitan district) and sanitation (G. A. Soper, G. C. Whipple and A. Hazen, J. T. Fetherston) ... e98, 104, *179
Odors and tastes, Cleveland (J. W. Ellms and W. C. Lawrence) ... a1039
Operators' school advocated ... n913
Pavement breaker for starting trenches ... *937
Pipe, concrete pressure, water jacketing, 943
Pitometer, see Pitometer.
Plan water-works now ... 481
Problems and practice, abstracts of convention papers (A. Wolman and others) ... a1039
Pump, centrifugal, in Baltimore sets new record ... *938
High-head centrifugal, Shenandoah, Pa. (Gannett and Crane) ... *983
Reservoirs, see Reservoirs.
Residence systems efficiencies of ... 464
San Francisco, see San Francisco.
Seattle, construction of reservoir forbidden ... n47
Department shows profit ... n658
Plans for addition go forward ... n287
Service factors form layman's viewpoint ... 910
Shenandoah, Pa, high-head centrifugal pumps (Gannett and Crane) ... *983
Springfield, Mass., city pays bonds ... 70
Tastes and odors, Cleveland (J. W. Ellms and W. C. Lawrence) ... a1039
Terre Haute, Ind., basis for extension of water mains ... 458
Trenching machine ... n359, n532
Washington, D. C., appropriation for conduit ... n1095
Waste, and water-closet flush tanks (A. O. True) ... *951
Waste prevention, Superior, Wis. (W. C. Lounsbury and A. W. Fowler) ... *461
Water hammer, in long railway force main, preventing (J. L. Campbell) ... 951
Wells, deep, with packed strainers to exclude sand (F. D. Yeaton) ... *895
Wisconsin, water supplies, sewerage and wastes ... 567
Water, transportation (book review) ... 1044

WATER TREATMENT, see also WATER SUPPLY

Bacterial tests, B. Welchii ... e921, e922, 929, 998
Chemicals, coagulation and sedimentation with (J. W. Ellms) ... a1041
Chlorination, tastes and odors from (L. C. Billings) ... a1041
Coagulation and sedimentation with chemicals (J. W. Ellms) ... a1041
Chlorine, control by absorption method (A. Wolman) ... *639
Filters:
Alum coagulation by prolonged agitation (Prof. W. F. Langelier) ... e921, *924
Alum, in water, residual aluminum compounds in filter effluents ... 844
Alummum sulphate, rate of solution, (J. W. Ellms and others) ... a1039
Buffalo, N. Y., filtration proposed ... n525
Cambridge, Mass., mechanical ... n569
Chicago ... 520, e707, 730 (see also e492, 736
Concrete walls and dams, porous, spall under frost ... *947
Control of plant, state vs. local, (R. B. Morse) ... a1040
Cost-plus contract gives low cost, Ashland, Ky. (L. R. Howson) ... 388
Drilled plugs replace strainers, Terre Haute ... 855
East Chicago, Ill., tuning up ... 520
Great Lakes cities' water supply ... e492, (J. N. Chester) letter 736, see also e492, 520, e707, 730, 736.
Hay as filter for boiler water ... h*869, (L. E. Tribe) letter 1047
Indianapolis, fifteen years' operation, 218
Milwaukee, filters urged ... n1138
Milwaukee chemists advise postponement of filtration ... 604, n698
Mud balls in filters, piping rearrangement as cure (H. W. Blaisdell) ... letter *234
Philadelphia, Queen Lane filters, alteratons (J. S. Ely) ... *942
Sacramento adopts cost-plus plan ... 77
Work started ... n92
Underdrains, filter; investigation of perforated-pipe (H. N. Jenks) ... e145, *162, (W. Gore, H. N. Jenks and P. Hansen) letters 735
Sand bed and wash water experience (M. Pirnie) ... 371
Highland Park, Mich. plant ... *772
Licensing plant operators, New Jersey (C. H. Capen, Jr.) ... a1041
Lime-softened water, stabilizing ... 208
New Jersey, licensing purification plant operators (C. H. Capen, Jr.) ... a1041
Phosphoric acid, etc., in water softening ... 81, 208
Settling periods in basins or tanks, formula for (Prof. T. Saville) ... 647
Small plant operator as scientist (A. Wolman) ... a1039
Stabilizing softened water ... 208
Sulphate of aluminum, rate of solution (J. W. Ellms and others) ... a1039
Tests, B. Welchii and B. Coli ... e921, e922, 929, 998
Waterproofing vertical lift well (G. L. Knott) ... h*607
Waterways, Governors may discuss ... n1136
Watson, Col., G. L., declines New Jersey tunnel appointment ... n870, e880
Watson, W. M., on monolithic brick road built of fine aggregate ... *55, 259
Wayne County, Mich., highways, traffic on 28
Webster, G. S., new pres. Am. Soc. C. E. ... n139
Weirs, waste, computing capacity (Prof. W. S. Pardoe) ... e98, 104, *114
Welding, electric, repairs bascule bridge ... *727
Oxyacetylene, on steel gas mains ... *731
Wellington transportation prize, conditions n189
Wells, deep, with packed strainers to exclude sand (F. D. Yeaton) ... *895
Vertical lift, waterproofed (G. L. Knott) ... h*607
Welsch, W. F., on specialized use of mechanical equipment on road job ... *205
West, J. R., on a Chinese tidal power plant ... *378
West Coast lumber production ... n1140
West Coast Lumbermen's Assn. cited ... n1055
West Point, Engineer Corps to get 7% of graduates ... n914
West Virginia, highways, contractors organize ... n47
Licensing bill ... n275, n870
Western Soc. of Engineers elects officers ... n828
Protests against appointment in Chicago Sanitary District ... n740, personal note, 572
Westinghouse Co. to build California plant ... n703
Wetherell, J. G., on curve traverse chart for lining track ... *719
Weymouth, F. E., and others, on interstate water conflicts ... 755
Wheeler, W. H., on adding six stories to reinforced-concrete building ... *585, (R. E. W. Hagarty) letter 825, (W. H. Wheeler), letter 1005
Whipple, Prof. G. C., on water supply and sanitation in metropolitan district, New York ... e98, 104, *179
Whistler, J. T., on interstate water conflicts ... 755
White ants, protection against ... 13
White lead in paint ... 126
Whited, W., on roughness impact on highway bridges ... 582
Whitten, R. H., on thoroughfare plan and program for Cleveland ... *382, *715
Wight, F. C., on Los Angeles the crowded On San Francisco ... 57, 27
Wigley, C. G., on physician and engineer needed to control yellow fever ... 372
Wilkes-Barre, Pa., coal mines under city must file maps ... n401
Wilson, J. A., on colloid chemistry in sludge pressing ... a1042
Wilson Dam, see Muscle Shoals.
Winchester & Western R.R., Va., motor bus successful on ... *648
Wind pressure on inclined surfaces (R. Fleming) ... 125, (Prof. H. Sutherland and R. Fleming) letters 352, (A. S. Niles) letter 606
Winslow, F. I., on changes in cleanness coefficient, Sudbury River aqueduct ... *1132
Winston-Salem Southbound R.R., valuation report ... 686
Winston, W. O., new head of Assoc. Gen. Contractors ... n*235
Winter work on Quebec water-power development ... *1122
Wireless signals, transcontinental, in moving autos ... 643
Wireless tower, concrete, 672 ft. high ... *847
Wisconsin, highways, high freight rates for materials protested ... n442
Day-labor construction (W. C. Buchtow) ... 1070
Patrol maintenance ... 200
Law proposes unemployment insurance ... n321
Snow survey ... 181
Water, sewerage and wastes ... 567
Wisconsin Engineering Soc. wants school for architects ... n398
Wolf Lake, Ind., bill for harbor survey ... n571
Wolman, A., on small water plant operator ... a1039
On water chlorination control by absorption method ... *639
Wolman, A., and R. B. Morse, on meeting water-supply and sewerage costs ... e921, 944
Wood, C. L., on new concrete arch survives washout of centers ... *809

WOOD (see also LUMBER, SOUTHERN PINE, WOOD PRESERVATION)

Chestnut, from blighted trees, better than healthy wood (E. A. Weimer) ... letter 312
Drying periods ... 344
Dry rot ... 206
Rapidly destroys timber floor (W. F. Smith) ... *390
Hickories, various, properties compared, 335
Kiln drying, rapid, new process ... n138
Testing machine, million-pound, Forest Products Laboratory (L. J. Markwardt) ... *31
Timber from live and dead trees ... 1076
Wood block paving in St. Louis (J. S. (Crandell) ... *376

WOOD PRESERVATION

Amer. Wood Preservers' Assn., convention reports (R. G. Smith and others) ... a297
Charring does not stop decay ... 767
Creosoted pipe in use 28 years ... 304
Dock stringers, tests (Prof. M. O. Fuller) ... *928
Machine "perforates" timber ... 730
Non-pressure treatments ... a298
Ties and timbers, Mexican railways, life of ... 224
Wood waste, alcohol from ... 268
Woods, V. K., on log-flume engineering ... e747, *768, correction 935
Writing, use of personal pronoun advocated (C. T. Brady, Jr.) ... letter 125, (Prof. P. B. McDonald), letter 307, (W. H. Breithaupt), letter 474
Wyoming, highways, bonds voted ... n968
State authorizes city manager plan ... 1003

Y

Yeaton, F. D., on deep wells with packed strainers to exclude sand ... *895
Yellow fever, physician and engineer needed to control (C. G. Wigley) ... 372
Yellowstone River dam opposed ... n1095
Young, R. B., and T. V. McCarthy, on proportioning concrete on job by exact methods ... e450, *456 (Prof. G. M. Williams and R. G. Young), letters 867
Young, T. C., on use of rammed earth as "masonry" in building construction ... *267, ("Former Lieut. Col., A. E. F.)) letter 652
Youngstown, Ohio, builders plan wage cut ... n530

Z

Zinc chloride, see Wood Preservation.

*Illustrated; e, editorials; h, hints; n, news notes; a, abstracts

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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"Engineering News-Record" is a consolidation of "Engineering News" and "Engineering Record," effected in 1917.

"Engineering News" was founded in 1874 as the "Engineer and Surveyor," which title subsequently became the, "Engineer, Architect and Surveyor," then "Engineering News and American Railway Journal" and, finally, "Engineering News."

"Engineering Record" was established in 1877 as the "Plumber and Sanitary Engineer." The name was subsequently changed to the "Sanitary Engineer," "Engineering and Building Record" and, finally, "Engineering Record."

The staff of "Engineering News-Record" consists of:

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W. W. DeBerard, E. E. R. Tratman and C. S. Hill, *at Chicago;*

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1920 Uneventful in Engineering

THE year 1920 was an uneventful year in civil engineering—in the construction industry. In all lines, except highway work, construction was below normal. Projects outstanding either in magnitude or design were rare.

Though there was little in the way of construction, the railroad field may be accorded first place in the importance of the year's developments. The roads were returned to their owners for operation, new rates, designed to give a 6 per cent return on investment, were put into effect, and efficiency greatly increased by the co-operation of the public with the very intelligent efforts of the management. But much remains to be done to bring the railroads up to the demands of traffic, and this will require expenditures that will make work for every branch of the construction industry.

Highways take second place. No material abatement of construction activity in that line is to be expected, though the thinking has reverted from expensive to cheaper forms of construction.

With this emphasis on railways and highways has come new interest in the design and operation of rail and water terminals.

In actual accomplishment, judged by magnitude of construction and interest of design, first place would be accorded the field of hydraulics. A satisfactory water-power bill, after almost a decade of bickering, was passed by Congress. Excellent progress was made on the remarkable Miami Conservancy project. On the American side at Niagara Falls record-breaking reaction turbines of 37,500-hp. capacity were put in operation, while on the Canadian side work continued on the great Chippewa project. On the Pacific Coast projects were started or carried along on which a number of records will be broken. These include a 220,000-volt transmission line, an 806-ft. head on a reaction turbine, 40,000 hp. from a single vertical-shaft reaction turbine and 30,000 hp. from a double-overhung impulse wheel under a 1,008-ft. head. At Muscle Shoals work progressed on one of the half-dozen largest construction projects in the United States—the Government's big hydro-electric scheme.

In structural lines the organization of the new joint committee on concrete and reinforced concrete must be recorded. Among miscellaneous projects was the inception of the work on the New York-New Jersey vehicular tunnel.

In engineering education there were no notable developments, but the schoolmen generally have an inquiring and receptive attitude that augurs well for future development.

In the field of society organization there is to be recorded the launching of the Federated American Engineering Societies, the very great growth of the American Association of Engineers and the rounding into shape of the Associated General Contractors.

Licensing has entered the stage of general acquiescence.

By and large, however, the year has been relatively uneventful. In the construction industry it has merely repeated the general business experience of painful progress toward a more normal and sounder footing.

The Benefits of 1920

BECAUSE the year 1920 was so unsettled, we are likely to overlook its constructive effect.

Its tendency has been to bring us back to a saner, a more conservative basis. The situation, on the whole, is sounder.

Brief consideration will show the contrast clearly:

The extravagant buying in 1919 has been replaced by the conservative buying of the last six months of 1920.

The over-extended credit situation of 1919 and the early months of 1920 has been replaced by the deflated condition of the latter half of the year.

The labor radicalism of the war and of 1919 has largely disappeared. Wage reductions have been accepted. The talk of industrial control has ceased. There is the beginning of co-operation between labor leaders and engineers on a sound industrial program.

The attitude of employers is reasonable. They have not taken advantage of the present opportunity, due to unemployment, to force down wages sharply. On the contrary, there is a desire, if production will justify it, to continue present wage levels.

All these are evidences of calmer, sounder thinking.

The construction industry, in company with the rest of the community, has been going through the same settling-down process. Among engineers there is a return to serious thinking, to the study and analysis on which sound design—and therefore sound construction—are based. The conservative swing in the American Society of Civil Engineers is an indication of a more settled point of view.

Contractors take a calm view of conditions. They

are not busy, but the outlook is improving. Labor is plentiful and more efficient. Credits are easier. Materials are coming down in price. Transportation conditions promise to be better next season.

Only the members of one of the three major branches of the construction industry—the manufacturers—are still in a badly disturbed condition. But the reason is obvious. The slackening of business has left heavy inventories on their hands. The contractor, comparatively, is in an ideal position. He has no inventory, and his plant is paid for in good part. It may not be earning, but the financial burden it imposes is relatively small. Nevertheless, manufacturers are gradually getting rid of their stocks and the spring trade will clear up the difficulty.

On the whole, the construction industry is settling down, and as a result of the deflation process of 1920 is in a sounder position today than it was a year ago.

Troubles Not Yet Over

IN APPRAISING the benefits of the latter half of 1920, there is no desire to carry the impression that all of our difficulties are at an end. We are not yet "out of the woods"; indeed, we are far from being out.

For some years yet the process of working to lower levels will be in progress. That will occasion repeated disturbances, for it requires budget readjustment by every business enterprise and every individual.

We have made only a small impression upon our war debt. Our government expenditures continue at an extravagant figure. Taxes are high and probably must go higher.

In Central Europe there is little improvement, while the exchanges with the whole of Europe are a serious detriment to the marketing of our cotton and grain crops. The first step is now being taken in broad-scale export-trade financing. It is, however, but a start and unless followed by further vigorous efforts is not calculated to have any considerable immediate effect on the situation. As long as Europe cannot buy our goods, we are bound to suffer.

Even the end of 1921 will not see a permanent stabilization. The dislocation caused by the world war was too great to be wiped out in a three-year period. All we can hope to do by the end of the present year is to make a further considerable step in the readjustment process.

The Outlook for Construction

IN a time of stress we are especially concerned about the future. The question today is—What of construction next year?

Prediction must rest on experience. Fundamental conditions are sound. Crops have been large, the financial situation is well in hand, there is a large withheld demand.

The present depression, as a result, should be short lived. So argue, in fact, many of the country's shrewdest students of business. They expect the present inaction to continue for some months, with revival in the spring and good business in the latter part of the year. Such, for example, is the view of Professor Persons, of the Harvard Bureau of Economic Research. Other students, such as Judge Gary, look for steady improvement but do not attempt to fix a date for the definite initiatio of a forward movement. In general, the concensus of opinion, such as is expressed in the *Review of Reviews'* symposium, inclines toward the expectation of a fairly active year with a steady upward trend.

These views relate to general conditions. Have the engineer, the contractor and the manufacturer in the construction field equal reason for courage and calmness, even for optimism?

A brief review of conditions will help in forming a judgment.

There has been no normal construction year since 1916—if, indeed, that could be called normal. The whole country is under-built. There is work ahead for many very busy seasons.

Whether projects will be undertaken—how much will be undertaken at once—depends on the attractiveness of conditions; and they are decidedly better now than they have been for four years.

In 1920 materials prices were high; labor scarce, expensive and inefficient; transportation disorganized; the financial situation stringent. These were serious bars to the effective conduct of construction work.

By contrast the indicated conditions for 1921 are:

Lower wages; ample and more efficient labor.

Lower materials prices.

Better transportation.

Easier money; an improved credit situation.

Materials prices, it is true, have begun to break only recently and recessions thus far have been small. But the tendency is downward. Transportation conditions should be better though we must not expect them to be equal to a pre-war normal. That would be too much to expect.

Certainly these favorable conditions should tempt owners and public agencies to proceed with construction. The factor holding back work is the expectation, always an accompaniment of a falling market, of still lower prices. But with demand pressing hard on facilities and with a set of conditions more favorable than those of 1920, or 1919, it appears to us inevitable that a good volume of construction will be forthcoming. Knowledge of conditions will spread during the winter. The spring should see an active construction revival.

Engineers and contractors, then, have as much reason for optimism—or at least for calmness and courage—as those who base their views on general business conditions.

Revival in Railroad Work

SOME contractors are basing high hopes on a large revival in railroad building. In this hope we cannot share. Highway work there will be—a lot of it; there will be municipal and other public-works construction; there will be building work. But in railroad work the lagging pace of these many lean railroad years is not likely to be much accelerated. The railroads will have to be assured of the 6-per cent standard return before they will be able to finance improvements on a satisfactory basis. The new rates are not producing up to the mark set. Therefore the construction program will be limited to bare necessities.

As T. De Witt Cuyler puts it in his article in this issue, "Capital expenditure programs for 1921 will of necessity be directed mainly at removing situations which prevent the existing railroad lines from carrying maximum traffic over the existing trackage."

Intimations to the same effect are to be found at the conclusion of the article by Mr. Parmella on maintenance.

New York's Building Scandal and Organized Contracting

FOR over two months a New York State legislative committee has been inquiring into the operations of the building industry of New York City. The situation, apparently at first merely local and concerned with labor organization, has developed into a matter of nation-wide import. Not only are there labor rings, but rings of contractors and even tighter rings of supply dealers. So flagrant were the operations and such is the suspicion that similar conditions obtained in other cities that the Calder Senatorial committee has secured power from Congress for a nation-wide investigation of the construction industry.

The situation, therefore, is now far beyond a matter of mere local importance. In particular does it concern every one connected with construction in any manner or anywhere in the Union.

Coming just at this time, too, the scandal points to a great opportunity for organized contracting.

In brief, three things have been shown at New York:

1. That the building-labor organizations were under the control of a single individual who brazenly levied tribute, for his own pocket, upon contractors and labor alike.

2. Subcontractors through the operations of "open-price" associations have been in a position to do collusive bidding. Pleas of "guilty" on indictment indicate that in some cases, at least, advantage was taken of the opportunity.

3. General contractors, even some of nation-wide reputation and operation, have bowed to the rule of the labor boss and have either directly paid tribute to him, or have done so indirectly by employing only such labor as he approved of. The boss, of course, got his return in the latter cases by tributes upon his closely controlled labor groups.

4. Materials dealers—possibly also materials manufacturers—through "open-price" associations and other forms of agreement have collusively raised prices—have raised them to figures not warranted by costs nor by the law of supply and demand.

The sum total of these operations has been to increase materially the cost of building operations in New York City.

Particularly is it important to note that a mechanism —the "open-price" association—designed to allow the exchange of price information while removing those operating under it from possible punishment under the anti-trust laws, was the favorite means for carrying on the price-raising activities of the materials dealers and the subcontractors. Obviously, there are advantages accruing to industry from the work of industrial associations. Obviously, too, as soon as price exchange is started or price discussions are entered upon there is danger that price raising will result. This is exactly what happened at New York City.

Manifestly, the chief concern of the construction industry is in measures that will prevent a repetition of these conditions. Sole reliance on legal measures will prove futile. The result of the present investigation will be the punishment of some of the participants and the temporary suspension of the pirating. In a year or two the disclosures will be forgotten, new rings will begin to form, and in four years' time, at the outside, the conditions can well again be repeated.

Engineers and architects are not likely to be effective in preventing this sort of thing. They do know of it, many of them knew the conditions that obtained at New York, but their organizations—unless possibly the new federation—are not of the type to take up a matter of this kind and fight the case through.

The contractors alone, as we see it, can prevent similar conditions developing in the future. To do that requires widespread sources of information, financial strength, and an organization of nation-wide scope. All of these things the contractors either have actually or potentially. They, more than any other single interest in the construction industry, know what is going on. They employ the labor, they employ the subcontractor, they buy the materials. Their sources of information extend to every city in the land. Their combined financial strength is large. Their influence is nation-wide.

Unto these things must be added a strong organization and strong leadership. Now, for the first time in the history of the contracting interests of this country, that strong organization and that strong leadership seems to be forming. We refer, of course, to the Associated General Contractors.

Of course, this is not the only one of the great opportunities before the association, but it is a big one—and it looms large just as the association is apparently settling down in organization and preparing for vigorous functioning.

For the best interests of the public which buys construction, whether as individuals, private corporations or public authorities, the Associated General Contractors needs to grow into a thoroughly well-knit fighting agency. If it becomes that it will place the construction industry of this country in an enviable position, to the benefit of the industry itself as well as of the public.

Am. Soc. C. E. Activities

NO ACCOUNT of the year's doings would be complete without brief mention of the activities of the American Society of Civil Engineers. The year has been an unusual, even if unfortunate, one. Discussion and contest have waged over management policies and mechanism. Have not the main purposes of the society been neglected?

Among broadminded men the purpose of discussion is to bring out and to clarify to themselves and to others the true merits and demerits of proposals. In the society's discussions last year, the contests were taken as the medium for personalities, for casting suspicion on the motives of opponents, for partisanship that has been a reflection on the society and on the members participating in the propaganda on both sides. Men otherwise fair have in the heat of contest given their opponents credit for not one shred of honesty. They have deluded themselves into belief that the opposition's motives are entirely selfish—a desire to control the society for personal benefit rather than in the interests of the society as a whole. Both sides make the charge and both are equally wrong. Disinterested onlookers know that both parties honestly believe that their victory would be for the best interests of the organization and that they place the society's interests first.

The stage is set for an annual meeting that may be unpleasant. We hope that the rabidness displayed in private discussion and printed documents will have spent itself before that time, and that the meeting may be a man-to-man, fairminded, considerate discussion of whatever topics are brought up.

Benefits From the Strife

AFTER so much strife there should accrue to the American Society of Civil Engineers some benefits for the time and energy expended. Surely, from the standpoint of technical work even a calm discussion of internal policies and mechanism for a whole year would be deplorable. Under the frenzied temper of the contest, the effect upon the society's technical wellbeing has been mischievous. It has rendered lukewarm those whose interest in the society was mainly in its professional and technical service. "A plague on both your houses," as one of these members has expressed it.

The only benefit to be expected from the year's discussion should be agreement upon some ground common to the two factions. This result has, we believe, been achieved, even though there may need to be further discussion before the agreed-upon essentials can be expressed in satisfactory constitutional changes. These essentials, which both sides approve, are that the choice of the districts for their directors must be respected, and that the local sections must be developed into virile elements of the organization. Now that the conservative leadership has accepted these essential principles that which remains is agreement upon precise method and wording.

Another result of the year's strife seems to be that the "stand-pat" element is definitely out of a place of power. When the organization again functions normally it is to be expected that there will be a conservative element, but this conservative element, if it be true to its pledge, will not be hidebound but will work for a widening and intensification of the society's work.

The return to a normal functioning is much to be desired. New vigor needs to be put into committee work and there needs to be a papers committee based on the theory of active effort to secure papers representative of the important advances in every branch of civil engineering rather than upon the old theory of indifferent solicitation of papers or of waiting for them to be sent in voluntarily.

Even as the year 1920, despite its disturbances, has been of benefit to the country and the industrial community, so in the American Society of Civil Engineers has it, through turmoil, produced good results. There is near-agreement on the essential changes required, there is less difference in outlook, in program and in aim between the two chief articulate and active groups in the society. A moderate, sane progressivism seems assured.

The Federation

FOREMOST among the engineering society activities of the year has been the launching of the Federated American Engineering Societies. Historically, it is a development from the occasional inter-society committee work begun some years ago. The need for a permanent committee being apparent, Engineering Council came into being, and that, failing to bring the local societies into co-operation with the nationals, led in turn to the federation.

How serious is the failure of the civil engineers to join it only the future can tell. The three major societies and the locals which are in the organization are fully capable of giving the plan a thorough test.

That there is need for functioning through some clearing house or centralizing organization is fully conceded. Failure of the civil engineers to join was not due to lack of appreciation of the need for some unifying body (for that was strongly endorsed in the questionnaire early last year) but rather to traditional conservatism, to the weakness of the presentation made by the sponsors of the federation, to the failure to make clear in the federation's constitution the determination to keep out unqualified organizations. Had there been a representative of the conservative element of the Am. Soc. C. E. on the conference committee, ideas might have been interjected into the plan that, without changing materially the fundamental idea of federation, would have won the support of many of the conservative members. There was too much "progressivism," not only as to the federation plan itself, but as to the personalities responsible for it. The federation matter was bound up with an intra-society quarrel.

Despite the adverse decision, however, on entrance into the federation, it is clear to everybody who wants to be fairminded that the failure of the federation would be serious for the engineering profession. It would put off indefinitely the day when all societies would co-operate harmoniously. Eventually that co-operation will come. Some method will be found by which the civil engineers will be brought into the fold, even if there must be, to accomplish that object, radical change in the organization's constitution.

We look to the federation, therefore, to become the eventual nucleus of any co-operative movement. Should it fail, there would be no other alternative than the separate establishment or development of a welfare and civic-activity body. Of the latter proposal there are many supporters. For the present, however, the majority of the strong elements in the profession have pinned their faith to the federation.

The A. A. E.

PROGRESS of the American Association of Engineers has been notable during the year. The membership has increased from 10,000 to 24,000, making it by far the largest engineering society in the country—nearly double the size of the next largest. With growth has come a softening of the antagonism hitherto shown toward the association by many prominent engineers in the older national societies. That softening has not been due to mere recognition of the power of the organization, but to an awakening appreciation that the association is not radical, that the charge that it was a union was without any basis. The study by Engineering Council of compensation and of registration—paralleling some of the association's work—may have had something to do with the change in attitude. But whatever the reason it is a fact that the A. A. E. is now mentioned in conservative quarters without the former denunciation and display of antagonism.

Internally the association is rapidly maturing. Large-scale experimentation, necessary at first, is being replaced by definite operating practice. The intensive character of chapter development—with paid secretaries in half a dozen strategic centers—is particularly worth noting.

With the 50 per cent increase in dues, which has been voted, the association's influence is bound to increase. The year 1920, however, is a landmark not soon to be rivalled, for it records the real finding of itself by the association and its wide recognition, even by former antagonistic circles, as an element that cannot be neglected in professional organization.

N. Y. Section, Am. Soc. C. E.

THE New York Section of the American Society of Civil Engineers is worth recording as a real accomplishment of the year. It is a local organization, it is true, but it has a national import, for if it be vigorous it will not only cast luster on the society in the nation's metropolis, but will help to solve the problem of weak and uninteresting meetings, which has been the bane of the New York gatherings for these many years. Fortunately, it has been vigorously manned and is vigorously functioning. It has held three meetings. Each one of them was a record breaker, not merely in attendance but in the timeliness and technical value of the discussions. Very properly, the meetings concerned themselves with large local problems, obviously a very proper point of attack for a local section. It is not too much to say that the coming of the New York section has put new life into the society in New York.

Fortunately, too, the section was launched without any of the partisanship which might easily have been injected into it. The judicious selection of officers—all of them men of unusual ability—representing a good balance between the various points of view has resulted in an entire absence of that partisanship which, unfortunately, at the minute is afflicting the society at large.

From every point of view, therefore, the happy inaugural of the New York section is a civil-engineering society event of 1920 well worth recording.

Licensing

THE year 1920 brought to some finality the question of the registration or licensing of engineers. Until the beginning of this year there was constant debate on the advisability, on the advantages and disadvantages, of licensing.

Within the twelve-month, however, the discussion has given way to calm acquiescence or indifference on the part of former vigorous opponents. No longer are the merits and disadvantages discussed. The outstanding fact is that licensing is now accepted as inevitable and that its extension to many other states, beside the eleven which have it, is to be looked for.

Such being the case, study from now on will be directed toward the administration of the various measures. The problem of reciprocal relations between states will come to the fore, codes of practice will be built up and the administration of the acts refined. We are, to use an engineering simile, going from the field of construction to that of operation. There will result from the operating experiences material for the modification of existing statutes.

Somebody, and it will naturally be a licensing committee of the Federated American Engineering Societies, will need to follow the experiences closely, to correlate them, to draw conclusions, and to place the experiences and conclusions at the disposal of officials administering the laws and also of engineering societies in states where changes are needed. The conference in Chicago of officials administering engineers' licensing laws and the one in St. Louis of those administering architects' laws show that the officials appreciate the need of uniformity. Now that the principle of licensing is accepted, it is the part of wisdom to do all in our power to render the laws most effective and their administration most efficient.

Spending Highway Dollars

LIKE all other activities, highway work is recovering from the war's unsettlements. In the era of easy money huge expenditures were freely planned. The people were free with their own money and placed the public's money freely at the disposal of officials. A reversion has set in. The private dollar and the public dollar are being more carefully scrutinized. Retrenchment, or at least circumspection, in public expenditures is the order of the day.

The results are seen in the thinking of highway engineers the country over. That has been clearly brought out in the series of articles on "The Trend of Highway Development," published recently in this journal. The trend in many sections is distinctly in the direction of using a cheaper type of surface, under efficient maintenance, instead of the expensive permanent types so universally popular only two years ago. In the Middle West the art of gravel-road construction and maintenance is being given careful study—with gratifying results. In Illinois, the practice of letting work and more work, despite hold-over contracts, has given way to a policy of finishing first that which is under way. In the New England States, with their long and careful highway experience, economic problems are to the fore. Is it just, they ask, that a small percentage of very heavy vehicles should force upon the community extraordinarily high construction and maintenance costs?

To commend the soundness of the changed point of view is unnecessary. It was bound to come with freedom from the war's turmoil and its muddled 1919 aftermath.

Highway Research

NOTABLE among the highway developments of the year is the impetus given to scientific research. The Bureau of Public Roads continued its studies of impact loads and of methods of reducing the water content of subgrades. The Pennsylvania highway department began laboratory studies of cores cut from pavements in service and will take the opportunity offered by the removal of these cores to study the action of subgrade. A test road of several sections of different construction has been built in Illinois and a series of subgrade and surface investigations has been undertaken. Other states are making observations on the capillarity and the compacting of soils and on methods of soil treatment to reduce moisture troubles. The engineering division of the National Research Council in November created an advisory board on highway research.

Surely the unsolved problems in highway work are so many that a wide program of research was badly needed. It is fortunate, too, that the subject has elicited the interest of engineers in so many parts of the country. Experimentation is needed under a great variety of conditions and by many experimenters, to the end that the conclusions may be generally applicable and that all of the original thinking available in the various highway departments may be brought to bear on the task. Scattered experimentation will all serve the common end if there be co-ordination in program and in the study and interpretation of results. To secure that co-ordination is the work of the committee of the research council.

A Municipal Dilemma

MUNICIPAL governments and taxpayers at the present moment face a dilemma. Further postponement of water-works, sewers, paving, bridge and other construction now long in arrears seems suicidal, but the labor, material and capital markets are still unfavorable, and, worse yet, uncertain. The taxpayer blows hot for city improvements and cold against the increasing tax burden.

Under such conditions what shall the city authorities do? There is only one safe course: Every municipal improvement must be considered first on its own merits, then in relation to the merits of all other municipal needs. When this has been done a program must be adopted—a construction program for several years, carefully adjusted to the relative urgency of various improvements, to the financial condition of the city and to the reaction of the proposed outlays on the taxpayers and on the credit of the city.

The financial burden of city improvements can often be reduced by seeing that it is properly distributed among those directly or chiefly benefitted. This applies particularly to (1) all those public works that may properly be paid for by assessments for benefits, and (2) to revenue-producing utilities. Besides being just, such a distribution of cost tends to moderation and discrimination in the popular demand for improvements.

The determination of the actual and relative need for various city expenditures, the formulation of a corresponding program and the allocation of costs, are all problems that demand careful engineering study.

Garbage Disposal Uncertainties

GARBAGE disposal is a municipal activity that at the minute involves more than the usual number of difficulties. There are so many uncertainties that beset costs and revenues that cities having to make a choice of methods should take unusual care. That capital seems bound to remain high is about the only certainty. What will happen as regards labor, materials and supplies is a matter of conjecture, as is also whether the recent slump in the prices of grease, tankage and live hogs will be permanent.

Until conditions become more settled there is strong reason for choosing that method of garbage disposal, where the choice is open, that involves least capital, labor and material, and at the same time will produce some revenue to help reduce the cost of disposal and can most readily be abandoned in favor of some other and better method if one is offered. Taking this into consideration there is much to be said for garbage disposal by feeding during the next few years. The installation and operation of incinerators or destructors requires much capital and yields no revenue. Reduction means still larger capital, labor and material requirements with uncertain revenue for the immediate future, besides the possibility of the loss of the entire capital investment. Feeding to hogs requires a relatively small capital investment and operating expenses that are also relatively light as compared with reduction and, very much in its favor, the principal capital investment required for hog feeding is liquid in character since the hogs can always be converted into cash, and they form the bulk of the capital investment.

Finally, in these unsettled times, there is more need than ever that cities large and small should be guided by competent engineers in everything pertaining to the choice, design, construction *and operation* of garbage disposal works, including collection, transportation and final disposal.

The Water-Power Act

ONE of the distinct engineering accomplishments of the year just closed was the passage of the water-power act. For fully eight years water-power legislation had been the subject of strife in each succeeding Congress. When finally the conservationists, who proved in effect to be actual obstructionists of water-power development, were satisfied with the measure it died in 1919 through failure to bring it to a vote in the Senate. At last the measure has gone through with the approval of all parties.

Applications for permits or licenses for development under the act have been made at the rate of about one a day since the Water-Power Commission was organized, which means that 134 projects had been entered up to Dec. 25 for more than 12,000,000 hp. This development would cost well over a billion dollars and represents 40 per cent more power than the estimated water-wheel production of the country today. So far as *intentions* go, then, the new federal water-power policy has proved successful. *In actual construction* nothing whatsoever has resulted; in fact, no license or permit under the act has yet been issued nor is there much prospect of many being issued until the commission is given the money, for which it is now asking Congress, to make the investigations and surveys required under the law.

The number and distribution of the applications, however, indicate a lively interest in hydro-electric development. Undoubtedly many of the proposed projects are merely promoters' dreams and others—such, for instance, as the much advertised 3,000,000-hp. development of the Colorado River above the Grand Canyon—are far ahead of any present intentions, but most of them must represent honest prospects which will proceed just as fast as money can be obtained. The state of the money market is the main retarding influence in water power today and it operates nearly as actively under the present water-power act as it would under the old restricted government regulation. Not until money eases up will the real test of the new act come. Meanwhile several amendments of the act are before Congress. Most of them are of a routine nature and of little importance except that if passed in proper form they may serve to remove the doubts cast on the act's validity by the peculiar circumstances of its signing. The irregularity of this signing has been consistently ignored by most of those connected with the law, but there are some who fear injunction or other delaying tactics at a critical time in the prosecution of a project under the law and would prefer to see all doubts as to its validity removed.

It was freely predicted during the campaign for the act that the rush to build power plants would be immediate. Conditions beyond the scope of the act have served to retard any such rush, but the prospects for development as indicated in the applications seem to show that the work will be undertaken when conditions are ripe. Actual permits and work started will be better evidence than promises to start, but the multitude of applications and the amount of power involved in them augur well for future extensions.

Financial Situation of the Railroads and Its Effect on Improvment Policies

Returns From New Rates Thus Far Justify Only Such Improvements as Are Necessary to Put More Traffic Over Existing Tracks

By T. De Witt Cuyler
Chairman, Association of Railway Executives

In a country growing like the United States and with such great possibilities the job of building up railroads, to keep pace with the development of the country's business will never be ended in our time. "Man never is, but always to be blest."

The decision of the people of the United States in favor of legislation establishing private ownership and government control, though the Transportation Act of 1920, has been adopted for these reasons:

1. To assure to the public adequate railroad service and to preserve in railroad management and work that spirit of individual enterprise, economical administration and competitive emulation in good service which is lacking in governmental work.
2. To establish rates which will not only be fair to the public but establish and preserve the credit of the railroads so as to insure their extension in localities where new lines are needed and the expansion of equipment and facilities where railroads are already established, so that the needs of the entire nation may always be met.
3. Last, but not least, to maintain skilled personnel and to maintain a high morale in a system which preserves American traditions and one which has given to America, notwithstanding the experiences of the war and the resulting increase of rates, a railroad service cheaper and better than any other in the world.

Returns From New Rates

The new rates, made effective by the Interstate Commerce Commission Aug. 26, had as a major objective the establishment of railroad credit. These rates were based, necessarily, upon a volume of traffic determined by estimate. This volume, however, may or may not be actually developed by the business of the country. The roads have no guaranty of earnings under the act.

The ability of the railroads to engage in any expansion program of large dimensions is dependent upon two things:

1. The actual achievement of a 6-per cent earning power as contemplated by the Transportation Act, and
2. A world-wide readjustment of the conditions of money and credit which would give an industry with a 6-per cent earning power the necessary standing in the investment market to command large funds.

We have at this writing only two months' complete returns of earnings under the present rates. But those for October, which was the biggest traffic month in the history of the country, indicated that the carriers were still over $20,500,000 a month away from a 6-per cent earning power. The October figures showed earnings of 4.9 per cent on the $18,900,000,000, which is the tentative property valuation of the Interstate Commerce Commission for rate-making purposes. At present there is a seasonal falling off in traffic.

As the carriers would be loath to attempt to make up this deficiency in net income by asking for a further increase in rates, the attainment of the 6-per cent earning power will be dependent on the ability of the roads during the coming year to make still further substantial economies and increases in efficiency.

The capital expenditures programs of the railroads for 1920 and, so far as one can see, for 1921, *have been, and will of necessity be, programs directed mainly at removing situations which prevent the existing railroad lines from carrying maximum traffic over the existing trackage.*

Steady development for many years in heavy-power locomotives has left the country considerably deficient in adequate engine, roundhouse and repair facilities, and has cramped many freight yards and made many existing sidings inadequate.

In general, therefore, the expansion of these facilities—lengthening of sidings, new sidings, automatic signals, better train dispatching facilities, the further application of superheaters, and other devices increasing or economizing power, and the elimination of or widening of limiting tunnels, reducing grades, flattening curves, reinforcing rail, ballast, trestles and bridges for the use of heavier power, constitute the main items of work now being carried forward and to be carried forward during the coming year.

Lack of adequate terminal capacity is recognized as one of the most important aspects in which the railroads are not in advance, if even abreast, of the development of the country. A number of important improvements in terminal capacity are now in process of construction, notably the grain elevator of the Pennsylvania at Baltimore and the coal pier of the Western Maryland at the same city.

Other important projects on foot are:

1. The application of heavier power to the Chesapeake & Ohio Railway Co.
2. The building of a double track on the ruling grade of the Virginian which will almost double its coal-carrying capacity.
3. Three big freight yards on the New York, New Haven & Hartford.
4. The elimination of a limiting tunnel on the Delaware & Hudson.
5. The extension of the Louisville & Jefferson bridge.
6. The building of a cut-off on the Kanawha & Michigan.
7. Shortening curves and reducing grades on the Norfolk Southern.
8. The enlargement of yard and engine facilities on the Texas & Pacific and the Wheeling & Lake Erie.

All told, it is estimated that the carriers are expending some $250,000,000 upon such improvements, of which about $70,000,000 is being financed by loans from the fund provided by the Transportation Act and most of the remainder out of earnings.

The railroad companies have ordered approximately 50,000 freight cars this year. Of these, some 15,000 will be refrigerator cars, there having been no net additions to this class of equipment for some years, and there having been no refrigerator cars constructed at all during the entire twenty-six months of federal control.

The companies either have ordered or are making the financial arrangements to purchase approximately 1,500 additional locomotives and about 1,200 passenger cars. The total cost of this equipment is approximately as follows:

45,000	Freight cars	@ $ 3,000 each	$135,000,000
15,000	Refrigerator cars	@ 4,500 each	67,500,000
1,500	Locomotives	@ 70,000 each	105,000,000
1,200	Passenger train cars	@ 35,000 each	42,000,000
	Total		$349,500,000

In addition to this, the Pullman Co. is building 500 Pullman cars this year, none having been built during the period of federal control.

In addition some rather extensive development of railroad piers is in contemplation in the harbor territory of New York City, but whether or not this can be carried forward until the railroads are really earning a 6-per cent return and on that basis are able to attract large investment of new capital is a question which cannot at this time be confidently answered.

With regard to equipment—its present high cost will probably put a premium upon the reconstruction of old equipment to an unusual extent, while the higher efficiency with which the companies recently have been able to use cars and locomotives will probably reduce the amount of new equipment which they feel justified in purchasing at present prices.

Economy Necessary

The economy of the carriers in making only minimum expansions in equipment and facilities at the present time is ultimately to the interest of the public as well as the railroads, as it will prevent getting into the property value of the railroads (on which the rates of the future must be based) a relatively large amount of property at the present excessive prices.

With readjustment of investment conditions, and ampler earnings, the railroads will undoubtedly proceed with more confidence, but until then sound policy on their part was well expressed by Interstate Commissioner Aitchison in his speech in Washington on Nov. 10, when he said:

"The present financial situation coupled with the apparent downward trend of construction costs makes it seem prudent not to engage upon any undue or avoidable construction program until conditions become more normal . . ."

While a great deal has already been done by the carriers the following general considerations should be taken into account:

1. The railroads could certainly not be expected to expend the money until they receive it, but it can hardly be claimed that the railroads are in actual receipt of any great benefit as yet, nor could they possibly have already expended any large amounts from recently increased rates.

2. The transportation Act provides for the next two years that rates shall be fixed by the Interstate Commerce Commission which will provide net earnings equal to 5½ per cent of the value of the property. This, generally speaking, was for the purpose of a return to the investor and an improvement in credit, and an additional ½ per cent of such property value to make provision in whole or in part, for improvements, betterments, or equipment. From the figures so far obtainable, few railroads have realized from the increased rates and fares a return of 5½ per cent, much less one-half of one per cent to be devoted to betterments.

3. Taking the matter of equipment—a permanent investment at the present high costs and high rates of interest involves a continued high charge to provide the necessary return. Expressing the idea in other words, a box car bought now for $3,300 on 8 per cent money would require an earning of $264 for interest alone, and would require much higher rates of freight to make such a return, than for the same car bought for $2,500 at 5 per cent money, for which the interest charge would be $125 per year.

I do not mean to contend that the matter of prices is more important than service, but it should be made clear that economy is unavoidable, as the credit foundation for large expenditures at present prices has not yet been established. The policy of the carriers, therefore, will have to be for a time, to some extent, to feel their way.

At the same time the more efficient use of present facilities, the betterment of their maintenance, the reconstruction of old equipment, and the steady, even though small, acquisition of new equipment, will assure at least a considerable and steady improvement in service.

While with regard to the provision of new facilities and additional equipment for 1920 the results are not as great as the railroad companies would have desired and as they expect them to be, I feel that the carriers so far have fully met their responsibilities in this difficult period of national adjustment.

The year 1920 has been the record year of American railroad operation. Not only has a larger gross tonnage been moved than ever before, but new records have been established in the amount of transportation gotten out of each car. Even during the war year of 1918 the highest performance was 494 ton-miles per car per day, while for August, 1920, the average was 557, and for September and October, 565.

Results Since March 1

In the nine full months since the government turned back the railroads to their owners on March 1, the railroad companies under private operation have:

1. Increased the average movement per freight car per day 6.3 miles—from 22.3 to 28.6 miles.

2. Increased the average load per car 1.7 tons—from 28.3 to 30 tons.

3. Made substantial reduction in the number of unserviceable locomotives.

4. Reduced the accumulation of loaded but unmoved freight cars from 103,237 on March 1, to 21,991 on Dec. 3, of which only 6,386 were detained because of the inability of the railroads to move them.

5. Relocated approximately 180,000 box cars from the East to the West for the movement of farm produce.

6. Relocated approximately 180,000 open-top cars from the West to the East to keep up the production of coal.

7. Moved the third highest coal production in the history of the country.

8. Spent over $500,000,000 extra on improving

the maintenance of tracks, bridges, cars and locomotives.

9. Contracted to spend about $250,000,000, largely out of earnings, for additions and betterments to promote the movement of cars.

10. Made arrangements to purchase approximately 50,000 new freight cars, 150 new locomotives, and 1,000 new passenger cars.

11. Begun the reconstruction of thousands of old cars.

12. Moved—with a deteriorated plant, under disturbed labor and business conditions—the largest volume of traffic ever known in a single year, with the highest efficiency yet achieved, and with a minimum addition to the value of the property on which the public has to pay a return through rates.

With this record for 1920, despite its adverse conditions, I see no ground for pessimism as to the future of private operation of the railroads.

Existing Water-Works Conditions and Needed Planning

Postponement of Betterments Because of War and Post-War Conditions Have Resulted in Widespread Inadequacy of Service

By George W. Fuller
Consulting Engineer, New York City

WATER-WORKS in many American cities were operated under severe stress during the war. High prices of labor and materials, restricted transportation facilities for all materials and supplies, reductions in net operating revenues, and inability to sell securities or to obtain necessary legislation, have prevented normal extensions and betterments for about five years. Depleted operating personnel, deferred maintenance to an abnormal degree, and increased water consumption due to war industries and to lack of vigilance in restricting waste and needless use, have been factors contributing to present predicaments. As a result the margin between peak demands of water consumption and the capacity of supply works is rapidly becoming inadequate in many cities. In some the margin is deplorably small because it will be difficult to supply the needs of the growing communities during the period necessary for financing, designing and building necessary extensions and betterments.

In large cities these conditions are ordinarily of more significance than in small cities because longer periods are required to provide remedial measures. Industrial cities, where manufacturers use the city water supply, are more involved than those communities which are not required to furnish much water for the industries, or where the more sizeable establishments can get water supplies of their own. This aspect is of practical importance because no community will intentionally restrict its future industrial growth on account of inadequate water supply facilities.

Postponements of betterments have occurred in all types of plants, both municipally and privately owned. But some of the latter are in a more serious condition than those of the former class. Decreases in their net earnings and uncertainties as to future income have made it impossible for them to finance new works, and the outlook in some instances is very precarious both for the plant owners and those desiring service from them.

The present inadequacy of water service involves both quantity and quality of supply. The danger stage for many water plants is being approached in one or the other of these aspects, or both.

Before the war water-works extensions and betterments on a sizeable scale were under consideration or execution at San Francisco, Winnipeg, Toronto, Montreal, Providence, Hartford, New York, Wilmington, Washington, Richmond, St. Louis, St. Paul, Detroit, Cleveland and numerous smaller cities. The projects were at various stages of inception or completion. Some went forward but others were halted by the war where that was permissible or necessary. Stringent need caused Winnipeg to complete its new supply during the war period.

Since the armistice reports have been made or other steps taken as to water supply betterments at San Francisco, the Oakland district, Kansas City, St. Paul, Milwaukee, Chicago, Detroit, Grand Rapids, Saginaw, Cleveland, Buffalo, Columbus, Memphis, Nashville, Knoxville, Atlanta, Baltimore, Wilmington and Philadelphia. Other cities are considering the matter and are endeavoring to get betterments under way.

The metropolitan district of northern New Jersey is facing a deplorable lack of water-works facilities, notwithstanding the fact that the Wanaque reservoir has recently been put under contract by the city of Newark. In portions of this district the general situation is distressing because the margin in capacity of supply works is insufficient to provide safely for local needs during the period required for financing and installing new supply works. The problem is still further complicated by some of the works being owned by private companies which are apparently unable to finance extensions, or to make satisfactory arrangements for the sale of their properties to the municipalities, or to effect negotiable programs for joint undertakings where the municipalities would build new supply works for delivering water to the local distribution systems. Such conditions usually spell delay and disaster unless practical co-operative programs are developed in fairness to all concerned. In this connection our thoughts revert to the successful program started some twenty-five years ago by the Massachusetts Metropolitan Water Board for the benefit of Boston and its suburbs.

Inadequate Recognition

The foregoing illustrations as to localities, where water-works conditions demand prompt and efficient attention, are obviously far from complete. It is known that a great many small cities and towns, particularly in the West, have had recent difficulty in getting water. Some towns in Kansas are so deficient in their water supply at times that they are obliged to ship in water by tank cars for domestic consumers. Even in the face of careful investigations some cities are finding it hard to formulate a program for providing an adequate water supply within their financial reach.

Small towns can be more quickly provided, from an engineering standpoint, with new works than large cities. But financially and as to the readiness with which public opinion can be crystallized behind a definite project, it is frequently the case that difficulties are relatively greater and perhaps more bothersome for small than for large communities.

During the past five years high costs and other obstacles to making replacements and building new works have caused a general postponement of water-works improvements. The resulting conditions as to water-works facilities are approaching the danger state to an extent far greater than has been generally recognized either by officials or by the public. When the line of demarcation between adequate and inadequate service is once passed it is frequently most difficult to recross it again, both as to time and money.

Warning Necessary

For the safety of the public a warning must be sounded urging that shortcomings in water supply facilities be investigated and placed clearly on record in various communities, where present or prospective deficiencies exist. Engineers have a service to perform during this reconstruction period in the formulation of sound public policy in this field. Collectively they should be more capable than any other group of men in getting the essential facts appreciated by local officials, civic organizations and the general public. But to attain this end they must forego their tendency to dilute their findings with needless technical details.

Reports should be based not only on sound engineering data and principles but they must be adjusted to a feasible financial and legislative program.

During the war and the later period of rising prices and of other handicaps to construction work there were reasons why many communities allowed their water situation to carry on as best it could. With the present period of falling prices and of unemployed labor it is inexcusable for officials to neglect this subject any longer.

One of the most important steps to be taken at the outset in viewing a water-works undertaking is to see that a well considered program of operating economies and efficiencies is put into practical effect. In particular does this relate to curtailing needless waste.

In many communities it is far cheaper and quicker to save a million gallons of water now being wasted than it is to install facilities to increase the capacity of the existing works by such a volume. Since the armistice progress has not been rapid in many places in restoring operating conditions to a pre-war basis and there is much that can and should be done to conserve present facilities.

Far-Visioned Planning Needed

One of the great difficulties with American water-works has been that too frequently they have been built piecemeal, in conformity with the views of the particular personnel in charge at the time, and without reference to either past or future programs for connected procedure. At Boston, New York, Cincinnati, New Orleans and some other places well-conceived plans for a long term of years have been prepared and new construction adjusted to such a program.

As a part of effective city planning such undertakings are essential and well worth their cost. There are many cities in the country today that will do well to set about at once to make the most they can of their present water-works facilities and at the same time to lay out a definite, general program for future water requirements which should be specifically adopted and carried into execution regardless of changes in local administrative bodies.

The Water Supply of Barranquilla, Columbia, South America

Intermittent Operation Permits Draining of System —Fuel Is Wood and Getting Scarcer— Filter Plant Projected

By George C. Bunker
Sanitary Engineer, Balboa Heights, C. Z.

Until recently the raw turbid Magdalena River water was delivered unsterilized to the citizens of Barranquilla, but a chlorination plant now protects the user and plans have been made for a purification plant. Three steam pumps located in a station on the Magdalena River opposite the center of the city distributes the water directly to the consumer, the excess flowing into a 900,000-gal. reservoir.

The pumps are operated only 10 to 12 hours daily starting between 1:00 and 3:00 a.m. This system of intermittent pumping calls for the installation of individual service tanks of sufficient size to hold a supply to cover the demands during the non-pumping periods. When the pumps are shut down the valve on the discharge line from the reservoir is closed to hold

FILLING STATION FOR WATER PEDDLERS

the water in reserve for fire protection, and a large part of the distribution system is therefore drained during the non-pumping period. As a large number of taps are always left open, a large amount of air must be expelled from the system when the pumps are started. Water hammers frequently open the joints and start many leaks.

Due to the non-development of coal mines and the oil fields and to the lack of transportation facilities, wood is used as a fuel throughout the city. It is cut on the watershed of the Magdalena River and brought to the pump station in small sail boats. The price has advanced from $2.50 per cord in the latter part of 1919, to $4.50 and $5 in the first half of 1920. Furthermore the deliveries are daily becoming more uncertain due to the gradual depletion of the forests bordering on the river. This condition is not surprising when one stops to consider that all of the industrial plants have used wood as fuel since their installation and that the river boats use the same fuel. It is predicted by the business men of the city that crude oil of the country will be available for fuel within a year.

No meters are in use on the 4,000 services, the charges being based on the size of the service pipes. For example the respective charges for ½-in. and ¾-in

services are $1.50 and $1.80 per month, with no restrictions on the amount of water used. Galvanized-iron pipe screwed directly into the cast-iron mains is used exclusively for services. The average life is four to six years. As is the case with many South American cities there are no fire hydrants.

TINAJA (WATER JAR) UNDER AMERICAN-MADE HOUSEHOLD FILTER

The poor people on the outskirts of the city are supplied from public hydrants known as *pilas* from which casks or other containers are filled and the water is then peddled on burros. An employee of the water company is stationed at each hydrant to collect the charge of 2c. for each cask of a capacity of 3 gal. The same amount of water is retailed for 6 to 10 cents.

The river water is muddy and of moderate hardness during the greater part of the year. During the extreme low stages in February and March the turbidity decreases to a minimum, but during the same period salt water from the ocean works back up the river past the intake. In some years a salty taste is noted.

Up to June, 1920, no method of purification was employed by the water company, but during that month a chlorinator was installed as a result of an investigation and recommendations made by the writer in the latter part of 1919. Preliminary plans, estimates of cost and a detailed report on the purification of the water supply have also been submitted by the author and are under consideration. It is probable that the first steps toward the construction of a purification plant will be taken during 1921.

Epidemics of dysentery have been frequent and the death rate of children has been excessively high, but contrary to what would be expected the death rate from typhoid fever has been comparatively low.

The better class of inhabitants use in their residences small American-made filters containing hollow cylinders of diatomaceous earth through which the water is forced by the pressure maintained in the distribution system. In office buildings and factories, filters of the same type but of a larger size are in use. These filters will easily remove a turbidity of 400 p.p.m. (not to be taken as a maximum), leaving the effluent clear and sparkling with a true color of 10 to 25 parts. Bacterial examinations of the effluents from several of these filters indicate that the bacteria were reduced to from 0 to 10 per c.c. from 4,000 per c.c. in the raw water, and that members of the B. coli group were absent in 50 c.c., provided that the stones were free from cracks and were carefully cleaned each day and that the gaskets were in good condition.

WATER JAR MARKET NEAR CANAL

It is customary to allow the effluent from the filter to drop into a large red-colored earthenware vessel, known as a *tinaja*, which will maintain the water at a temperature lower than that of the air due to the cooling produced by the evaporation of the moisture on the outside surface.

Prior to the introduction of this type of filter large blocks of porous stone were employed. These were hollowed out in order to hold a few gallons of water and were supported on a framework of wood at a suitable height above a *tinaja*. It is necessary periodically to clean these stones with a soft brush in order to remove the sediment which fills the pores and prevents the passage of water.

The majority of the poor people use the water as it comes from the river without attempting to purify it beyond allowing some of the mud to settle out in a *tinaja*. A few people add a certain species of cactus, which grows wild, in order to clarify the water in a manner similar to that resulting from the use of alum. Flaxseed is also used to a limited extent for the same purpose.

There are two bottling works which sell artifically carbonated waters, derived from wells drilled in the limestone formation. The waters are hard and the salt content is high, but it is advisable for travelers to drink them while stopping at the hotels.

Plastering Code to Be Written

In collaboration with various people in the plastering industry, the United States Bureau of Standards has undertaken to write a national plastering code which will contain specifications for all materials used in wall plaster, with directions for their use. The results of the work will eventually form the basis of a Bureau publication. It is intended to be in such shape that it may be adopted by the municipal and state legislative bodies in the preparation of building codes. To assist the bureau in the work there has been called together a conference of representatives of the Portland Cement Association, the National Brick Manufacturers Association, Hollow Tile Building Association, Associated Metal Lath Manufacturers, National Lumber Manufacturers Association, Gypsum Industries Association, National Lime Association, National Association of Sand and Gravel Producers, Contracting Plasterers International Association, Operative Plasterers and Cement Finishers International Association, Wood, Wire and Metal Lathers International Union, National Board of Fire Underwriters, United States Supervising Architects Office, and the American Institute of Architects.

Maximum Traffic Service the Highway Tendency of 1920

Pavement Construction Curtailed and Construction of Permanent Grade With Temporary Surfacing Greatly Increased

SERVICE to traffic was the dominant idea in highway improvement in 1920. This is indicated (1) by the tendency to spread construction expenditures over a large mileage of grading and gravel surfacing instead of confining them to a small mileage of highly improved road; (2) by a wide extension of patrol maintenance, and (3) by increased attention to traffic investigation and control.

Pavement Curtailed

Actually there were more miles of paved road constructed in 1920 than in any previous twelve months of road building, but only a fraction of the construction contemplated was undertaken and not more than half of the work undertaken was completed.

Curtailment was compulsory in most instances. There were not enough contractors to construct the mileage planned, but the greater obstacle was lack of railway transportation for materials and equipment. Again, because of the lack of materials and contractors, combined with high prices and wages, the prices asked for construction were felt to be more than the public could pay and planned programs were voluntarily curtailed. There was no lack of money for construction, but where this money had to come from the sale of bonds so great a discount, generally, had to be allowed that the charge per mile for financing paved roads was excessive. This was a final reason for curtailing their construction.

Supporting all these specific reasons for reducing paved road mileages, there was the general conviction, in many sections of the country, that money should not be expended on a small mileage of highly improved highway until traffic was well served by a large mileage of highway moderately improved by grading and temporary surfacing.

Permanent Grade Increased

There was, then, last year in all states having large mileages of unimproved main roads—despite curtailed paving operations—a large increase in highway construction. In many states this construction exceeded a thousand miles and in some states it approached two thousand miles completed to permanent grade and, in large part, gravel surfaced. This construction was possible because it could be conducted, largely, regardless of railway transportation. Local gravel pits supplied the surfacing, and the equipment required and the construction talent called for were of less special character than are necessary for paving operations and were, therefore, more generally available. This construction also was largely permanent. Wherever it prevailed as a definite improvement policy the old roads were built to final gradient and width and provided with permanent drainage; even the surfacing possessed a permanent value as a subbase for pavement when traffic demands this final improvement.

Quality production, prior to hard surfacing, of permanent grade and temporary surfacing was the construction policy particularly of those states having a large mileage of unimproved main roads. These states comprise most of the Mississippi Valley, the Far West and the South and parts of the East.

In states where main highway systems have been largely improved new construction has of necessity meant replacement with a more permanent structure or widening and strengthening the existing permanent surface. New York and Pennsylvania represent the extremes of policy. New York practically ceased construction except on work already in progress; Pennsylvania undertook new construction until, with the contracts brought forward from 1919, it had over a thousand miles of paved roads in progress. Briefly, New York values the needs of traffic at less, and Pennsylvania values them at more, than the market price of heavy-traffic paved road construction.

Maintenance Extended

Irrespective of construction policies, the extension of maintenance was universal. Wherever there was state control of construction, patrol maintenance was inaugurated or extended. With this extension there has come the new conception that maintenance is not merely the task of restoring and repairing highway structure, but is the business of facilitating travel by highway. Within this broader meaning are included all activities which increase the length of time when, and the safety and ease with which, *all the highways* may be traveled. Marking of routes, snow removal, planning detours and conducting repairs so as to block the road are all maintenance duties under the extended meaning.

Methods of patrol maintenance exhibit an improvement in the greater use of machinery, particularly of motor trucks and tractors, and in the selection of better qualified patrolmen. Truck and tractor patrol, by lengthening the section which can be traveled, have helped to meet the problem of labor shortage. They have, however, not demonstrated that they are materially cheaper than team patrol. The year's experience strengthens the conviction that it is the character and skill of the patrolman which determines the quality of maintenance, and these can be secured only by careful selection and by holding the men by adequate pay.

Snow removal and drift prevention are the outstanding development of 1920 in traffic maintenance. Practice in Pennsylvania exemplifies the best methods. It involves prevention of drifts by snow barriers, organization and equipment of patrolmen to remove snow, and prompt removal as fast as the depth reaches 6 in. In surface maintenance of gravel roads the year's experience demonstrates that success depends on continuous and persistent attention and not on special equipment.

Miscellaneous Developments

Traffic—Traffic has come to be considered the master problem in highway development. In 1920 the study of road failures from traffic demonstrated beyond question, if there were room for question before, the necessity of weight regulation of motor-truck traffic if present road structure is to have a reasonable life. The need of regulation was first experienced in the heavy-traffic manufacturing states of the East, but it has also appeared in the prairie road states of the West. Occasional heavy-truck travel, perhaps less than 1 per cent of the total truck traffic, accomplishes the damage. Opinion generally has settled upon legislation restricting weights as the most practicable remedy, and such

legislation has been drafted by a number of highway departments for consideration at coming sessions of state legislatures.

Consideration of traffic problems has, however, during the last year proceeded far beyond weight regulation of vehicles. It is perceived that the matter is of such importance as to demand a comprehensive and accurate study by every state. Opinion is coming to the agreement that without such studies there is no sound basis for highway legislation, appropriations, organization and design.

Design Tendencies—Thought on highway design in 1920 exhibited a radical departure toward design in detail. This is particularly true in reference to foundation design. Studies of soil physics have created a strong conviction that a road foundation must be a different structure for each character of subsoil. They have also indicated that with subsoils of high capillarity safety of design can be secured only by treating the natural soil to reduce capillarity or by replacing it with a more stable material. These conclusions from the study of soil physics are supported by service studies of paved roads in a number of states. In highway design in 1920 the notable development has been the preparation made by important road-building states to continue the study of soil physics and to observe the behavior in service of foundation soils of different character.

Construction Methods—No radical changes in methods of constructing paved roads occurred during 1920. The methods and equipment developed in 1919, as summarized in *Engineering News-Record*, Jan. 1, 1920, p. 8, have remained in use. There has been perfection in details. Except that methods which involve stock-piling on the subgrade are being generally discouraged and in some states prohibited, there is no evident approach to standard methods and equipment, nor has any method or type of plant demonstrated its superiority.

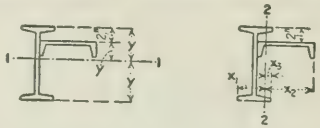
In grading practice the notable development has been the increased use of tractors in place of teams for operating grading equipment, and, in swamp locations, the use of dragline excavators and dredges for constructing fills. Tractor operation has been applied to elevating graders, heavy-blade graders and scarifiers and large-wheel scrapers in several Western States with very considerable advantage over team operation.

To sum up the highway tendencies of 1920: There is an effort to get for the public the maximum amount of traffic service with the funds available. This, the engineers are trying to accomplish by building more miles of less expensive surfacing, by maintaining roads adequately, by keeping them open in winter and by initiating studies and movements looking toward preventing a very small amount of traffic doing the greater part of the damage.

Properties of Crane Girder Sections

By John H. Sawkins
Schenectady, N. Y.

CRANE girders composed of a single I-beam stiffened by a horizontal channel attached close to the top flange are listed in the accompanying table. The



location of the gravity axis of the section is referenced both vertically and horizontally by three different dimensions in each direction, and the moments of inertia around the gravity axes are given.

PROPERTIES OF I-BEAM CRANE GIRDERS WITH LATERAL STIFFENING CHANNELS

	Section of Girder Depth and Weight Per Foot			Axis 1-1				Axis 2-2			
	I-Beam	Channel	Area	y_1	y_2	y_3	I	x_1	x_2	x_3	I
1	8x18	6x8	7 71	4.46	3.54	1.54	61 21	2.965	5 17	1 035	32.96
2	8x18	8x11½	8.68	4.547	3 453	1 453	62 35	3.595	6.54	0 405	71 20
3	9x21	6x8	8.69	5.04	3.96	1 96	92 38	3 03	5 28	1.30	35.26
4	9x21	9x13½	10.20	5.22	3.78	1.78	95.29	3 94	7 37	0 39	104 47
5	9x21	8x11½	9.66	5.16	3 84	1.84	94.25	3 60	6.71	0 73	75.06
6	10x25	6x8	9.75	5.60	4 40	2 40	133.84	3.085	5 40	1 575	37 80
7	10x25	8x11½	10.72	5.76	4 24	2.24	136 87	3.635	6 85	1 025	78 90
8	10x25	10x15	11.83	5 89	4 11	2 11	139 84	4 265	8 22	0 395	147 70
9	12x31½	8x11½	12 61	6 91	5.09	3 09	245 81	3 615	7 06	1 385	84 70
10	12x31½	10x15	13.72	7.09	4.91	2.91	251.96	4.175	8 50	0 825	156 75
11	12x31½	12x20½	15.29	7 31	4.69	2 69	259 35	4 945	9 73	0 055	276 50
12	15x42	8x11½	15.83	8.54	6 46	4 46	507 02	3.645	7 31	1 855	93 65
13	15x42	10x15	16.94	8 775	6 225	4 225	521 65	4 125	8 83	1 375	170 50
14	15x42	12x20½	18.51	9 07	5 93	3 93	539.30	4.775	10 18	0 725	299 10
15	15x42	15x33	22 38	9.58	5 42	3 42	572 10	6 135	11 82	0 635	654 00
16	18x55	8x11½	19.28	10.115	7 885	5 885	911 00	3 73	7.50	2 27	103 08
17	18x55	10x15	20.39	10.39	7 61	5 61	938 40	4.14	9 09	1.86	183 30
18	18x55	12x20½	21.96	10.73	7 27	5 27	972 90	4 70	10 53	1 30	319 20
19	18x55	15x33	25.83	11.38	6 62	4 62	1038 8	5.96	12 27	0 04	698 3
20	20x65	8x11½	22.43	11.10	8 90	6 90	1327 6	3 765	7 61	2 485	111.72
21	20x65	10x15	23 54	11.395	8 605	6 605	1367 4	4 115	9 26	2 135	194 17
22	20x65	12x20½	25.11	11 75	8 25	6 25	1417 5	4 625	10 75	1 625	334 90
23	20x65	15x33	28.98	12 46	7 54	5 54	1516 2	5 765	12 61	0 485	731 30
24	24x80	8x11½	26 67	13 18	10 82	8 82	2348 0	4 035	7 715	2 965	128 12
25	24x80	10x15	27 78	13 50	10 50	8 50	2417 0	4 34	9 41	2 66	212 85
26	24x80	12x20½	29 35	13 91	10 09	8 09	2506 3	4.78	10 97	2 22	358 05
27	24x80	15x33	33.32	14 75	9.25	7 25	2684 4	5 81	12 94	1 19	772 90

This table, while it introduces no new ideas in design, should save time for the structural engineer and may frequently make it possible to select the right section more precisely than would be the case if the calculations must be made separately for each size of girder.

Attention is called to the fact that the full cross-section of the channel is included in the section effective to resist vertical bending.

Protecting Buildings Against White Ants

Referring to the article on "Protecting Buildings from White Ants," in *Engineering News-Record*, June 3, 1920, p. 1110, a correspondent in India writes that Indian practice improves on the methods given in the article "in one small but effective particular. The ant-proof floor is carried without a joint over the whole plinth area of the building, covering the walls too, and the walls are then started afresh over this floor."

Business Conditions in Relation to Construction

Labor Well Along in Readjustment, and Unemployment Threatening To Become Serious—Materials Prices Have Only Recently Begun To Recede

THE close of 1920 finds all industry in the grip of the same giant swing downward that has followed each former period of great industrial and financial inflation. All phases of American industry, keyed to a super-pitch by war pressure, entered the year functioning at maximum capacity, and continued to produce both fabricated goods and raw materials in unprecedented quantities. World-wide crops of record-breaking size and European difficulties in financing importations combined to cut agricultural values to such an extent that the buying power of America, originating in the marketing of farm products, shrunk something like $6,000,000,000. The immediate result was to curtail sales of all commodities both in wholesale and retail markets, and thereby cause an overproduction and an accumulation of unmarketable stocks. Inevitably, production has been and is now being curtailed, such curtailment being evidenced by shorter hours of work, fewer shifts, reduced staffs and shutdowns throughout a wide range of activities. The construction industry is lagging in its progress along this troubled path of readjustment, in that deflation of prices has failed to keep pace with reduction in activity. Only in the last three weeks have appreciable price changes occurred in any building material line other than lumber and such reductions as are reported have the appearance of being tentative as they are not proportionate to price recessions in kindred commodities.

Wage Reductions Widespread

Labor being a large part of the cost of all construction, its present condition and future outlook is a prime consideration. The nation is today more nearly free from strikes and threatened strikes than at any time in five or more years. Labor councils are showing every evidence of a disposition to submit differences to arbitration and to accept wage reductions where such action is vital to continued operation. Reduced industrial operations have caused all sections of the country to report plentiful supplies of labor, particularly common labor, and in some localities unemployment has approached the proportions of a problem. In the Pacific Northwest, particularly hard hit by reason of reduced activity in the lumber industry, reports show over 10,000 men out of work in both Portland and Seattle. Tacoma and Seattle are taking steps to start certain public works which were to have been inaugurated in the spring, as it is necessary to provide work at once for the heads of distressed families, the number of whom is being augmented daily by the closing of additional logging camps, mills and factories. On this public work no wage adjustment from existing scales is contemplated. In private work, recessions are the rule, wage cuts ranging from 15 to 25 per cent being reported in many lines. San Francisco reports a threatened strike of public service employees averted, at least temporarily, and a plentiful supply of labor even in the construction field. A greater influx of Eastern skilled labor is reported from Southern California than is usual at this time of year and skilled workers are more easily obtained than formerly.

The copper-producing sections all report reduced wages, effective January first. In the Upper Peninsula of Michigan and in Minnesota reductions range from 12 to 22 per cent, averaging 17 per cent. Certain companies desiring to assist their employees to lighten living costs in the face of reduced incomes are selling coal to their men at $7 per ton regardless of its cost of $9 and have cut the rent on company-owned houses from $1.50 per room per month to $1 per room. Several thousand men have been laid off in this district, production being curtailed about 30 per cent. In Montana, where miners have been drawing $5.75 per shift, the new scale is established at $4.75. This is still $1.25 above the wage specified by the sliding-scale schedule. Cuts in Arizona are announced as being 80c. per shift in the smelters and $1 in the mines. Some talk has been heard, particularly in Arizona, regarding resistance being offered to the cuts, but it may be discounted as a shutdown would be clear profit to the operators.

The steel industry, under pressure of reduced demand, is reducing working forces instead of cutting wages. In the case of the independents this reduction approximates 50 per cent while the companies allied with the Corporation are operating with about 70 per cent of the force employed during the summer. The railroads have cut shop forces in all sections of the country and report ample supplies of labor to handle any demand that fluctuating traffic may put upon them. Wage cuts and reduced forces are broadcast in the lumber industry, reports from Wisconsin, Michigan, New England and the South being echoes of those from the Far Northwest. The average report throughout the country is of 50 per cent operations in all branches of lumber production and handling. The textile workers, so busy early in the year, are not only being deprived of jobs by the thousand but have been compelled to accept a 22½ per cent wage reduction in New England, 15 per cent in the Carolinas, and greater or less cuts throughout the country. The garment trade is similarly affected.

The building trades, more closely organized than the workers of most other lines, have in general held wages up to scale. Great numbers of skilled tradesmen are out of employment however, and signs are noted which look to a downward revision of present scales or a breaking down of closed-shop rule. From Atlanta and Minneapolis, widely separated geographically, come reports of similar nature—from Atlanta, a new scale with common labor 30c., carpenters 70c., plasterers and bricklayers 90c. and painters 60c. per hour, with casual laborers easily obtained at 25c. The Minneapolis scale is held intact, but numerous instances are noted of men cutting under the scale, even on union jobs. Here also skilled workmen are reported as taking jobs as common laborers. In Chicago, mill operators have asked the carpenters' organization to accept a reduction from $1.10 per hour to 85c., "to the end that plants and factories may be kept going and continued employment for employees be assured." The probable alternative is closing of the mills. In Chicago not more than 45 per cent of the building tradesmen are working at their trade

and the Illinois Free Employment Bureau reports 260 applications for work for every 100 jobs offered. No great unemployment problem is apparent, as here, as well as in certain New England cities, a reversal of the war-time migration of labor from the country to the city is in evidence.

In a survey of conditions in all sections of the country the most encouraging single feature is the almost universal willingness of labor to accept wage adjustments where forced by economic conditions and compatible with living costs.

Supply and Price of Materials

One by one, in the past twelve weeks, raw materials and commodities used in all industry have had the price peak established during the boom days of last spring sheared off. Building materials have offered at least as great resistance to the downward trend as any other class. In this line the first to succumb was lumber. The buyers' strike, now so universal, was first noted in a refusal of the prospective home builder to proceed with his plans. This, coupled with low export demand, beat lumber prices down in 10 and 15 per cent jumps until it is now bringing practically pre-war prices, when sold. The drop has averaged close to 45 per cent. The force of this movement has lately been arrested with the exception of its action on West Coast lumber, on which further recessions of from $1 to $3 per M. feet are noted in the closing days of December. Claims that lumber prices are now on the bottom seem substantiated by the fact that mill prices now are in many cases below cost of production. The future policy will apparently be to lower cost via the wage-cut route rather than to increase selling prices.

November and December saw the price of coke, an important factor in iron and steel production, cut in two, and lower steel and iron prices followed. The U. S. Steel Corporation's prices are unchanged, but the independents, formerly charging from 20 to 30 per cent more, have cut to the corporation scale, the last change to be announced being on bessemer-steel rails, which are now quoted at $47 per ton base by all interests. The Pennsylvania Railroad Co. closed orders for 200,000 tons at that figure during Christmas week. The corporation's report of unfilled orders has shown a decrease of 1,600,000 tons in the last two months and all companies are curtailing output, the average reduction being placed at around 30 per cent. Ample supplies of ore are on hand at the various plants and with coal available in any desired quantity, supply of steel products promises to be no problem in the coming season.

Coal has taken a real slump. The much-talked-of famine has, by a combination of 120,000,000 tons of production in ten weeks, reduction of industrial consumption amounting to probably 5,000,000 tons in the same period, warm fall and winter weather discouraging household consumption and a complete cessation of overseas buying, been turned into an over-supply. Operators state that the market is "saturated" and pit-mouth prices on bituminous grades have suffered reductions of nearly 50 per cent in the past three weeks. Ample supplies at reasonable prices are everywhere available and all materials in the production of which coal enters very largely will benefit by lowered costs.

Producers of other building materials have, in general, held fast to peak prices, but dealers are cutting in all directions, contenting themselves with lessened profits. In the New York district small cuts are recorded on cement, amounting to 20c. per barrel from producers and 30c. from jobbers. Plate glass, paints and roofing materials are also off from 10 to 20 per cent in the New York market, while brick is quoted firm at $22.70 per M. but is being shaded to as low as $21. New York prices should be helped toward readjustment by the resumption of free lighterage service by the railroads, which will cut the laid-down cost of all materials from $1 to $2 per ton.

Chicago, Minneapolis, Atlanta and Kansas City report widespread reductions in all classes of material from dealers, cast-iron pipe, roofing materials, paint, brick, gravel, cement, sheet metals and electrical supplies being variously mentioned. All cities reporting, which fail to report reductions in cement and aggregate, state that dealers expect cuts on these items soon.

Taken generally, material prices are unsatisfactory in that they lack stability. There is no uniformity, either in similar items in the same market or in any commodity in the various markets. When new coal, transportation and labor costs are firmly established and digested by the producing industry the much-needed stabilization will automatically come about and the intrinsic value of building materials will once more be a matter of common knowledge.

Slow Progress of Construction

The effect of the unstable markets in all lines has been to cancel or defer the greatest building program America ever considered. Without exception, all sections of the country report more construction contemplated than ever before. A billion dollars is available for road construction, and deferred projects in various localities aggregate another billion. Authorities in charge of public work show no disposition to go ahead on any development requiring great consumption of materials until prices have demonstrated some permanency. Private enterprise is held up, not only on account of uncertain prices but also because of the questionable future of industry which renders the future value of any structure problematical. As the liquidation movement approaches an end, both classes of work should show new life.

Nineteen-twenty totals of new work undertaken will exceed those of 1919, but the increase all occurred in the first six months of the year. Since July steady declines are noted, until now in the entire country only about one-third as much work as the 10-year average is in hand. California is fortunate in this connection, the activity common in other localities being maintained there until December. Los Angeles, in particular, has initiated more new work each month this year than in the same month in 1919.

From the remainder of the country reports are uniform. Seattle says "much big building construction awaits lower costs." Minneapolis reports "contracts, both public and private, are being deferred awaiting price and labor readjustments." New Orleans engineers have many finished plans on which unsatisfactory bids have been received and progress has been stopped for the time being. St. Louis is doing nothing but plan. Chicago lists $150,000,000 in deferred work. Cleveland and Cincinnati have extensive plans awaiting developments. New England, hard hit by the terrific slump in textiles, is just waiting. New York, with gigantic plans on the board, is letting but few con-

tracts. Atlanta, where wage and price cuts have already amounted to something, reports that much work is going ahead in January and February. A compilation of building permits from a score of cities scattered from the Atlantic to the Pacific shows November, 1920, figures 20 per cent less than the preceding month and 60 per cent less than in November, 1919.

Inability of rail facilities to handle the needs and product of American industry caused a large part of our troubles in the past year. In this connection it is worthy of note that the coal situation has so improved that, not only are the roads themselves assured of ample supplies, but the probable need of priorities to supply necessary industry with fuel is rendered remote. In common with other interests, the roads note material increases in the efficiency of labor, reflected in faster car movement, more rapid repairs and more economical operation. It is also stated that rolling stock, for two years depreciating in volume and efficiency, is now on the upward trend, the number of cars and locomotives being gradually augmented by both the addition of new equipment and the increased rapidity noted in effecting repairs. The policy of controlling authorities for the coming year, while not announced, is felt to be against the issuance of priorities in all cases except where really extreme necessity is shown. It is desired rather to permit the needs of industry to adjust the flow of facilities.

The Outlook

For once in our history reports of lowered wages, decreased output and falling prices seems to point direct to better business ahead. Our trading basis has been pitched too high for successful progress, and a shaking-down process was absolutely necessary. Decline of building permits all over the country and accumulation of deferred projects give proof of this. Wage reductions represent a return to solid basis. The fact that many wage adjustments are not so radical as might be justified, notably in the copper mines, shows that capital means to be fair, and the acceptance of the necessary reductions indicates the reasonable attitude of labor. Curtailed production proves producers to have ceased turning out finished product regardless of need or the lack thereof and will prevent clogging of markets with high-cost goods. Price cuts foretell a return of conditions under which it will be possible to proceed with construction with some assurance as to the future value of the finished project.

Engineers bid fair to be the favored individuals in the approaching industrial currents. The same conditions which seem to preclude the chance of any great volume of industrial work in the coming season point to the undertaking of a vast amount of public works and institutional enterprises. Never were so many municipalities considering water purification, sewage disposal and flood protection. Never were so many highway projects ready to start; never more school, college, bank, amusement and religious structures under consideration.

And for all these, money is available as soon as price stabilization is advanced sufficiently to satisfy the minds of the various officials in charge of government and institutional funds. Once more get wages and materials down to a point where a mile of hard-surfaced road can be built in the Middle West for $35,000, with proportionate costs elsewhere, and such work will start.

Financing Road Construction —A Banker's Viewpoint

By Howard F. Beebe
Harris, Forbes & Company, New York City

The remarks following are an elaboration of a paper read by Mr. Beebe recently before the American Institute of Consulting Engineers. They are of special interest because they bring out phases of the road building problem which engineers and many public officials do not always carefully consider. Mr. Beebe, in addition to his activities in his own banking house, speaks from an experience gained as vice-president of the Investment Bankers Association of America, and as former chairman of municipal securities, and legislative committees of that association.—Editor.

Modern road building is being done on such a comprehensive scale that the matter of financing it on the part of the states and their political subdivisions has become one of increasing interest and importance. The magnitude of highway work throughout the country made necessary to meet present-day traffic problems involves an outlay so large as to represent in many cases a large percentage of the total outstanding indebtedness of counties and municipalities. Whereas, in years gone by, counties having an indebtedness in excess of from 3 to 5 per cent of the assessed valuation of property for taxation were regarded as extravagant, in many recent cases issues of road bonds have been authorized to an amount in excess of 10 per cent of the taxable values. It, therefore, follows that such a debt should be assumed only after the most careful consideration, the end in view being to keep expenditures for road purposes within reasonable limits of the ability of the taxpayers to meet the debt without undue burden, and to lay out the roads so as to serve the best interests of the taxpayers as a whole. To all intents and purposes these roads, with proper maintenance, should be permanent improvements. With the smaller debts which prevailed in the past, investment bankers could handle and recommend securities without careful thought to the expenditure of the funds, because, even though they were wasted in part or in whole, the payment of the debt would not work a severe hardship upon the taxpayers. With the increase in the ratio of indebtedness to taxable property values, the problem has radically changed, and conservative bankers are requiring that proper provision should be made to see that the money is carefully and wisely spent; that provision is made for maintenance of the improvements when installed; and that the principal of the debt incurred in connection with the improvement is retired in full within the useful life of the improvement.

The various committees of the Investment Bankers Association of America have been working consistently for some years past to provide more comprehensive and scientific laws governing the issuance and payment of debt for road purposes. While there is necessarily quite a wide difference of opinion as to just what the proper limits are, there is a substantial agreement that the percentage of indebtedness to

property values should be modest, inasmuch as the improvement was one which was not "self-sustaining," in that it returned no definite revenue from its use, such as waterworks, electric light plants, etc.

Time Bonds Should Run

The principal has also been very generally accepted that public debt should be retired within the life of the improvement installed with the proceeds. Although there is difference of opinion as to how long a period road bonds should be made to run, due to the wide variations in the character of construction of the roads and the volume and type of traffic passing over them, it is generally recognized that 30 years should be the outside limit for the most permanent kind of road, while bankers are more inclined to recommend a limit of 20 years, with the further recommendation that where it is not unduly burdensome, it is better practice to pay the debt off within 15 years.

Officials and bankers have also been working together so that proper provision may be made for funds sufficient to maintain roads properly, and great progress has been made in this direction. It is but natural that for the lack of a practical and comprehensive system of road maintenance and a well thought out scheme of finance, there should have been created a very unfavorable impression in the states where large expenditures have been made for road improvements which have been allowed to go to rack and ruin within a comparatively short period of years. Inasmuch as modern road building on a more or less extended scale was first undertaken in the northeastern part of the country, the feeling that such work has been accompanied by extravagance and waste is more prevalent in New England and in this part of the country than it is in other sections.

The fact that the history of road making and road financing is so unsatisfactory in our own state of New York has made it difficult for the average citizen, even though he be fairly well posted, to realize what a change has come about in the last few years. I think we may confidently look forward to the future for radically different results.

Problem Widely Discussed

The financial officials of some of the large insurance companies are giving the matter careful thought and are discussing it with investment bankers so that the weight of their opinion is being added in a helpful way in convincing officials and legislators throughout the country that changes are very necessary.

When speaking of the useful life of a road it is interesting to note that the U. S. Department of Agriculture, through its Bureau of Public Roads, has collected data of the most valuable kind, and I feel that I have been able, through the study of information received from that source, to speak understandingly with the officials in the various parts of the country. I likewise have been able to disabuse my own mind of certain prejudices which I had due to what I learned from a number of isolated cases, and which upon a further study and knowledge of the subject had proved to be anything but typical. For instance, I had been strongly inclined to criticize bonds running for more than 10 years when the proceeds were to be used for gravel and similar types of road construction, whereas I have become convinced that where a strict and adequate system of road maintenance is provided for such roads can be counted upon, where traffic and other conditions are favorable, to have a much longer life of usefulness.

With all due regard to the interests and comfort of those using the pleasure automobile, I think we would all agree that unless a road can be justified by sound business reasons it should not be built. That comprehensvie schemes of road building have been embarked upon in some counties, particularly in the southeast and southwest, without due regard to the tax burdens which they imposed, I think anyone will agree who has had occasion to be in touch with the agitation for road improvements. I believe it to be to the interests of each of us to use his influence in discouraging inadvisable projects of this kind. Possibly, references to what has been happening in one or two sections will illustrate what I mean better than any generalizations:

Arkansas Example

In Arkansas a roadway was projected through a very prosperous farming section. The engineering estimates of the cost exceeded $60,000 per mile, while the best bid received for the work under specifications exceeded $70,000 per mile. The contemplated expenditure was a very large one to be levied on the special benefit assessment plan against adjacent property. The character of the construction and the tax burden contemplated seemed to be unreasonable, and it appears that one of the most important arguments in favor of it was the ability, by the expenditure of a large amount of money, to get a liberal share of Arkansas' quota of Federal aid. The same argument was used largely in one of the important counties in Florida where authorization was made for road bonds to an amount approximating 14 per cent of the entire assessed valuation of properties within the county. In this case the desire of certain property holders to have the improvement so that it would benefit their holdings of land, to enable them to sell it at a handsome profit, was evidently the chief factor in enlisting their advocacy of the proposed authorization.

While not desiring in any way to be listed among those opposed to federal aid for state and county road building, I do wish to voice the belief that it was unfortunate that the matter has been handled in such a way as to stimulate the expenditure for roads at a time when costs of labor and material were at their peak. Authorizations and expenditures for road improvement work throughout many states have admittedly been made at the most inopportune times in order to secure as large an allotment as possible of the Federal-aid funds, and I sincerely hope that any additional contribution by the Federal government in aid of good roads will be handled in a much more practical way.

I think we will all agree that if the various individuals and organizations who have the good-roads problem at heart could work in close harmony the effect would be much more beneficial to everyone concerned than if their efforts are exerted singly. I also believe it would be most unfortunate if some of even the smaller political subdivisions of the states are allowed to embark on a program of road improvements which brings disaster upon themselves, for its effect will be to deter the cause of good roads in far-removed localities.

In solving financial problems incident to road building I have no hesitation in pledging the helpful co-operation of the investment bankers working either through their association or individually.

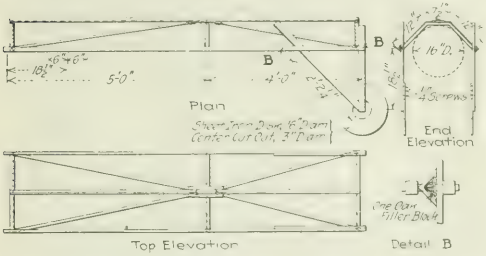
Velocity Tests in Hydraulic Dredge Pipe

Practicable Field Methods of Measurements Devised —Large Solids Lag Behind Main Stream— Kutter's *n* Determined

By Ivan E. Houk
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

VELOCITIES of flow in dredge pipes may readily be determined in the field by methods employed by the writer in tests conducted for the Miami Conservancy District. In these tests the velocity of clear water and also the velocity of single large stones, while pumping clear water, were measured. The methods employed are applicable in the field and give results which can be used to control dredge performance. The test data include velocities and friction slopes and values for Kutter's *n* and Chezy's *C*, which are useful.

The tests were made at different dates in the spring



APPARATUS FOR MEASURING VELOCITY OF DREDGE PIPE DISCHARGE

of 1919 in connection with the hydraulic fill operations at Taylorsville and Englewood. (*Engineering News-Record*, June 10, 1920, p. 1142.) Dredge pumps having 15-in. suction and discharge and direct-connected to induction motors with variable speed control, are in use at both places. At the time the tests were made two kinds of dredge pipe were in use in each line. One was a riveted pipe, made of comparatively soft steel, and the other, a hard steel, welded pipe, having a high carbon and manganese content. Both pipes had an internal diameter of 15 in., were made in lengths of about 16 ft. and were put together with stove-pipe joints. The pipe line conditions are described precisely in the foot notes to Tables I, II, and III.

Methods of Measurement—Rock velocities were obtained by simply noting the time required for the fragments to pass through the pipe, their passage being easily followed by the noise they made as they bounced along. The velocities of the water were measured by two methods, first, by noting the time required for potassium permanganate to pass through the pipe, and second, by noting the time required for salt to pass through. The former method needs no discussion since, having been frequently used, it is well known to engineers. Salt, however, has not been previously used in measuring velocities in pipes, so far as the writer is aware, although a very similar method has been used in measuring the flow of underground water.

The appearance of the salt at the discharge end of the pipe was determined by inserting in the jet two pieces of sheet metal, one zinc and the other copper, held about ¾ in. apart and connected to the terminals of a very sensitive voltmeter. The electrolytic action set up between the two poles as the salt water passed between caused a definite deflection of the voltmeter needle.

TABLE I. VELOCITY OF CLEAR WATER IN DREDGE PIPE AT ENGLEWOOD DAM, MAY 11, 1919

Motor Speed Step	Run No.	Velocity, Ft. per Sec.	Friction Slope, Ft. per 100 Ft.	Chezy's *C*	Kutter's *n*
	1	9.4	3.09	95.8	0.0124
	2	8.3	3.09	84.6	0.0136
	1	16.0	6.14	115.7	0.0108
	2	16.0	6.14	115.7	0.0108
	3	16.0	6.14	115.7	0.0108
	1	19.0	7.28	126.1	0.0106
	2	18.5	7.28	122.8	0.0101
	3	17.8	7.28	118.1	0.0106
	4	17.4	7.28	115.5	0.0107
	5	17.3	7.28	114.8	0.0108
	6	17.6	7.28	116.8	0.0106
Average value of Kutter's *n*					0.0110

NOTES—Static lift, 30 ft. Area of cross section of pipe, 1.23 sq.ft. Hydraulic radius of pipe, 0.312 ft. Length of delivery line, 780 ft., including one flap valve, two-15° bends, one long radius 90 bend, 60 ft. of standard wrought iron pipe with bolted screw flange joints, 20 lengths of riveted dredge pipe, and 26 lengths of welded dredge pipe. The alignment of the dredge pipe also contained some curvature made by a slight bending at the joints.

Both the salt and the potassium permanganate were inserted in the suction end of the line simultaneously, using about a pound of salt and about an ounce of potassium permanganate, wrapped together in a stout paper sack. The sack was attached to a stout cord and was lowered over the end of the suction pipe. When the sack entered the pipe the cord was jerked out of the observer's hand so that it was possible to determine accurately the time of entering the pipe. Of course, the paper sack was dashed to pieces by the high velocity in the pipe, or by the pump, if it held together until it reached the pump, so that the materials were well mixed with the water. The time of the arrival of the salt and permanganate at the discharge end of the pipe was noted by two observers, one watching the voltmeter and the other the color of the jet.

Different quantities of salt and permanganate and different methods of introducing them into the pipe had been tried before the date of the first experiments. Different materials for poles and different substances for the electrolyte had also been experimented with in the laboratory. The procedure described was found to be the most satisfactory.

The two methods were found to check very closely. While the permanganate method was entirely satisfactory for measuring the velocity of clear water, it could not be used when pumping material. The salt method was found to be satisfactory for either condition and was later used to some extent in determining the velocities and friction while pumping different materials.

A somewhat different method of measuring the velocity, similar to the one described by P. J. McAuliffe in *Engineering News-Record* of July 8, 1920, p. 62, was developed by Prof. S. M. Woodward, consulting engineer for the Miami Conservancy District, in August, 1918. It consisted, essentially, of an apparatus for measuring the curve of the center of gravity of the jet, as shown by the accompanying drawing. The two circular disks were a fixed distance below the center of the pipe and were centered over the jet by movig the apparatus along the pipe. One man moved the apparatus and noted the longitudinal distance of the center of the disks from the end of the pipe, while a second man, standing op-

posite the jet and on line with the two disks, watched the disks and directed the movement of the apparatus until it was in the proper position. This method was found to be entirely practicable and to be the best way

TABLE II. VELOCITY OF CLEAR WATER IN DREDGE PIPE AT TAYLORSVILLE DAM, MAY 25, 1919

Motor Speed Step	Run No.	Velocity, Ft. per Sec.	Friction Slope, Ft per 100	Chezy's C	Kutter's n
1	1	7 70	1 16	128 0	0 0099
	2	7 66	61 13	129 0	0 0099
2	1	8 74	52 15	121 8	0 0104
	2	8 94	21 7	127 7	0 0100
3	1	9 94	14	121 6	0 0104
	2	10 2	2 09	126 5	0 0101
4	1	11 1	2 44	127 1	0 0100
	2	10 9	2 44	125 0	0 0102
5	1	11 4	2 61	126 5	0 0101
6	1	12 6	3 05	128 6	0 0099
7	1	13 6	3 60	128 3	0 0099
	2	13 4	3 67	125 2	0 0101
8	1	14 8	4 10	130 5	0 0098
	2	14 5	4 10	128 0	0 0100
9	1	15 8	4 61	131 8	0 0097
	2	15 4	4 49	130 3	0 0098
Average value of Kutter's n					0 0100

NOTES—Static lift, 13.5 ft. Length of delivery line, 1,340 ft., including one flap valve, one-30° bend, two-45° bends, two long radius 90° bends, eight joint of welded dredge pipe, and 76 joints of rivetted dredge pipe.

in which to determine the almost instantaneous variations in velocity which occur while pumping heavy loads of material.

Results Obtained—The results of the measurements are given in tables I to IV, inclusive. Tables I, II and III give the data on the velocity of the water and Table IV

TABLE III. VELOCITY OF CLEAR WATER IN DREDGE PIPE AT TAYLORSVILLE DAM, JUNE 24, 1919

Motor Speed Step	Run No.	Velocity Ft. per Sec.	Friction Slope Ft. per 100 Ft.	Chezy's C	Kutter's n
1	1	7 01	1 34	108 1	0 0114
	2	6 92	1 34	107 2	0 0115
2	1	8 04	1 72	109 5	0 0113
	2	8 10	1 74	110 1	0 0112
3	1	8 80	2 06	109 7	0 0112
	2	8 88	2 04	101 4	0 0111
4	1	9 33	2 33	109 5	0 0113
	2	3 93	2 33	116 4	0 0108
5	1	9 58	2 66	106 2	0 0116
	2	9 88	2 65	108 2	0 0114
6	1	10 9	2 89	114 8	0 0109
	2	10 9	2 92	114 2	0 0109
7	1	11 8	3 29	115 5	0 0108
	2	11 3	3 36	110 4	0 0112
8	1	12 7	3 78	116 6	0 0107
	2	12 7	3 7	118 5	0 0106
9	1	13 4	4 50	112 5	0 0110
	2	13 7	4 50	115 0	0 0108
Average value of Kutter's n					0 0111

NOTES—Static lift, 16.0 ft. Length of delivery line, 2,075 ft., including one flap valve, one-30° bend, four-45° bends, two long radius 90° bends, one-Y, 74 lengths of rivetted dredge pipe, and 56 lengths of welded pipe.

gives the data on the velocity of the rocks. The values of the Chezy coefficient and of Kutter's n are included in tables I to II. The friction slope was determined from readings of a carefully calibrated pressure gage, procured especially for test purposes, proper correction of course being made for static lift. The values of n are seen to vary from 0.0100 to 0.0136, in Table I, averaging 0.0110; from 0.0097 to 0.0104 in Table II, averaging 0.0100, and from 0.0106 to 0.0115 in Table III, averaging 0.0111.

In Table IV the weight of the rock, its velocity in feet per second, and its velocity in per cent of the velocity of the water, are given for each run. The averages of the latter quantity are also given for the different runs made with the same motor speed. It will be noticed that at Englewood the rock velocities varied from 77 to 100 per cent of the water velocities, the averages for the three motor speeds being 82.0, 95.8 and 93.5, respectively. At Taylorsville, where the velocities of the water were considerably lower than at Englewood, the corresponding averages varied from 78 to 86. This would indicate that the ratio of the velocity of the rock to the velocity of the water increases as the velocity of the water increases, which seems reasonable. At Englewood measurements were made of the velocities of the rocks from the suction entrance to the top of the toe of the dam, a distance of about 150 ft. on a slope of about 20 ft. in 100 ft., as well as of the velocities through the entire length of pipe. The velocities up this comparatively steep grade were practically the same as those through the entire length.

TABLE IV. VELOCITIES OF ROCKS IN DREDGE PIPE AT ENGLEWOOD DAM

Motor Speed Step	Weight of Rock, Pounds	Vel. of Rock, Ft. per Sec.	Vel. of Rock in per Cent of Water Velocity
	Test of May 11, 1919		
1	4 5	7 2	77
	5 0	7 2*	87
	2 5	6 8	. .
Average	.	.	82
4	. 5	15 7	98
	5	15 8	99
	0	15 0	94
	0	14 8	92
Average	.	. .	95.8
5	2 0	14 3	75
	8 0	17 4	94
	6 0	17 0	95
	5 0	15 7	90
	3 5	17 4	100
	5 5	17 8	100
	6 0	16 1	92
	4 0	16 2	93
	6 0	16 3	93
	7 0	15 5	99
	5.5	17 1	98
Average	....	.. .	93 5
	Test of May 25, 1919		
2	8 0	7 16	82
3	4 0	7 77	78
4	5 5	9 55	87
	3 5	9 29	84
Average		.	85.5
5	5 0	9 89	83
	3 0	10 1	89
Average	.	. .	86
6	7 0	10.6	85
7	4 5	11 0	81
	4 0	11 8	89
Average		..	85
8	6 0	13 2	90
	13 5	11 9	82
Average			86

The tests described were made with the co-operation of the division engineers, O. N. Floyd and H. S. R. McCurdy, at the Taylorsville and Englewood dams, respectively, at times when the work would interfere least with the construction progress.

Mr. Arthur E. Morgan is chief engineer of the Miami Conservancy District, Mr. Charles H. Paul is the assistant chief engineer and Mr. C. H. Locher is the construction manager.

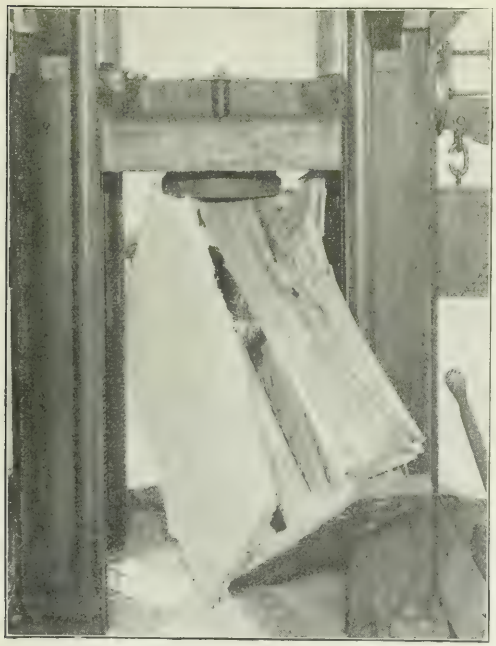
Engineers Demobilized in 1920

Approximately 60 Engineer organizations, a total of 94,000 men, were demobilized during the fiscal year ended June 30, 1920, according to the annual report of the Chief of Engineers.

Results of Tests for Distortion on Exterior Wall Sections

DISTORTION tests of frame-house-construction wall sections made by J. C. Peebles, testing engineer at the Armour Institute of Technology, indicate that a back-plastered Portland cement stucco on metal lath will produce the strongest wall. Four types of wall were tested. The specimens were 42 in. square, and all were framed with 2 x 4 studs held in an enclosing frame of the same material. For test, a section was set on its diagonal in a testing machine and loaded to failure. The results, as given in a report of Mr. Peebles to the Associated Metal Lath Manufacturers, are summarized below:

Back-Plastered Stucco on Metal Lath—No effect was noted until the load reached 10,000 lb., at which cracks appeared in both plaster and stucco near top and bottom corners of the sample. At a load of 14,200 lb. the sample was destroyed by the failure of the interior framework of 2 x 4-in. studs. The metal lath was torn from the studs, due to the failure of the latter, but the greater part of the plaster remained unbroken except for cracking and crushing around the edges.



BACK-PLASTERED SAMPLE TESTED TO DESTRUCTION MAINLY UNBROKEN

Siding and Sheathing—Plaster slightly crushed at top and bottom corners and a crack produced about 12 in. long near the top corner at a load of 5,460 lb. Sample destroyed by failure of interior framework at a load of 8,800 lb.

Stucco on Metal Lath Over Sheathing—Small cracks appeared in both plaster and stucco near top and bottom corners at a load of 9,100 lb. Sample destroyed by failure of interior framework at a load of 10,800 lb.

Stucco Over 6-In. Hollow Clay Tile—Tile, plaster and stucco crushed at top and bottom corners, and a crack about 15 in. long developed in the plaster just above the center of the sample at a load of 8,000 lb. Sample crushed so that tiles fell apart at a load of 9,600 lb.

The following is a description of the test specimens:

Back-Plastered Wall—Metal lath furred out by $\frac{3}{16}$-in. pencil rods on 2 x 4-in. wood studding with $1\frac{3}{16}$-in. Portland cement stucco on outside, back-plastered with $\frac{1}{16}$ in. of gypsum plaster. On the inside was $1\frac{1}{4}$ in. of gypsum plaster. Each wood stud was toe-nailed to the sill at the top and bottom with two 10d. nails.

Siding and Sheathing—Metal lath and gypsum plaster $1\frac{1}{4}$ in. thick on inside, and sheathing and drop siding $1\frac{3}{4}$ in. thick on outside. Each stud was toe-nailed to sill at top and bottom with two 10d. nails. Each piece of sheathing was nailed to each stud with two 10d. nails, and each piece of drop siding nailed with one 4d. nail.

Stucco on Metal Lath Over Sheathing.—Same as preceding except that in place of the drop siding $1\frac{1}{16}$ in. of Portland cement stucco on metal lath was used, furred out with $\frac{3}{16}$-in. pencil rods laid on ordinary building paper stretched over the siding.

Stucco Over 6-In. Hollow Clay Tile—Six-inch hollow clay tile covered on the outside with $\frac{7}{8}$ in. of Portland cement stucco and on the inside with $\frac{7}{8}$ in. of gypsum plaster.

Labor View of British Coal Settlement

TERMS of settlement of the controversy in the British coal-mining industry were commented upon in the *Engineering News-Record* of Nov. 25, page 1018. The industry, it was there noted, is put on a profit-sharing basis. A labor correspondent's view of the significance of the settlement appeared in a recent issue of the *Observer*, London. The following paragraphs from it will be of interest to American readers:

The profit-sharing introduced in the provisional arrangement is profit-sharing on a national basis. It assumes unified national control, the pooling of all the receipts of the industry, and the basing of advances on the results of the industry as a whole. It will be difficult for the National Wages Board, when it comes to base wages on profits after March 31, to go back on this principle, and to restore the district basis for wages which obtained before the war. Therefore the industry, unified by the Government for the purposes of the war, is likely to remain unified.

The miners secure the formal recognition of a principle for which they have been striving ever since the federation was formed, that wages shall be negotiated on a national basis. The main task of the new wages committee will be to consolidate the various cost of living bonuses, eliminate anomalies and systematize wages on a national basis. Before the war wages were on a district basis. If the seams of a field were poor, or the coal inaccessible wages were low. Today's wages could not be paid on half the coal fields of the country if they were not helped out by the richer fields. A national wage system will therefore rivet on the industry the unified control which the war instituted and national profit-sharing requires. But if the industry is to be unified public control will continue, for it is in the last degree improbable that any government will entrust a unified coal industry to a private trust.

Finally the district output committees which are to be set up are in effect an admission of the workers to a share in control. They go far beyond the Whitley report, since they allow the workers to interfere with the management of the pit, or at any rate to participate in the supervision of the management.

The miners, therefore, will secure by the settlement, if it goes through, not only the continued operation of the industry as a financial and industrial unity, but some participation in its control. It is just because their possible gains are so great that the task of the new National Wages Board will be highly controversial; and the public would do well to moderate their satisfaction until March 31 arrives, and the owners and men produce an agreed scheme for the permanent regulation of wages.

Engineering Legislation in Canada

An Outline of the History of the Movement for Statutory Control of Professional Practice, With a Synopsis of Acts Passed by the Provinces

By Fraser S. Keith
Secretary, The Engineering Institute of Canada, Montreal, P. Q.

The registration and licensing of engineers has been such a live issue in the United States during the past year that a recital of the progress of this same movement in Canada is particularly timely. "Engineering News-Record" feels fortunate in having induced Mr. Keith to tell its readers what the Dominion's engineers have accomplished in the control of professional practice. As Secretary of The Engineering Institute of Canada and in close touch with the legislative situation in all of the provinces, Mr. Keith is in a position to present the case comprehensively and authoritatively.—Editor.

LEGISLATION affecting the engineering profession in the Dominion of Canada, while an achievement of the past year, is in reality the result of many years of thought and effort on the part of the men interested in securing it. Attempts have been made from time to time to obtain the passing of acts limiting the practice of the profession. It was discovered in the initial attempts made, however, that the Dominion Government had no jurisdiction and that any legislation must be forthcoming, if at all, from the various provincial legislatures. An effort towards this end was made 25 years ago, which resulted in acts being passed in the province of Manitoba in 1896 and in the province of Quebec 20 years later. These, in the main, limited the practice of the profession to membership in the Canadian Society of Civil Engineers, the forerunner of the present national organization, The Engineering Institute of Canada. These acts, while continued on the statute books for many years, were found to be inoperative and in both cases were superseded during the past year.

In 1910 a petition was presented to the late premier, Sir Wilfrid Laurier, by the civil engineers in the employ of the Federal Government, enclosing copy of a proposed bill to organize and establish the engineering service of the Government of Canada. A change in government the following year resulted in the proposal being shelved. For a quarter of a century one of the stalwarts of the profession, C. E. W. Dodwell, of Halifax, at all times an ardent advocate of its interests, has endeavored to keep constantly before his fellow members his ideas of the benefit to be derived through legislation and no one man in Canada has been more responsible than he for what has recently taken place.

Activity Dates From 1918

The present activity might be truly said to have had its origin, development and fruition within the past 3 years, the year 1918 being one of discussion, 1919 of planning, and 1920 of achievement. During the past year acts regulating the practice of engineering have been passed in Quebec, Alberta, British Columbia, Manitoba, New Brunswick and Nova Scotia, while in Saskatchewan and Ontario it is planned to secure, if possible, similar legislation during the coming session from the respective legislative assemblies.

Although the subject had already been discussed at a number of the branches of the Institute, particularly in the west, it was introduced officially for the first time at a general meeting of the Institute at the second professional meeting at Saskatoon Aug. 10, 1918 by F. H. Peters, of Calgary, in a paper entitled "Legislation Concerning the Status of Engineers," in which the author expressed a firm belief that one of the surest methods of improving the status of the profession was by legislation, and this seemed to be in general the opinion of the western branches on the subject. At the same meeting a committee of the Saskatchewan branch presented a draft of a bill which it hoped to have approved by the council of the Institute for presentation to the local legislature. It proposed incorporating the membership of the Institute in Saskatchewan into the Engineering Institute of Saskatchewan. This draft was referred back to the branch with the suggestion that it be given further consideration. At that time there were members of the profession in Canada who considered that nothing would be gained from a policy advocating legislation, and others were openly opposed. The situation developed, however, until legislation has become an object of attainment in every province.

On Oct. 1, 1918, a special meeting of the council of The Engineering Institute of Canada was called to discuss legislation and consider the proposed act of the Saskatchewan branch. It was resolved at this meeting that inasmuch as other branches were considering the matter their ideas should be received before passing judgment on any single proposal. The same month the Vancouver branch at a general meeting passed resolutions endorsing legislation on certain broad lines, one of which was that any member of the profession qualified to practice in any province should be free to practice in any other province. It now became evident from the general interest in the subject, both east and west, that something should be done, and soon. The principle of securing legislation for engineers was endorsed by the council of the Institute and co-operation was promised the engineers of the various provinces in their efforts, it being laid down as fundamental that no legislation should be sought that did not include all qualified engineers, whether members of the Institute or otherwise, that legislation should be as uniform as possible and that it should include the right of an engineer registered in any province to practice in any other.

The following annual meeting of the Institute, held at Ottawa in February, 1919, saw such interest aroused in the subject that definite action was taken in a resolution passed calling for the formation of a special committee composed of one delegate appointed by each branch to meet at Montreal before April 15 to draw up such sample legislation as might be deemed necessary and advisable in order that uniform legislation might be asked for in the different provinces. The resolution further provided that the proposed legislation be sub-

mitted to the council of the Institute before May 1, to be followed by a letter ballot to the corporate members of the Institute before June 1 and, following a favorable vote, that the Council should co-operate with the branches to have such legislation enacted.

Following this resolution these representatives were appointed: A. E. Foreman, Victoria; A. G. Dalzell, Vancouver; F. H. Peters, Calgary; R. J. Gibb, Edmonton; H. R. Mackenzie, Regina; E. E. Brydone-Jack, Winnipeg; Newton L. Somers, Sault Ste. Marie; R. F. Uniacke, Ottawa; Willis Chipman, Toronto; Arthur Surveyer, Montreal; E. R. Gray, Hamilton; A. R. Decary, Quebec; C. C. Kirby, St. John; C. E. W. Dodwell, Halifax. This committee met at Montreal April 5, continuing its sessions until April 10, with C. E. W. Dodwell chairman and Arthur Surveyer secretary. The result of their deliberations was embodied in a proposed act in framing which they were guided by the following definite ideas:

(a) Before any legislative body can be reasonably expected to accept or to give serious consideration to any proposed bill it must be made apparent, not only to that legislative body but to the public, that the bill, as an enacted law, would redound, directly or indirectly, to the benefit of the community at large.

(b) It is eminently desirable that any such bill as may finally be decided upon shall be uniform for all provinces so far as reasonably possible.

(c) It is of the first importance that any such bill shall meet the views of and be acceptable to every individual engineer and to every engineering and technical organization in the country.

(d) It is indispensable, especially with a view to the future, that any such bill shall be as clear as language can make it and be also practicable and workable.

Main Features of Proposed Act

This act defines a professional engineer as any person registered under the provisions of the act. Its main features are summarized below:

The practice of a professional engineer within the meaning of this act embraces advising on, making measurements for, laying out and the design and supervision of the construction, enlargement, alteration, improvements or repairs of public or private utilities, railways, bridges, tunnels, highways, roads, canals, habors, harbor works, river improvements, lighthouses, wet docks, dredges, cranes, floating docks and other similar works, steam engines, turbines, pumps, internal combustion engines and other similar mechanical structures, airships and aëroplanes, electrical machinery and apparatus, chemical and metallurgical machinery and works for the development, transmission or application of power, mining operations and apparatus for carrying out such operations, municipal works, irrigation works, water-works, water purification plants, sewerage works, sewage disposal works, drainage works, incinerators, hydraulic works and all other engineering works. The execution as a contractor of work designed by a professional engineer, or the supervision of the construction of work as a foreman or superintendent or as an inspector, or as a roadmaster, track master, bridge or building master, or superintendent of maintenance shall not be deemed to be the practice of a professional engineer within the meaning of this act.

All persons registered as professional engineers under the provisions of the act shall constitute the Association of Professional Engineers of the Province of ..... and shall be a body politic and corporate with perpetual succession and common seal.

The association shall have power to acquire and hold real estate not producing at any time an annual income in excess of ten thousand dollars and alienate, mortgage, lease, or otherwise charge or dispose of such real estate or any part thereof as occasion may require. All fees, fines and penalties receivable and recoverable under this act shall belong to the association.

The association may pass by-laws for the government, discipline and honor of the members, the management of its property, the maintenance of the association by levying fees not in excess of five dollars per annum, the examination and admission of candidates to the study and practice of the profession and all other purposes reasonably necessary for the management of the association.

Who May Practice

(a) Only such persons who are members of the association hereby incorporated and registered as such under the provisions of this act, or who have received a license from the council of the association as hereafter provided shall be entitled within the province of ..... to take and use the title "professional engineer" or any abbreviation thereof, or to practice as a "professional engineer."

(b) Any person residing in the province of ..... at the date of the passing of this act, who is at that date and has been for five years previously practicing as a professional engineer shall be entitled to be duly registered as a member of the association without examination, provided that such person shall produce to the council within one year of the passing of this act satisfactory credentials of having practiced.

(c) Any person who may come to reside in the province of ..... and who at that time is a duly registered member of the Association of Engineers similarly constituted of any other province of the Dominion of Canada may become a duly registered member of the association without payment of fee for that year providing he shall produce to the council a certificate of membership in good standing in such province, and an application for transfer of registry endorsed by the registrar of the province in which he lately resided.

(d) Any person not otherwise qualified as hereinbefore mentioned residing in the province of ..... and who may desire to become a registered member of the association shall make application to the council, and shall submit to an examination, or shall submit credentials in lieu of examination, whichever the council may decide, and shall be admitted to registry as a member of the association on payment of prescribed fees after the council shall have certified in writing that such examination or credentials have been found satisfactory to it.

(e) Any person not residing in the province of ..... who is a registered member of an association of engineers similarly constituted of any other province of the Dominion of Canada shall obtain from the registrar a license to practice as a professional engineer in the province of ..... upon production of evidence of his registry in such other province and upon payment of a fee of one dollar. In the event of such person being unable by reason of emergency or neglect on the part of the registrar or for any other good and sufficient reason to obtain such license within three months of his making application thereof he shall be entitled to practice as a professional engineer in the province for such period of three months without holding such license.

(f) Any person who is not a resident of Canada but who is a member of any engineering or technical organization or society of standing recognized by the council may obtain a license to act in an advisory or consultative capacity to a registered member of the association.

(g) Any person who is employed as a professional engineer by a public service corporation, a private corporation, public utilities or government department whose business is normally carried on in two or more of the provinces of Canada, and who is by reason of his employment required to practice as a professional engineer in other provinces than that of his residence, may so practice in the province of ..... without holding a non-resident license or payment of fee, providing such person can on demand of the council produce credentials satisfactory to the council showing that he is a registered member of the Association of Engineers similarly constituted by some other province of Canada. It shall be the duty of such person to produce such credentials whenever so required by the council.

(h) Any professional engineer who is a resident of some other province of Canada in which there is no association of engineers similarly constituted may obtain a license to practice, subject to the discretion of the council.

(i) Assistants working under the direct supervision of a professional engineer and not taking responsibility for the work other than to their direct superiors shall not be deemed to be practicing as professional engineers when so engaged.

(j) The provisions of this act shall not apply against any person employed in the actual service in his Majesty's navel, military or aërial service.

(k) In the case of engineers who are practicing in the province of ....., and who have been accepted for overseas service in the present war in the forces of Great

Britain, or any of her allies, they shall on their return to Canada be entitled to all the rights and privileges conferred under subsection "b."

Administration—The administration is provided for by a council of management consisting of a president, vice-president and an optional number of councillors, the president and vice-president to hold office for one year and the councillors for two years.

Suspension—Provision is made for censuring, suspending or expelling from the association by the council any engineed guilty of unprofessional conduct, the method of doing so being embodied in the act.

Penalties—A penalty of a fine of not less than one hundred dollars and not more than two hundred dollars or imprisonment for not more than three months, or a fine of not less than two hundred nor more than five hundred dollars, or imprisonment for not more than six months for any subsequent offence is provided against any person who unlawfully practices as a professional engineer.

Examination—The council of the association has the power to nominate a board of examiners subject to such approval as the government of the province may require. A candidate failing on examination may after an interval of not less than one year be examined again.

Registration Without Examination—Application for registration or license shall be considered by council from any person who submits proof of qualification. The establishment of a central examining board is provided, to which the council may delegate powers to hold examination.

Age—The age limit for registration is 23 years. Any candidate must have been engaged for 8 years in some branch of engineering except in the case of a graduate from a recognized engineering college where the minimum requirement is 6 years, which may include his term of instruction.

Restrictions of Act—No provisions of the act restricting the practice of the profession or imposing any penalties shall take effect until one year after the passing of the act. The activities of the association are restricted to the functions necessary to the administration of the act.

The Quebec Act

The Quebec act differs from all others in Canada in that it is not a new act, having been on the statute books of the province since 1898 and is in the main a transfer of the operations of the act from the Canadian Society of Civil Engineers to the Corporation of Professional Engineers of Quebec, which consists of the corporate members of The Engineering Institute of Canada resident in the province of Quebec at the time of the passing of the act, which was Feb. 14, 1920. This act is more strict in its application than any of the others, being the former Quebec act under new administration. It provides for ipso facto membership in the corporation of all corporate members of the Institute in Quebec.

Inasmuch as it is planned to modify this act at the coming session of the legislature to conform to other provincial acts it need not be further discussed.

The Manitoba Act

The act incorporating the Association of Professional Engineers of Manitoba was passed March 27, 1920. Manitoba being the first province to adopt legislation based on what is known as the "Proposed Act" and which for the sake of brevity will be referred to as the "model." The association is governed by a president, vice-president and five councillors. It provides for a limit of $10,000 income but does not specifically limit the activities of the association to the functions necessary to the administration of the act. The age limit is 21. Candidates for admission shall serve under articles with a registered professional engineer 4 years unless a graduate of a recognized engineering college, in which case the term of service may include the term of instruction. Examinations are as in the model, subject to the approval of the Lieutenant-Governor-in-Council, there being provision for a central examining board. Reciprocity is included and registration of non-residents is as in model, except that newly resident non-members of other associations shall pay a fee. Exemptions are as in the proposed draft, the fee limited to $5 per annum. Penalties $200 or two months' imprisonment. Appeal for non-registration or suspension is heard before the King's Bench. All engineering work having a value of $1,000 or over must be done by professional engineers.

The Alberta Act

The bill incorporating the Association of Professional Engineers of the Province of Alberta became law April 10, 1920. The administration is as in the model except that councillors equally represent the various branches of engineering. A two-thirds majority is required to amend by-laws subject to the approval of the Lieutenant-Governor-in-Council, which is the provincial government. The age limit is 25 and the requirements are the same, graduates of recognized universities being required to have served two years at practical work. Examinations are provided for and a reciprocity clause is included which allows engineers from other provinces in Canada where similar laws are in force to register. The registration of others from outside the province is left to the discretion of the council. The exemptions as to those who may practice without examination are in part as in the model but no provision is made for employees of registered engineers, members of military, naval or air service or war veterans. The fee is fixed by the Council. A seal is compulsory. The provision for suspension is also similar. Penalties are $50 to $100 and $100 to $200, while suspended $100, and for misrepresentation $100 with costs. Other provisions are as in the model.

The British Columbia and New Brunswick Acts

In British Columbia the legislative assembly witnessed a stormy scene during the discussion of the bill to incorporate the Association of Professional Engineers of British Columbia, which was sponsored by Fred Anderson, an engineer and a prominent member of the government side of the assembly. The act was passed, however, on April 16, 1920. The administration is represented by a president, a vice-president, the immediate past president and nine councillors, four of whom are elected by ballot, four by the Lieutenant-Governor-in-Council, or in other words, the Government of the province, one of them representing the University of British Columbia, all being elected annually. The powers of the association are the same as in the model. There is no limit to activities. The procedure regarding by-laws is similar to that of Alberta. The age limit is 23, six years of engineering being required which may include a four year engineering course. A non-graduate must serve six years under a registered engineer. The examination board is appointed annually. Reciprocity is the same as in Alberta, and the registration of other non-residents is left to the Council. Provision is made for temporary licenses. The exemptions are as in the model. The fees are payable in advance and are fixed by the Council. A seal is compulsory. The penalties are, for misrepresentation, $50 to $300, and for false entries, $20 to $500. This act provides a money limit of $5,000 under which value a non-professional engineer may practise.

In New Brunswick the act incorporating the Association of Professional Engineers was passed April 24, 1920, and provides for management by a president, vice-president and elected councillors not to exceed 15 elected for three years. There is no limit to the Association's income. The by-laws are subject to change by two-thirds majority. The age limit is 23 years, six years' practice being required, except in the case of a graduate from a recognized engineering college, graduates of a recognized engineering college being exempt. Reciprocity is granted as in the model and exemptions are practically as proposed. The fees are established by the Council. Penalties are the same as those in the model. No minimum value is specified restricting professional engineers' operations.

The Nova Scotia Act

The last engineering act passed this year was that incorporating the Association of Professional Engineers of Nova Scotia, which is managed by a president, vice-president and 15 councillors, 7 of whom shall be be appointed by the Lieutenant-Governor-in-Council, the remainder to be elected by the Association. The president and the vice-president are elected annually, and the councillors for three years, the president holding office as councillor for the year succeeding his office. The annual income of the Association is limited to $10.000. By-laws may be changed by two-thirds' majority, subject to the approval of the Lieutenant-Governor-in-Council. Those who may practice with exemption from examination are substantially as in the model, three years practicing professional engineering at the time of passing the act, entitling to registration. Mechanical superintendents of industrial manufacturing or mining plants, having an installation of one hundred or more horsepower, are to be professional engineers. The annual fee is limited to $5. As in the case of every province except New Brunswick, the seal is compulsory. Penalties provided are $100 to $200 and costs or not more than three months imprisonment for the first offense, and not less than $200 and not more than $500, or imprisonment for not more than six months for the second offense. The striking feature of this act is that the practice of professional engineering, as described in the definition, shall apply only when the work to be done involves an expenditure of at least $25,000.

Saskatchewan

Application was made to the legislature in Saskatchewan for an act to regulate the practice of engineering, prior to efforts in the other provinces but was referred back to its sponsors. It is proposed to renew the efforts at the next session of the legislature.

Ontario

Ontario, the most important province in Canada as far as the total number of engineers practicing is concerned, has given the subject greater deliberation than any other province.

Owing to the fact that there are a number of technical organizations—acting upon a suggestion made by the Ontario Provincial division of the Institute—an advisory conference committee was established, thoroughly representative of these bodies, for the purpose of drafting an act which would be satisfactory to all concerned. This committee has just completed its labors and is at the point of submitting its draft to the various organizations interested. Provided that the proposed draft, which is designed on plans similar to the acts in existance in other provinces, meets with general approval, it is expected that an effort will be made during the coming session to have a bill presented and an act passed.

Summary

It will be seen from the foregoing that engineering legislation in Canada has been promoted with a definite plan which, owing to the similarity of the various acts, may some day permit the enactment of federal legislation providing for a central examining board, provision for which has already been made in all but one of the acts passed to date. This would place the engineering profession in the same position as that now occupied by the medical profession in Canada.

Calibration of Circular Orifices Under High Heads

By F. W. Greve
Assistant Professor of Hydraulics, Perdue University, Lafayette, Ind.

The most commonly quoted tables of coefficients of discharge for vertical circular orifices are those published by Hamilton Smith, Jr., in 1886. These tables show a constant value of the coefficient equal to 0.592 for heads above 100 ft. for all orifices from 0.5 to 12 in. in diameter. It is interesting to note that there is little or no experimental confirmation of the statement that the coefficient is independent of the size of the opening for high heads. It was to throw further light on this subject that a thorough investigation was conducted in the hydraulic laboratory of Purdue University on 1- and 1.5-in. vertical circular orifices with heads ranging up to 231 feet.

The orifices were cut to exact size in 8-in. blank flanges, the edge of the orifice in contact with the water being ¾ in. in thickness. The opening tapered outward so as to give a width at the downstream face of the flange equal to one and a half times the true orifice diameter. The flanges were bolted to a horizontal piece of 8-in. pipe, 4 ft. in length, that served as a channel of approach to which water was brought through about 100 ft. of 6-in. pipe from a 6-in., 1,800 g.p.m. centrifugal pump. The pressure on the center of the orifice was measured by a Bourdon gage, located 20 in. back from the orifice. The discharge was conveyed through a 6-in. pipe to a weighing tank of 20 tons capacity. Both the gage and the tank were calibrated previous to the experiments. The time was noted on a stop watch. A small cock on top of the channel of approach permitted the escape of any air entrained in the water.

The tests covered a range of pressures from 20 to 100 lb. per square inch. At least five tests of approximately three minutes each were made for any one condition of constant head. The cock on the 8-in. pipe remained open until all the entrained air had escaped before any readings were recorded. The presence of such air was easily detected by loud reports made as the air suddenly expanded after leaving the orifice. The flow was controlled at the pump. Reliable experiments conducted by other investigators during the progress of the tests showed the water in use in the laboratory to have a weight of 62.33 lb. per cubic foot. The tem-

perature of the water varied between 57 and 61 deg. F. The total head was assumed equal to the pressure head, thus omitting the effect of the velocity of approach. This assumption is warranted because the area of the channel of approach is 64 times that of the 1-in. orifice. The maximum possible error in neglecting the velocity of approach was 0.024 per cent for the smaller opening and 0.124 per cent for the larger.

VARIATION OF THE COEFFICIENT OF DISCHARGE WITH HEAD FOR 1- AND 1.5-IN ORIFICES

1-Inch Orifice			1-Inch Orifice			1.5-Inch Orifice		
No.	Correct Head, Ft.	Coefficient	No	Correct Head, Ft.	Coefficient	No	Correct Head, Ft.	Coefficient
1	47.48	0.600	9	139.88	0.597	1	47.48	0.599
2	59.03	0.596	10	157.43	0.599	2	70.58	0.599
3	70.58	0.599	11	62.98	0.600	3	93.68	0.602
4	70.58	0.598	12	174.53	0.601	4	116.78	0.595
5	93.68	0.594	13	186.08	0.600	5	139.88	0.592
6	105.23	0.595	14	197.63	0.598	6	162.98	0.598
7	116.78	0.597	15	209.18	0.599	7	168.08	0.598
8	128.33	0.599	16	220.73	0.600	8	209.18	0.598
			17	232.28	0.597	9	232.28	0.599

The results are summarized in the table. It will be noticed that there is some variation from the third decimal place of the coefficient, but in no case does this variation from the mean value exceed one per cent. Another significant fact is that the variation is irregular, leading one to believe that the variations are probably due to slight observational errors rather than to any change in the conditions of flow. There seems to be no reason for believing that the true coefficient would vary in any other than some regular manner. The mean constant value of the coefficient of discharge is 0.598 for both sizes of orifices. While the range in size was not sufficient to warrant any broad statement, it may, however, in the light of these tests, be stated that with a weight of 62.33 lb. per cubic foot and with a temperature range of 57 to 61 deg. F. the coefficient has a constant value of 0.598 for all vertical circular orifices from 1 to 1.5 in. in diameter when operating under heads from 47 to 231 ft. It is recommended that the coefficient of discharge be taken as 0.600.

British Coal Production Increases

During the week ended Nov. 20, the British weekly coal output exceeded 5,000,000 tons for the first time since October, 1918, the output being 5,211,000 tons, according to returns received by the Foreign Information Service of the Bankers Trust Co. The higher tonnage is taken as an indication that British miners have undertaken to justify wage increases tentatively granted in adjustment of the recent coal strike but conditional upon greater production. The effect of the strike on output is indicated by the following weekly figures: Oct. 16, 4,611,600 tons; Oct. 23, 12,500 tons; Oct. 30, 4,100 tons; Nov. 6, 756,300 tons: Nov. 13, 4,776,000 tons. The output of the week ended Nov. 20 was higher than the average weekly tonnage of coal mined in any year since 1913, when Great Britain's production reached the high weekly rate of 5,527,000 tons.

A striking gain in per capita production is indicated. For the first 9 months of 1920 the weekly output per person employed averaged 3.5 tons. This was raised to 4.31 tons in the week of Nov. 20. The average in 1913 was 4.9 tons. There are now almost 100,000 more persons engaged in British coal mining than in 1913. On Sept. 30 the total was 1,207,800 persons.

Monolithic Brick Road Built of Fine Aggregate

Difficulties With Fine Pit-Run Gravel Overcome by Altering Proportions and Omitting Dry-Mortar Bed

By W. M. Watson
State Highway Engineer, Topeka, Kansas

By constantly changing the proportions and omitting the dry-mortar bed, monolithic brick pavement is being successfully constructed in Reno County, Kan., using a combined aggregate. This road, designated as Federal-aid project No. 15, is located northeast from Hutchinson, and is being constructed on practically a level grade. The soil is a very sandy loam which will not compact readily under a roller. Construction started in July, 1919, and to the close of the 1919 season 2.4 miles had been completed. At the close of the 1920 season 10.5 miles had been completed. This project is divided into three sections, the contract price of each being shown in Table I. The design is shown by Fig. 1, vertical fibre brick being used.

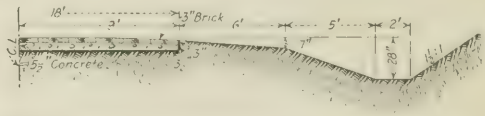


FIG. 1. HALF SECTION OF MONOLITHIC BRICK ROAD, RENO COUNTY, KAN.

TABLE I—CONTRACT PRICES FOR MONOLITHIC BRICK PAVEMENT, KANSAS

Items	Section A	Section B	Section C
Contract awarded, date	Oct. 10, 1919	May 12, 1919	May 12, 1919
Mileage	7.093	5.481	4.997
Average haul (miles)	[illegible]	1½	1½
Excavation in earth	$0.80	$0.60	$0.70
Borrow in earth	0.60	0.50	0.60
Monolithic brick	3.85	1.40	1.30
Class A concrete	35.00	15.00	10.00
Reinforcing steel	0.07	0.06	0.10
Lineal feet guard fence	1.10		
Small trees		2.00	1.00
Large trees	....	10.00	10.00
Rods of hedge		4.00	2.00
Section markers		45.00	45.00
Stumps		10.00	5.00
Raising bridge floor	400.00		
Cost slab per mile	$40,873	$32,110	$33,095
Cost of job per mile	47,998	35,658	37,335

Materials furnished by county. Cost of following unit prices not included in this price: Concrete, bulk plant, $0.98 per square yard; freight rate, 9½c. per 100 lb.; Cement f.o.b. plant, $2.50 per bbl.; gross freight, 12½c. per 100 lb. gravel or $0.25 per [illegible] at pit.

CONCRETE BATCH MACHINE TAMPED DIRECTLY AHEAD OF BRICKLAYER

No stone is locally available and on account of the abundance of local gravel and the difficulty of transporting material by rail under the present chaotic conditions of our railroads, it was decided to utilize this local material, making the mixture such as would give a strength equivalent to a 1:3:5 mix. The crushing strength of a concrete of a 1:3:5 mixture as fixed by the joint committee at 1,500 lb. per square inch was accepted and by numerous tests of the aggregate the curves of equivalent strength were derived as shown by Fig. 3. The bulk of the coarse aggregate passes a 1-in screen. As pumped from the river-bed pits the gravel is screened to remove a proportion of the fine aggregate before loading, but the disposal of the surplus fine material is considered to be in excess of the cost of extra cement required.

At the beginning of the work the base was poured at a stiff consistency and struck off by the Parrish type of multiple steel template, using a $\frac{3}{16}$-in. dry sand-cement bed. The brick were laid directly on the sand-cement bed before the base attained its initial set. The gravel aggregate, containing very little coarse material, produced a concrete with which it was difficult to obtain satisfactory results. When mixed sufficiently dry to permit the other operations it contained too little water properly to saturate the dry cushion, with a consequent separation between the base and brick surface. When made with enough water to give the

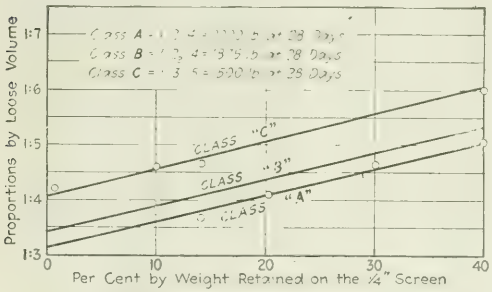


FIG. 3. GRAPH OF EQUIVALENT PROPORTIONS FOR RENO COUNTY GRAVEL

dry cushion a proper amount of water, due to the absence of coarse material, the concrete had little stability, rendering the operations of rolling and grouting exceedingly difficult and making it almost impossible to secure a smooth surface. This trouble has been overcome by the use of a mechanical tamping machine operated directly on the base, and by eliminating the sand-cement cushion. A marked improvement is noted by reason of this change, not only in the surface of the pavement but in the adhesion as well. For example, Fig. 4 shows space where five rows of brick have been removed after the base was prepared with a tamping machine and the brick rolled. Not only does mortar tamped to the surface firmly adhere to the brick but from $\frac{1}{4}$ to $\frac{1}{2}$ in. of mortar squeezes up between the bricks giving greater assured resistance to the sliding of the brick along the base, due to difference in coefficient of expansion. A much denser concrete in the base is also assured. Rolling is done by means of a hand roller and the joints are grouted with a 1 to 1 mortar in three applications.

Successful use of the combined aggregate depends

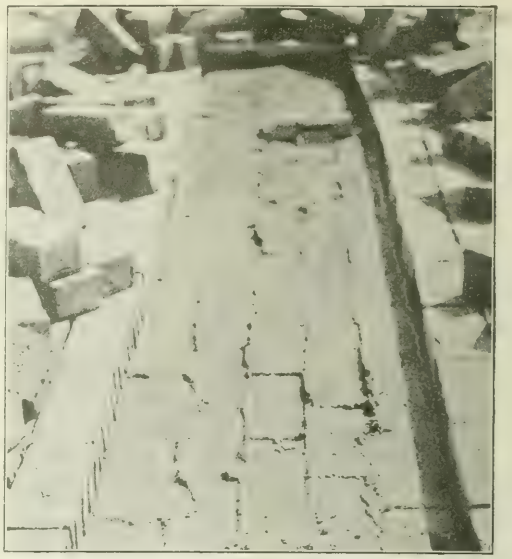


FIG. 4. APPEARANCE OF TAMPED BASE WHEN BRICKS ARE REMOVED AFTER ROLLING

upon very close inspection. An inspector is kept both in front and behind the mixer. One is employed to check the proportioning which is varied continually to insure the standard strength concrete. As a check on the strength of concrete obtained, cylinders of the actual concrete used in the base are taken each day and as often as the mix is changed. These cylinders are cured alongside the pavement under as nearly the actual curing conditions of the pavement as is possible. These cylinders are shipped to the laboratory at frequent intervals and tested.

Studying Power Possibilities on the Tennessee

An engineering and economic survey of the Tennessee River, its tributaries and its basin is being made by the Corps of Engineers, U. S. Army. The survey includes a study of the resources of the basin with the idea of determining the influence of water transportation on their development and the amount of tonnage that they might contribute for transportation by water. The work is being done under a Federal appropriation with co-operative work by the Tennessee River Improvement Association. The mountain areas which fringe the Tennessee Basin are being mapped aërially. One of the important features of the report will be the effect on the main stream by power developments on a non-navigable tributary. This question is a live one because of the many proposed water-power developments. The Parr Shoals dam on the non-navigable Broad River, near Columbia, S. C., so affected the flow of water in the Congaree River as to make navigation impracticable. The Chattahoochee River is navigable to Columbus, Ga. When a large power plant above Columbus finds it necessary to draw out the maximum quantity of water that it uses boats frequently must be tied up until the needs of the power plant have been supplied.

Observations on a Pacific Coast Trip

By Frank C. Wight
Associate Editor, *Engineering News-Record*

San Francisco, the Western Metropolis

IN THAT perfect short story "A Municipal Report" O. Henry quotes—to disprove later—a remark of Frank Norris: "There are just three big cities in the United States that are 'story cities'—New York, of course, New Orleans, and, best of the lot, San Francisco." That is as may be. It is no part of the duty or ability of an engineering editor to evaluate the fictional possibilities of the cities, but the comment sticks; San Francisco *is* individual. It is supposed to be the West incarnate; perhaps it is, but more than that it is itself. Some few cities in the United States have grown up; the rest still suffer growing pains, they have not found themselves. They worship at the shrine of the "booster" and their prophet is the Board of Trade secretary. San Francisco is not like that. It is serene and confident; it has arrived.

It is strange enough for an Easterner to find this spirit in San Francisco, for all his training and reading have led him to think differently of the Pacific metropolis. He expects to be set upon on his arrival by groups of enthusiastic native sons who will point out to him the unequalled advantages of climate, of resources and of a man-to-man friendliness peculiar to the Coast and to be compelled to listen to disaparaging comments on his own choice of residence.

It may be invidious to remark that there are cities on the Coast where his expectations are fully realized, but not in San Francisco. It is not that the advantages are not there; certainly the pride in his city and the conviction of its complete superiority are as strong in the San Franciscan as in any other but he has reached that desirable height where he is willing for his city to speak for itself. He has become a metropolitan.

Engineers Have Wide Field

It should be understood that these comments are based on an association almost entirely with engineers. Possibly ten days spent among the merchants or real-estate men would result in a change of mind. Their activities are in and of the city itself and self advertising is of the essence of their business. To the engineer, on the contrary, the city is but the center from which radiates out over all the Western country the many activities which are the sources of growth. And that is why San Francisco is different from other Western cities. It is more truly metropolitan; it is the "mother city" of the West. Now, to be metropolitan is considered in some quarters to be more a vice than a virtue. It has become the fashion to decry the big cities as the source of all evil and to belittle those who find their work there. But so long as a country or a part of a country continues to grow there will gravitate to the reservoir of the big city the money and brain power which flows out to nourish the smaller centers which do the actual producing. The function of the reservoir is quite as important as that of the producing field or factory or mine.

This, then, is what is most impressive regarding engineering in San Francisco. The engineers there are part and parcel of the West. In their own city they have much to do; the wonderful finished appearance of that down-town section which only fourteen years ago was laid waste is mute testimony of their work; the beautiful boulevards, the time-saving highway tunnels and the well-developed harbor show their handiwork. But it is in the highways and water powers and irrigation projects from the Rockies to the Coast that the engineers of San Francisco are most in evidence. There are more men there with practices reaching far out into the back country than anywhere else save possibly Chicago and New York.

In spite of its individuality San Francisco savors much of New York. It is partly this same metropolitan atmosphere but it is more its geographical location, for it reproduces remarkably the conditions that helped make Manhattan Island the business focus of the country. There is the same comparatively narrow peninsula—wider of course at San Francisco and now an island at New York—the same spacious harbor immediately on the open sea, the same, though smaller, river reaching up into a rich hinterland, and the same transcontinental terminus across the bay in one case, the river in the other. Both cities are wonderfully accessible from the ocean, both are comparatively inaccessible from the mainland. Because of the former they have both become great ports; unless the latter defect is cured they both must suffer.

Harbor Problem Like New York's

In New York today the isolation from the West is a source of constant worry and its remedy probably the most vital engineering problem in the East. San Francisco, on the other hand, has not yet begun to consider seriously its eastern approach. It is true that the matter of a trans-bay bridge is alive and the many proposals for different types of structures at various crossings are having more respectful hearing than ever before. The distances are so great—it is nearly four miles across the bay from the San Francisco ferry house to the Oakland mole—that the problem is unprecedented in size, but sooner or later some kind of crossing will have to be provided, not only for the large passenger traffic but also for freight. As regards the latter, the situation quite parallels that of New York. Except for the excuse of existing conditions, it is ridiculous that ocean steamers should dock on the San Francisco peninsula when there is available such admirable ground for terminals on the east side of the bay, directly connected to the transcontinental railways. Efforts have been made, are being made now in fact, to develop large terminals on this mainland, but San Francisco, like New York, is powerful in its own bailiwick, and precedent and financial control are hard to beat.

The time is coming, though, when this east shore of San Francisco Bay will be developed as a great ocean port. The obvious economics of the situation cannot forever be disregarded. And probably when that time comes, there will come with it the establishment of a great joint port, such as will surely come in New York. It may be that there will be an extension of the metropolitan district in San Francisco to embrace all that now comes within its real area, for its citizens feel keenly the passing ahead in population of Los Angeles, which takes in now practically its entire county. But even if this modern method of increasing population is not followed, the co-ordination of the

port may be brought about much more simply than at New York because the transbay district is in the same state and may be brought, by mere legislative enactment, under the jurisdiction of the State Harbor Commission, which already controls the port of San Francisco. There need be done of the interstate jealously which bids fair to retard New York's development.

The harbor of San Francisco is busier than any other on the Pacific. In multiplicity of wharves it is the largest and also in established steamship lines. While the business is not up to war years, the trade with South America and Hawaii is good and the passenger service, which is very large here, is crowded. The types of piers is between Eastern and Northwestern practice; that is, they still depend a good deal on ship's winch and stevedore loading but do have railway connections and fairly wide piers and sheds. The tendency of design, however, is toward a still wider pier and shed and a maximum of machine handling. Everyone who has to do with marine structures is, of course, tremendously concerned with the current difficulties with the teredo and his smaller neighbors, which have been reported in these columns, but the solution for the trouble has not yet been reached. On the San Francisco side, where sewage polution is high, the limnoria is particularly active, even destroying in a comparatively short time certain kinds of treated piles. Concrete, taking it by and large, is behaving well in the harbor. There are evidences of deterioration but there is much more that is solid and the solution seems to be in better concrete with thick covering of the steel.

Hetch Hetchy Work Typically Western

The Hetch Hetchy water-supply project is being carried on rapidly by the city, which is also now about ready to take over the local private water company. Hetch Hetchy is a story in itself; in such comment as this it is enough to say that its many miles of tunnels and yards of dams are representative of trans-Rocky engineering—high mountains, isolated camps, steep inclines, long construction railways, great distances engineering far away from the office and the telephone to the material and supply man in the next street.

No one can spend much time in down-town San Francisco without getting worked up over the miserable traffic conditions on Market St., the main artery of the town. Some years ago the city built a municipal street railway to compete with the private company and did what it would never have allowed anyone else to do, laid an extra two tracks on a street which already had two. Market St. is wide; otherwise one would not cross it at all, but even so one crosses it now at imminent risk of life and limb, particularly as the motormen run more or less at their own sweet will, and both pedestrians and motorists—to say nothing of the crossing policemen—seem to regard such traffic rules as there doubtless are as whimsical devices of some unauthorized theorist. Successfully to dodge four street cars, six automobiles, and thirty-six pedestrians all bound in different directions becomes a feat to be proud of.

Industrial conditions in San Francisco are about the same as elsewhere on the Coast. Being a financial center, the current tightness of money is perhaps better appreciated than in the other cities and the depressing reaction on new projects was felt somewhat earlier. There is a great deal of prospecting being done, mainly in irrigation and water-power, and engineers as a rule are busy, but the prospecting is mostly office work, and actual construction is awaiting a more favorable money market. Meanwhile there is quite a good deal of building construction going on in the city. Labor is reported much easier; that is, the men are working harder and there are more men available. Wages have not shown any signs of coming down, nor is there any indication of a loosening of the grip which union labor has had on San Francisco for years. So long as the unions continue so powerful there is little hope of pronounced industrial growth. New manufacturing enterprises will want to go to sections of the West, notably the Southwest, where labor, up to now at least, has been more reasonable.

They will tell you at San Francisco that there are more "Sunday supplement" engineers there than anywhere else in the world. More wild schemes, they say, are born and circulated there, and they warn you to discount all extravagant engineering stories which circulate in the daily press under the San Francisco date line. There is no good explanation for this unless we return to the metropolis theory, for New York, too, harbors more engineering "nuts" than any city in the East. It must be because there is more money in the big centers looking for release and the dreamer can find more sympathetic attention from those who want quick and multiplied turnover. But beyond that there is in San Francisco the old pioneer spirit which took chances and in the main made good. The forty-niner has left the native son the heritage of trying anything once. He will listen to schemes and apply theories that more prosaic folk know won't work, and every once in a while the scheme does work and the theory proves practicable.

Traffic on Wayne County Roads

Comparison of traffic counts made in 1920 with those taken during 1912 upon the main roads leading out of the city of Detroit just outside of the city limits reveal a tremendous increase in motor vehicle traffic and decrease in horse-drawn traffic. Traffic counts taken this year upon Woodward Avenue showed in excess of 14,000 vehicles for a 14-hr. day, the average for a week being greater than 10,000 vehicles per day. Traffic counts were taken during both years at the same points on the same road. The figures given in the above table are the averages for a week.

1912—24-HOUR COUNT

Road	Horse-drawn	Auto, Touring	Trucks	Total
Woodward	322	2,146	122	2,590
Gratiot	732	437	40	1,209
Grand River	471	528	53	1,082
Michigan	364	549	23	936
River	125	370	13	508
Van Dyke	389	209	20	618

1920—14-HOUR COUNT

Road	Horse-drawn	Auto, Touring	Trucks	Total
Woodward	90	9,440	1,007	10,537
Gratiot	46	3,203	315	3,564
Grand River	32	2,040	486	2,558
Michigan	17	1,979	613	2,609
River	33	1,619	329	1,981
Van Dyke	102	1,402	590	2,094

Trend of Highway Development —A Survey

THIS IS THE NINTH *of a series of staff articles on the highway situation. It deals with the policy of concentrating on construction brought forward from a previous year, with the transportation shortage of materials and with the regulation of the weight of traffic.*

The tenth article in the series will appear in next week's issue.—EDITOR.

Illinois Practice

ILLINOIS began the season of 1920 with 400 mi. of pavement uncompleted under contracts awarded in 1919. The policy of 1920 has been (1) not to increase largely the contract mileage of pavement but to concentrate on the completion of the work in progress; (2) to award grading contracts ahead on the 1,000 mi. of pavement originally contemplated for 1920 construction; (3) to advance experimental studies of pavement types and structure with a view to improvements in design; (4) to provide plans for regulating vehicle weights, which, uncontrolled, are in some localities destroying pavements, and (5) to develop the extension of state maintenance.

In a word, Illinois stopped letting contracts for paving in 1920. The reasoning ran as follows: Illinois began the year's highway construction with a large mileage brought forward from 1919; two plans of procedure were practicable to secure a large mileage of completed road, (a) to let new contracts and possibly have the extensive construction produce a large aggregate mileage, or (b) to cease to let contracts and concentrate on a definite mileage; analysis of the governing conditions led to the conclusion that equal progress would be made and greater economy secured by ceasing to award contracts. An examination of the reasons for and the results of this policy is of value particularly because other states which, like Illinois, brought forward a large mileage of uncompleted 1919 contracts adopted the opposite policy—of continuing to let contracts.

THIS YEAR'S WORK

About 575 mi. of pavement was placed under contract in 1919. This mileage had absorbed nearly all the contractors of the state available for pavement construction. These contractors had been able to complete only about 175 mi. of pavement because of the scarcity of labor and the transportation shortage of materials. As the working season of 1920 approached there was little indication of either cheaper labor or a more ready movement of materials. When, in March, contractors were asked to bid on new work only a few were free to undertake any considerable mileage and the prices which they asked were from 33⅓ to 40 per cent higher than the prices on the 400 mi. of contracts brought forward from 1919.

It was concluded under the circumstances that if contracts for any considerable new mileage should be awarded at the increased prices the contractors for this new work (1) would be in position to bid higher prices for materials and labor than could the contractors operating under 1919 prices, and (2) would put the old contractors at a disadvantage by competing for a car supply not sufficient for the work in progress. There was also reluctance to incur the higher costs because of a belief that the future would bring a readjustment of commodity prices and that with readjustment would come cheaper road construction. Another motive for proceeding slowly was that bonds would have to be sold to finance a much greater mileage of construction and, if sold then, a discount must be taken. To fill in gaps in Federal-aid projects 50 mi. of new pavement were placed under contract and no further bids for pavement were asked. In addition county construction of paved road was discouraged, except where large centers of population were to be served by the new mileage.

Looking back at the season's experience, the action taken is considered to have been justified. At the close of the season some 320 mi. of pavement had been completed. Could materials have been brought to the work by the railways the entire mileage under contract would have been finished. The organization and equipment were on the ground and labor was available but cars to transport material could not be had. On this evidence alone it is held that had a much larger mileage been placed under construction the completed mileage would not have been increased.

GRADING; CONSTRUCTION PRACTICE

While paving contracts were curtailed in 1920, the opposite policy was adopted in respect to contracts for grading. On the 1,000 mi. of bond-issue highway, which it had been the original intention to pave, contracts were let for the heavy grading operations. The thought was that the prosecution of grading would not materially interfere with progress in paving, that with the controlling heavy grading operations completed future paving operations would proceed with fewer delays, and that by completing this grading well in advance time would be allowed for consolidation and a better road structure be secured. This grading work, it may be stated, included permanent small bridges and culverts. In round figures nearly $3,000,000 were involved in these grading contracts. As a rule, competition for the work was active and the prices were reasonable.

Paving methods present no unusual features. Central mixing plants and wet-batch haulage (generally by truck), central proportioning plants and dry-batch haulage (generally by industrial railway), and various methods of operating from stock piles on the ground were employed. In wet-batch haulage the principal development was the use of one-ton trucks, with oversize pneumatic tires and turntables to protect the subgrade, as was described in *Engineering News-Record* Aug. 19, 1920, p. 356. In dry-batch haulage by industrial railway an interesting side light on the value of close co-ordination of operations was furnished by the work of Allan J. Parrish, some details of which were noted in *Engineering News-Record* July 29, 1920, p. 234. Complete records for the season are not available but for 14 working days this contractor averaged 565 ft. per day of 18-ft. 8-in. concrete pavement and maintained a record throughout the season of well over 450 ft. per working day. Explanation of this continuous good progress lies in the one word *management*, which included keeping the supply of materials constant.

As indicated previously, transportation shortage of materials has been the crowning obstacle to highway

construction progress in 1920. Its causes and effects are typical for the Mississippi Valley states and they probably will continue in a less virulent form in 1921, and, therefore, as summarized by the Illinois highway engineers they deserve attention:

In the latter half of 1919 contractors were faced with a shortage of cars—first, because of the strike of the railway car repairers; second, because of the steel strike, and, third, because of an embargo placed on open-top cars due to the impending coal strike. Profiting by the 1919 experience every effort was made by the contractors in 1920 to store sufficient sand, gravel, stone and cement to carry them well into the season; to this end they were given all possible assistance by the department. It was found, however, that transportation conditions were worse than in 1919. First came a more pronounced shortage of cars; this developed early in the year, when it became almost impossible to get box cars for shipping cement. The cement companies resorted to the use of stock and open-top cars in order to overcome the shortage. Second, this shortage was greatly increased by the switchmen's strike. Third, the coal situation, which tied up a very large number of cars for a considerable period of time, became acute much earlier than usual, resulting in an order being issued by the Car Service Commission restricting the use of open-top cars to 50 per cent of the requirements of any producer of materials, and also providing that open-top cars could not be used for carrying commodities that could be as readily shipped in other classes of equipment. This order prevented the sand, gravel and stone producers from getting sufficient cars to take care of the highway contractors and also prevented the shipment of cement in open-top cars. Fourth, the order issued by the Car Service Commission was followed by an order from the Interstate Commerce Commission which provided that coal cars could be loaded with other commodities only when returning in the direction of the mines.

These two orders issued from Washington, which were made more rigid as the season advanced, demoralized shipping conditions as applied to road-building materials and made it impossible for the contractors to depend upon regular deliveries. Practically all of them have been obliged to shut down at frequent intervals because of the shortage of materials, and some of them for weeks at a time. The department has kept in constant touch with the requirements of the contractors, with the material producers and with the railroad officials, endeavoring to assist in procuring cars and securing shipment of materials so as to keep as many contractors as possible at work.

At best, with about one hundred paving outfits in commission only a few over fifty were ever in operation at one time.

Prevented from proceeding as rapidly (800 to 1,000 mi. annually) as had been planned for the paving of the 4,800-mi. bond-issue road system, plans are being developed to bring this system as it stands under state maintenance. The thought is to establish a truck patrol system with sections of 20 to 30 mi. In this connection it may be noted that on the hard-surface mileage now maintained wholly by the state gang maintenance is becoming inadequate in certain localities, and that here patrol maintenance will probably be substituted in 1921.

The standard hard pavement in Illinois is an 18-ft. concrete slab uniformly 8 in. thick or, for other types of construction, a design of equivalent quality. With a view of determining the need of an improved design an experimental road, which will be described in a future issue, has been constructed for observation. These studies will include pavement design and construction and subgrade conditions. While final conclusions are not determined, the indications are that future developments will not be toward a lighter slab design. In this connection the fact is noted that this year a number of pavements have been destroyed by heavy trucks. A more rigid regulation of vehicle loads in 1921 is therefore contemplated. Illinois is feeling the same pinch of unregulated traffic which is distressing the states of the East, as was emphasized in the article of this series which reviewed practice in Connecticut, Massachusetts and Rhode Island. The department officials thus express the situation:

A pavement paid for by the public and which is ample to carry 99 per cent of the traffic cannot be permitted to be totally destroyed by a few unreasonably heavy trucks representing a fraction of 1 per cent of the traffic. The solution lies in arriving at the proper beam strength of pavements to meet the weight of the economic load and then through legislation placing the proper limit on weights of loads, and enforcing the law rigorously.

At the close of the season there will have been put into service approximately 450 mi. of hard-surfaced roads built in 1919 and 1920. When this is done it is proposed to place patrolmen upon them with devices for determining the weights of loads, and through these officers put the law now on the statute books of the state into effect. Only by such a system can these roads, costing the taxpayers millions of dollars, be protected from wilful violators of the load-limit law. Already a number of sections of state-constructed roads in Cook County have been either partially or entirely ruined by heavy truck traffic.

The plans to regulate vehicle weights and to extend patrol maintenances and policy of keeping reasonably small the margin between the mileage under contract and the mileage completed are the outstanding developments of 1920 highway practice in Illinois.

Economical Loading of Seagoing Dredges Studied

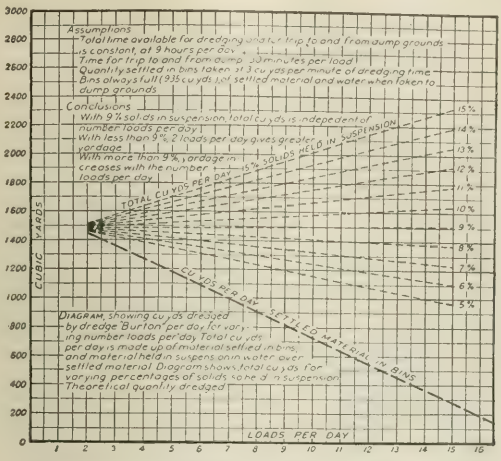
With More Than 9 Per Cent of Silt in Suspension Yardage Increases With Number of Loads Per Day

By G. S. Phelps
U. S. Assistant Engineer, Cleveland, Ohio

Conclusions of practical importance to dredgemen excavating silt, which settles slowly in the hoppers of seagoing dredges, are contained in an article in the November-December, 1920, *issue of the* Military Engineer. *Briefly* (1) *with* 9 *per cent of solids in suspension, the total yardage is independent of the number of loads per day;* (2) *with less than* 9 *per cent two loads per day gives greater yardage and* (3) *with more than* 9 *per cent, the yardage increases with the number of loads per day.*—Editor.

Investigation was made as to the number of loads per day which should be dredged at Cleveland Harbor with the seagoing hopper dredge *Burton*. At this harbor dredged material running overboard with the overflow is a waste of money, as it settles within the dredged area. The material was a fine silt, which settled slowly in the bins. The time required for one round trip to the dumping grounds was about 30 min. The total time available for dredging and dumping is assumed at 9 hr. per day. Two loads per day could be dredged with a pumping time of 4 hrs. each, which with the two trips to the dumping grounds consumed the 9 hr.

While the dredge worked on that schedule it was found that a fairly constant average of about 720 cu.yd. of settled material in the bins was secured with each load, or at the rate of 3 cu.yd. of settled material per minute of dredging time. The capacity of the bins was 935 cu.yd. The dredging time per load was varied from 30 min. to 4 hr. and it was found that the amount of settled material in the bins



PERFORMANCE OF DREDGE "BURTON" UNDER DIFFERENT OPERATING CONDITIONS

was practically constant at 3 cu.yd. per minute of dredging time, irrespective of the length of the dredging period. Thus when six loads per day were taken, the total time dredging was 6 hr.; 3 hr. were spent going to and from dumping grounds, and the quantity of measured settled material in the bins was about 1,080 cu.yd. for the day, still 3 cu.yd. per minute of dredging time. The question arose as to whether the solids held in suspension in the water above settled material in the bins were sufficient to justify the greater number of loads per day. The settled material had fallen from 1,440 to 1,080 cu.yd. per day. It is apparent that volume of dirty water carried to the dumping grounds was increased from 2 (935) — 1,440 = 430 cu.yd. with two loads per day, to 6 (935) — 1,080 = 4,530 cu.yd. with six loads, an increase in volume of water carried of 4,200 cu.yd. The loss in settled material was 360 cu.yd. If the water contained 8.76 per cent solid material held in suspension, then the loss in settled material was exactly balanced by the gain in suspended solids; if less than 8.76 per cent, two loads per day gave the greater total of settled and suspended material; if more than 8.76 per cent, the shorter dredging period and greater number of loads were better.

It appears then that in this case 8.76 per cent is the critical percentage of suspended solids at which economy definitely demands a change from a policy of full loading of bins to one of many loads per day, the more the better, limited only by the times required to fill bins with muddy water. Satisfactory sampling of the water held in bins has not been made, since the dredge left the work before this was done. It is believed, however, that in a great many cases where the material consists of fine silt the solids held in suspension will considerably exceed this critical percentage, and that in such cases the dredge would better become a "water wagon" and take as many loads as possible of water to the dumping grounds. The illustration shows graphically, for varying numbers of loads per day, the total yardage which would be obtained under conditions as outlined for Cleveland dredging, with varying percentages of suspended solids. The importance of taking this suspended matter into account, when considering the total quantity of material carried, is strikingly illustrated by this diagram.

Three Canadian Provinces Lack License Laws

Saskatchewan, Ontario and Prince Edward Island are now the only provinces in Canada that lack legislation regulating the practice of professional engineering. Steps are being taken to pass bills in these provinces.

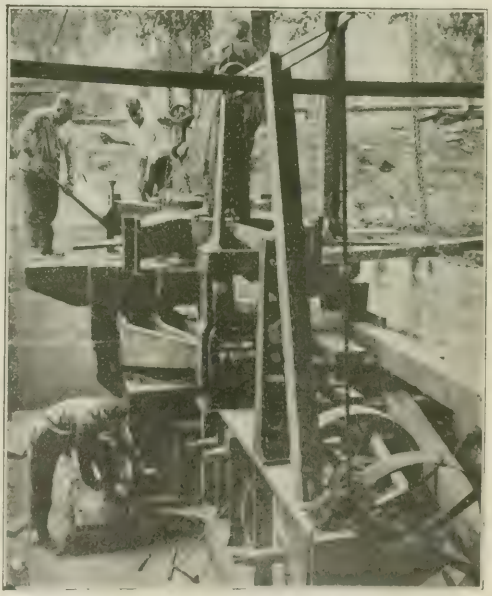
Million Pound Testing Machine for Forest Products Laboratory

By L. J. Markwardt
Assistant in Charge, Section of Timber Mechanics, Forest Products Laboratory, Madison, Wis.

A PROBLEM of no less interest than the conducting of special tests for which it was designed is that involved in the erection of the new million-pound testing machine being added to the equipment of the Forest Products Laboratory. The mammoth machine is of the two-screw type and has an over-all height of 45 ft., including the superstructure above the weighing platform, which will enable it to accommodate columns up to 30 ft. or tension members up to 27 ft. in length.

The total weight of the complete machine is approximately 160,000 lb. The heaviest single piece is the weighing platform, on which one of the men is standing in the accompanying photograph, taken during the progress of the erection. This part weighs 15 tons.

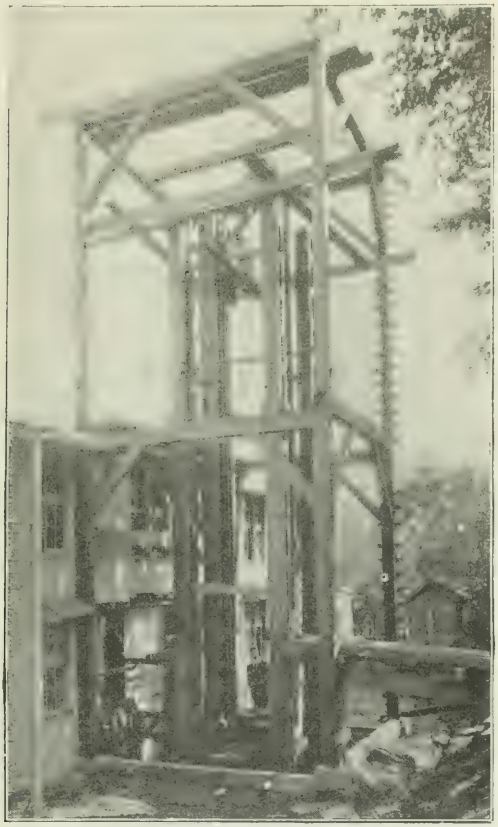
The base of the machine is placed in a pit, with the weighing platform at floor level. A timber frame-



ERECTING NEW TESTING MACHINE AT MADISON

work constructed around the machine first served the purpose of furnishing an erection support and later will serve as a housing framework. In housing the machine removable doors and windows will be provided to afford an opening the full height of the machine and the width of the screw clearance. Thus it will be possible, by constructing extensions to the weighing platform, to test built-up members such as roof trusses and girders of considerable spans.

The unique feature of this machine and the thing that differentiates it from most of the other machines now in use is its adaptability for testing pieces of great length. Moreover, this machine, unlike many other large machines of similar capacity, can be used



FRAMEWORK WILL SUPPORT FUTURE HOUSING

for testing in tension as well as in compression and bending.

One of the first investigations contemplated is a study of wooden columns, including the development of column formulæ, and an analysis of the effect of defects of wood on strength. It is generally recognized that present data on wooden columns are exceedingly meager, and that engineers have long been in need of more complete information on this subject.

Tonnage of Structural Materials Transported

Despite the car shortage a considerable tonnage of structural materials was transported during the quarter ended June 30, 1920, as shown by a statistical compilation made by the Interstate Commerce Commission covering 70 commodities carried on Class-1 roads—those with annual operating revenues above $1,000,000. The tonnage of certain building materials carried during the second quarter was as follows:

	Tons
Cement	3,829,734
Bar and sheet iron, structural iron, and iron pipe	6,437,342
Brick and artificia stone	4,115,520
Lime and plaster	1,141,336

Each of these items shows an increase over the tonnages transported during the first quarter. Comparisons with the corresponding quarter of the preceding year are not yet available.

Permanent Record of Field Changes in Highway Construction

By Jasper A. W. Davis
Logan County Road Dept., Logan, W. Va.

RECORDS in highway construction are often regarded as of little importance. In enterprises where public funds are being expended records ought to be made so complete as to leave little to be desired. Often those who have charge of the work technically, have passed through the period following their graduation or apprenticeship in meeting setbacks to their idealism and have lost the concientiousness that they could well have kept. Such circumstances produce an individual who pays little attention to absolute economy and puts the "getting by" and the "financial remuneration" above service.

The expenditure of public funds is a sacred trust. Highway engineers are now receiving large sums to expend. There are county bond issues up into the millions; there is aid offered by state and federal departments. True, the trained man receives poor compensation for his years of study and endeavor, but that cannot justify loose methods in keeping records. The public is entitled to records and they should have them.

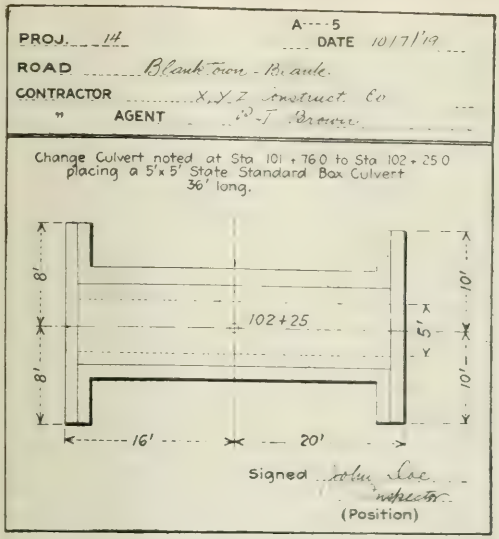
Unforeseen Changes Frequent

Plans are generally at hand before a contractor begins his work, but few sets of plans are so complete and so perfect as to go through without changes in construction. A pipe may be needed at some point not indicated on the plan, a rip rapped embankment may be deemed more economical than a retaining wall along some waterway, or the reverse; or it may develop that a stone underdrain is necessary at some point. Often a change in the alignment becomes possible and the relocation most desirable. With the general and flexible unit price contract used in much of the work let, these changes, additions and deductions can be made easy.

A changing engineering personnel is an added reason for the more elaborate system of record keeping. The engineer, his assistant or inspectors, may and very often do, verbally authorize a change in some of the details. Possibly before the monthly estimate is made up and more probably before the final estimate is taken, that individual may be off the job or has forgotten the whole or a part of what transpired. Those buried details are then hidden and forgotten until expensive digging reveals them—the records failing to show the information. Municipalities have had the experience of unravelling records concerning their sewer, water and gas pipes, and telephone and power conduits, and tomorrow there will be untangling on our highways.

Three counties I am or have been familiar with, completely neglect their permanent records in the construction programs. Simplicity and accuracy are essentials of a system for keeping permanent record. It is believed that the system herein outlined has these characteristics.

Each authority should carry a pad of order-form blanks with duplicates and triplicates. Such a form could be made similar to the one herewith illustrated. Upon these blanks should be noted any changes in construction, or any information supplied not on the plans and any failures to conform with plans, specifications



SUGGESTED METHOD FOR NOTING CHANGES IN CONSTRUCTION

or instructions, numbered and written up with sketches where a sketch will aid in the explanation, and signed by the person giving the information. One copy should be left with the contractor's agent, one copy to be filed away in the office and the third copy to be left in the book for reference by the individual.

Changes and orders may well be cross referenced with the engineers field book to aid in the tying the whole together.

The inspector could well keep a record of such information as materials brought to the job, labor and machinery, their quality and cost, remarks, etc. This record would act as a double check on the efficiency of the organization and make cost data readily available for use in similar work and estimates.

Upon completion of the work, these instructions may be easily grouped and the tabulation made. The original tracings may be then gone over and the data, so gathered together, supplied to them. Completed, these tracings showing the finished work could well be blueprinted and the sets of prints filed where readily available for the information of those who have the right to it. In the case of aid projects, prints could be supplied to either or both the state and federal departments as final records.

Up to the present time the writer has not seen or heard of a system used in highway construction work.

Drainage Work in Illinois

Drainage projects in the larger valleys in Illinois experience difficulty in organization owing to the number of land owners and the large amount of preliminary work and the expense involved in preparing a petition. According to a paper by F. W. De Wolf and G. W. Pickels, presented at the recent meeting of the National Drainage Congress, some land owners think the state should bear all the expense, but the majority are willing to pay their share of the cost though not willing to give the time to promote such projects.

Railway Maintenance in 1920

Despite Heavy Traffic, Plant in Better Condition Now than at Beginning of Year, but Ground Lost Under Government Control Not Fully Made Up

By Julius H. Parmelee
Director, Bureau of Railway Economics, Washington, D. C.

ADEQUATE maintenance of plant is vital to the welfare of any industry, and to none more so than to the railways, whose plant—especially the roadbed and equipment—is peculiarly subject to weather conditions and to operating wear and tear. A locomotive is literally a power plant on wheels, and must manufacture and deliver power at the drivers while moving rapidly around curves, over rough sections, up and down grades, and under varying conditions of cold, heat, and storm. Similarly, cars are subjected to the pounding and grinding of rapid movement, while under obligation to carry heavy loads and deliver them in good order at destination.

Railway maintenance, then, is a subject of vital importance to the industry. In normal pre-war days, as for example during the three-year test period of 1915 to 1917, the American railways spent a billion dollars annually on the two maintenance accounts, maintenance of way and of equipment. Relatively considered, out of every dollar of total operating expenses in that period, 17.7c. was expended for maintenance of way and 24.7c. for maintenance of equipment, or 42.4c. in all. Clearly, any element of expenditure that bulks so large as maintenance calls for most careful consideration, if only as a matter of financial policy. More important still, operating efficiency is involved in the maintenance of railway plant to such a level that it can function prompty and effectively at all times.

Under Federal Control

During the 26 months of federal control of the railways, from Jan. 1, 1918, to March 1, 1920, the railway plant was subjected to terrific pressure of traffic. Freight and passenger traffic in 1918 was the heaviest recorded up to that time. Freight traffic declined somewhat in 1919, but passenger traffic was even greater than in 1918. Yet the maintenance applied to roadway and equipment was less than normal, certainly below what the wear and tear of the unusual war traffic called for. This was due in part to lack of available labor and materials, and in part to the financial position of the Railroad Administration, which was confronted with heavy operating deficits and was finding it difficult to secure appropriations from Congress. Without going into an extended discussion of the moot question of under- or over-maintenance during federal control, there is considerable evidence, some furnished by the Director-General of Railroads himself, to the effect that railway maintenance in 1918 and 1919 was not all that the needs of the situation demanded. Statistics are available pointing to the conclusion that the railway properties came back to their owners on March 1 of last year less fit for service than when the government took them over; by how much less, it is difficult, and perhaps needless, to state with exactness at this time.

In this connection, citations from the Interstate Commerce Commission and the railways may not be out of

order. In a recent address Daniel Willard, of the Baltimore & Ohio, speaking of railway equipment, said:

"While the government did purchase, during the period of federal control, 100,000 freight cars and approximately 2,000 locomotives, it is only fair to say that the additional equipment so purchased was probably less in the aggregate than the equipment actually worn out during the same period,—so that when the railroads were returned to their owners on the first of March last, they undoubtedly had fewer available engines, freight cars and coaches than was the case when they were turned over to the Government on Dec. 28, 1917. This statement is of course not made in criticism, but in order that the facts may be understood."

Referring to the question of railway maintenance during federal control, S. M. Felton, of the Chicago Great Western, has made the following statement:

"Both the tracks and the locomotives had been subjected to the hardest kind of service without being maintained to as high standards as under private operation."

Perhaps the strongest evidence on the subject is furnished by the Interstate Commerce Commission in the annual report submitted to Congress a month ago. In the commission's discussion of the emergency service orders issued by them during the months of May to September, 1920, with the reasons therefor, appear the following significant statements respecting the deteriorated condition of the railway plant at the close of federal control (italics mine):

"The problem was forced upon the carriers and upon us as to how the demands of commerce for the movement of an extraordinary amount of tonnage could be met with *an impaired transportation machine.*

"It is clear that the problem cannot be solved without *substantial additions to equipment.*

"The foundation of each of these orders has been in finding that, because of *shortage of equipment* and congestion of traffic, an emergency has existed which required immediate action."

Under Private Control

Since March 1, or for the past ten months, the railways have been operating their own plants, and it is a fair question what they themselves have done as to maintenance. There are two ways of measuring comparative maintenance; by use of the monetary standard, and by use of the physical standard. The monetary standard would be accurate enough in a period of stable prices and wages, but where both wages and price levels have been changing rapidly, as in the past two years, it is of little service without the application of a corrective factor. The physical standard, that is, the number of ties and rails laid, units of equipment replaced, etc., is more nearly accurate, but it is more difficult to set up and maintain a statistical record of these factors than of those involving money. The alternative is to utilize both standards, and apply to both such elements of judgment and correction as may be possible.

As to the monetary standard, the following table shows the total maintenance expenditures of railways of Class I for the test period (annual average, years 1915 to 1917), and for the years 1918, 1919 and 1920 The figures for 1920 are necessarily estimated in part, as the table was prepared before the close of the year:

So far as the monetary standard goes, maintenance expenditures have kept even with other railway operating expenses, the ratio of maintenance to the total rising slowly from 42.4 per cent in the test period to 45.4 per cent in 1920. This does not, however, tell the whole story. If it did, the figures would settle the question of maintenance during federal control without further discussion, for the ratio of maintenance to total expense was higher in 1918 and 1919 than during the test period. Yet the physical condition of the railway plant was not so good at the end as at the beginning of federal control. Again, maintenance in

EXPENDITURES FOR MAINTENANCE, 1915-1920

	Amount	Per Cent of Total Expense
Maintenance of Way		
Test period	$407,111,000	17.7
1918	649,597,000	16.4
1919	778,105,000	17.6
1920	1,050,000,000	18.3
Maintenance of Equipment		
Test period	$567,665,000	24.7
1918	1,100,708,000	27.7
1919	1,232,702,000	27.9
1920	1,560,000,000	27.1
Total Maintenance		
Test period	$974,776,000	42.4
1918	1,750,305,000	44.1
1919	2,010,807,000	45.5
1920	2,610,000,000	45.4

1920 represented virtually the same ratio of total expense as in 1919, and the actual money expenditures were $600,000,000 greater than in 1919, yet we shall see that even this large addition to maintenance expenditures did not enable the railways wholly to make up the deficiency of the years of war-time exigency.

The question is not how much was spent, but what physical results were accomplished with the money expended. It is difficult to reach a categorical reply, because the records to date have not been summarized in full. We find it necessary, therefore, to approximate the situation as nearly as may be.

In normal years the railways lay about 100,000,000 crossties in their tracks, nearly 2,000,000 tons of steel rail, and approximately 20,000,000 cu.yd. of ballast of all kinds. The record of the Railroad Administration in 1918 and 1919 was below normal. [See article on this subject in *Engineering News-Record,* Jan. 1, 1920, page 12, and also discussion by T. DeWitt Cuyler in this issue.—*Editor.*] Statistics are not yet in hand regarding physical maintenance in 1920, either with respect to ties or rail, or ballast, or other physical elements of maintenance of way, such as bridge repairs, painting, and the like, but the railways made earnest efforts during the summer and fall to put their roadway and structures into good shape. That they succeeded, to a considerable degree, is evidenced by their ability to handle a record-breaking traffic without any such serious accidents or delays as would have resulted from weakened bridges, rotten ties, loosened or worn-out rail, uneven or insufficient ballasting. It seems safe to say, therefore, that the general condition of railroad roadway and structures was better at the close of the year than at the beginning, and on some of the railways very much better.

As to maintenance of equipment, the question is somewhat more complicated. In the first place, consideration of equipment maintenance falls naturally under two heads: Repairs, and replacements. In the second place, the railways on reassuming control of their own properties found their freight cars badly scattered, and a part of their efforts during the past ten months has been to relocate cars on home (that is, owning railway's) lines, so that proper repairs could be made in shops equipped to handle the particular types repre-

sented by home cars. This campaign has been progressing, and the situation at the end of the year was much improved over that at the beginning, yet conditions are not back to normal, and much remains to be done in 1921. In the third place, the very fact that traffic demands were so heavy in the summer and fall months forced the railways to press every locomotive and car into service, and their program of repairs could not be so extensive as a lesser traffic would have permitted. Heavy traffic conditions tend to slow up all maintenance work, of course, but especially so with regard to equipment repairs, where the necessities of the occasion virtually force railway managements to get along with minor repairs, postponing the inevitable heavy repairs to a later time, when traffic shall have become less heavy. Even with this drawback, we shall see that considerable progress was made in 1920.

Taking up these points in greater detail, we may first consider the matter of equipment repairs and replacements. As to repairs during the period of federal control, returns are available for about five-sixths of the railway mileage of Class I. From these roads the Railroad Administration took over 6,081 locomotives and 90,301 freight cars in bad order; when it retired from control, turned over to the same railways 8,111 locomotives and 119,231 freight cars in bad order —a larger number in both cases. Between March 1 and the latest date in 1920 for which figures are available at the present writing, the percentage of locomotives in bad order for all railways of Class I, has been reduced, while the percentage of freight cars in bad order has slightly increased. Roughly speaking, the condition of equipment as to bad order remained about stationary through the year 1920, although a large number of locomotives and cars were put into shape for active service, and the general condition of all equipment was improved.

Replacement Statistics

When we come to replacements, a new element enters the situation. In purchasing new equipment, no distinction is made between locomotives and cars that replace retirements of existing equipment caused by fire, wreck, obsolescence, or ordinary wear and tear, and those that represent new additions. As a matter of fact, there is a continual input of new equipment, and an outgo of old equipment, and it is proper to balance one against the other and regard only the excess of new equipment over retirements as additions, the remainder to be regarded as replacements. For example, if a railway in 1920 retired 600 freight cars from service and purchased 1,000 new cars, 600 of the new cars may be considered replacements and 400 additions. This is not the way the accounting officer handles it, nor is it the way his "retirements" account is maintained, but I am speaking rather from the general or economic point of view.

It follows that in discussing maintenance of equipment, the distinction between replacements and additions must be recognized. During the ten-year period ending with 1917 railways of Class I purchased or built 2,776 locomotives annually, and retired 1,545. Of the 2,776 locomotives, therefore, 1,545 may be regarded as normal replacements and the remainder, or 1,231, as normal additions. As to freight cars, the normal annual purchases during the same period were 126,857, and replacements 75,064, leaving 51,793 as additions.

During federal control (1918-19) the number of locomotives added annually was 2,115, of which 972 were replacements and 1,143 were additions. The number of freight cars added annually was 54,777, of which 47,762 were replacements and 7,015 were additions. It will be noticed that replacements were much below normal for both locomotives and freight cars, while additions were also less than normal, especially as to freight cars.

Statistics are not now available as to equipment retirements during 1920, although many cars—the figure is in the thousands—were retired for reconstruction. The number of new locomotives and cars delivered in 1920 was much below the average for 1918-19, principally because the Railroad Administration left few unfilled orders when it ceased active operations on March 1. Speaking generally, then, there were no additions to equipment in 1920, and not enough replacements to cover retirements, and the railways were forced to make up the lack of equipment by increasing the efficiency with which each available unit was operated, which they did with signal success. In fact, the Interstate Commerce Commission, in their annual report to Congress, pointed out that the increased average mileage per car per day and the increased loading per car in 1920 had the effect of releasing several hundred thousand cars which otherwise would not have been available.

Difficulties Encountered

The failure to provide adequate replacements in 1918 and 1919 threw an extra burden on the railways in 1920, in that they found many cars unfit for the type of transportation for which designed, and were obliged either to divert them to other uses or to retire them altogether from service. As stated, the railways have retired many locomotives and cars during the past ten months, and in addition have withdrawn thousands for complete reconstruction in their own shops or in outside contract shops. They have also shopped many cars and locomotives for lesser repairs, which is one of the reasons why the percentage of cars in bad order, i.e., withdrawn temporarily from service for shopping, remained high throughout the year 1920.

The second complicating factor referred to above is the necessity the railways found themselves under in 1920 to relocate freight cars on their home lines. At the beginning of federal control the percentage of home cars on line was 44 per cent; at the end of federal control, it had dropped to 21.9 per cent. During the ten months succeeding March 1 the railways made vigorous efforts to unscramble the situation and relocate cars on their home or owner lines, with the result that by Dec. 1 the percentage had risen to 35.5 per cent. Although still below normal, the railways are making every effort to further increase the percentage. The bearing of this situation on the matter of maintenance is that the scattered conditions of the freight cars in 1920, a condition inherited by the railways from the Railroad Administration, made it difficult to supply proper maintenance measures to cars as promptly and effectively as would have been possible had the percentage of home cars on line been greater.

The third difficulty mentioned above was the heavy traffic of 1920, which made it impracticable to withdraw locomotives and cars from service for repairs, without affecting the results of the campaign for "more trans-

portation" which the railways had launched. Especially was this difficulty apparent during the early summer, when cars by the hundred thousand were tied up at points of congestion, neither able to move nor to be withdrawn from service for shopping. As the congestion was gradually reduced, however, and the car shortage (i.e., unsupplied demands of shippers for freight cars) became less and less a factor in the situation, the railways found it possible to withdraw more of their equipment for shopping than during the congestion period, which is another reason for the relatively high percentage of "bad order," regardless of its physical condition, until it is actually taken out of service and put into the shop, or held awaiting shop, so that the percentage of "bad order" cars is governed not so much by physical condition as by the repair policy which the railways find it possible or necessary to adopt.

Unfortunately, the railways met another difficulty in November and December, just as their traffic was slackening to the point of releasing many locomotives and cars to the repair shops. This was the failure of net earnings to average anything like the six per cent contemplated by the Transportation Act. The rate earned in September, reduced to an annual basis, was 4.1 per cent, and in October 4.6 per cent, and with the possibility of lower earnings staring them in the face for November and December, many railways found themselves forced to adopt a policy of retrenchment, which of course had its effect on maintenance.

Summary

Summarizing the maintenance results for 1920, we find that the record is not yet fully written, nor will it be till 1921 is several months gone. But there is enough of a record spread before us now to indicate the outstanding features of the year: namely, that the railways received from the government on March 1 a somewhat impaired plant; that they encountered numerous difficulties in their effort to make up the maintenance deficiency and keep even with current wear and tear; that they expended considerably more money than did the government, representing a slightly larger proportion of total expenses, on maintenance; that the amount of work put into maintenance, measured in material and labor, was undoubtedly greater than during federal control, and probably greater than during the normal test period, but did not fully make up the ground lost during government control; finally, that the plant and equipment at the close of the year was in better condition than at the beginning, and this in spite of the heavy traffic forced upon the railway plant during the year. In brief, the railways made a good start in 1920; the success of their efficiency campaign made it possible to do more business with fewer facilities, and thus in part to neutralize the impairment of plant; it is their hope to take a still longer step in 1921 along the path of effective and adequate maintenance of their properties

Salary Scale Approved by 13 Societies

In its first report, dated Dec. 6, Engineering Council's committee on classification and compensation of engineers (Arthur S. Tuttle, chairman) reports that 13 societies have endorsed the classification recommended in the committee's previous report and reprinted in the issue of *Engineering News-Record* July 20, 1920, p. 224.

Industrial Waste Prevents Self-Purification of Water Courses

AN INDIRECT but none the less serious result of trade waste in streams, particularly those used as sewage carriers, was pointed out in a paper by Thurlow C. Nelson, assistant professor of zoology at Rutgers College, presented at the recent convention of the American Public Health Association.

"For five years," Mr. Nelson stated, "practically no oyster larvæ have advanced beyond the embryonic stage in New England waters. The industry there is facing total extinction. All scientific and practical testimony is united in attributing the chief cause of failure to the great outpouring of industrial waste incident to the war. New Jersey, Delaware and Maryland, with oyster grounds further removed from industrial centers, have thus far suffered less. The end is inevitable: let present conditions continue and in ten years the oyster will be only a memory.

"If the oyster alone were concerned, we could afford to lose it in view of the value of our industries and their products. However, the industrial wastes which have killed the oyster larvæ have at the same time destroyed the biological machine which normally takes care of the self-purification of these bodies of water. The stream which a short time ago cared for large volumes of sewage can now no longer do so and one finds the banks strewn with heaps of putrid fecal matter. During the warm months these accumulated masses swarm with flies, addiding to the danger of the situation.

"Pollution has passed far below its former bounds and is now invading the bathing beaches and shell-fish bearing areas which a few years ago were miles from any source of contamination. Evidence from all sources shows that pollution is progressing rapidly down nearly all of our large streams. There can be put one result—in ten or fifteen years the greater part of the eastern United States will be cradled in a septic tank."

Drainage Development in the Southeast

Drainage in the nine southeastern states dates back only to 1909, when the North Carolina law was enacted, as prior to that time none of these states had workable drainage laws. All of them now have laws which provide for the acquisition, financing and construction of improvements by drainage districts, although in two states the legal difficulties have only recently been cleared away. A paper by S. H. McCrory, chief of drainage investigations, U. S. Department of Agriculture, which was read at the recent meeting of the National Drainage Congress, shows that these nine states in 1909 had 46,571,000 acres of swamps and overflowed land, of which about 5,000,000 acres are now being drained, at a cost of about $28,523,000. This area includes 2,000,000 acres of improved farm land and 1,846,000 acres of timber or cutover land, the remainder being unimproved land. Financing by district bonds is the usual method, Florida being the only southeastern state to undertake drainage of agricultural lands. According to Mr. McCrory, the value of drainage bonds is now more generally appreciated by investors and in some states such bonds are legal instruments for school funds and savings banks. It is important that this reputation should be guarded carefully and that projects of questionable merit should not be undertaken.

Pending Railroad Construction Generally Confined to Current Transportation Needs

EFFORTS were made to secure for publication the pending construction programs of twenty large systems. Outlines of those of five big systems are here published, which indicate a considerable volume of improvement work, but which should be considered as the plans of large companies prepared far in advance. Seven other large systems, at the time of writing, had not yet determined their construction plans for 1921 in such form as to warrant statements—in most cases ascribed to the uncertain situation following the recent falling off of traffic. No indication of the situation on eight other large lines has become available.—EDITOR.

RAILROAD CONSTRUCTION for 1921 will be largely confined to the more immediate necessities of additional transportation and will not extend to large programs for improvements and extensions which were thought likely early last fall with the increase in rates and a very large volume of business, according to information received from twelve of the larger carriers and statements made by Interstate Commerce Commissioners and the Association of Railway Executives. While some of the carriers have already formulated fairly large programs for improvements in 1921, it is indicated by replies received from representative companies that work generally will be confined to more immediate and pressing needs due to the change in the business situation and consequent falling off of traffic.

Some of the principal improvements planned to complete or begin this year are: The Castleton Bridge over the Hudson River, New York Central R.R.; new coal pier at Baltimore, Western Maryland R. R.; new coal traffic facilities, Norfolk & Western Ry.; Claremont piers and deep water terminal, New York Harbor, Lehigh Valley R.R.; double-tracking on Virginian Ry.; double tracking Big Four R.R.; three large freight yards, New York, New Haven & Hartford R. R.; trestle filling, tunnel improvement, ballasting, and heavier rail, Southern Pacific Co.; elimination of limiting tunnel, Delaware & Hudson Co.; yard reconstruction at Baltimore and new bridge crossing Big Miami River at Lawrenceburg, Ind., Baltimore & Ohio R.R.; line revision, Norfolk Southern R. R.; enlargement of yards and engine facilities, Texas & Pacific Ry. and Wheeling & Lake Erie Ry. These improvements represent some of the larger work that has been in contemplation for some time, but the large bulk of improvement work now definitely or tentatively planned for the coming year is in extension of tracks, yards, freight-handling facilities, new ballasting and heavier rail to provide for immediate transportation necessities and to renew old plants.

Outlines of the construction program of five large systems follow:

Southern Pacific Co.

Pacific System

IN ADDITION to trestle filling and tunnel improvement work the Pacific System of the Southern Pacific Co. has adopted an extensive program of ballasting and laying of heavier rail. The entire program involves generous expenditures for ordinary maintenance and for additions and betterments to provide for the more expeditious handling of existing and prospective traffic.

The maintenance program includes bank widening, ditching, tie renewals, rail renewals and ballasting—particularly relaying rails. Authority has been given to relay 450 miles of track with new 90-lb. rail; 2,000 tons of maganese rail will be laid on sharp curves over the Tehachapi, Siskiyou and Sierra Nevada Mountains. Branch lines and sidings are being relaid with 75-lb. and 80-lb. second-hand rail. The ultimate intention is to have nothing less than this weight of rail in such tracks.

BALLASTING PROGRAM

Ballasting with crushed rock, slag and gravel is under way on various parts of the line, 130 miles of crushed rock and 90 miles of slag ballast having just been completed, with 220 miles of slag ballast to be placed. Gravel ballast is being used in reinforcing and in ballasting branch lines. On the ballasting from Niland to Araz Junction via Calexico, a distance of 96 miles, 28 miles have already been completed. From Stockton to Merced (Oakdale Branch) 72 miles, ballasting is nearing completion; 1921 program under way contemplates application of 650,000 yards during the year.

Additional trackage and yard improvements are being made at Ogden, Utah; Wells, Nev.; Carlin, Nev.; Sparks, Nev.; Bayshore Shops, San Francisco; San Jose, Cal.; Los Angeles; Yuma, Ariz.; Tucson, Ariz.; Bakersfield, Cal.

Attention has been given to the subject of freight house improvements. At San Francisco, for example, the company is constructing a 6-story reinforced concrete terminal warehouse and trackage, connecting rail with water. Existing facilities are being improved at East Portland, Ore.; Walnut Grove, Cal.; Nogales, Ariz. Freight house extensions are being made at the following places: Fruitvale, Brawley, El Centro, Calexico, Patterson, Weed, San Luis Obispo, Vacaville, Cordelia, Orland, Modesto, Gustine. Improvements in freight handling methods are being undertaken wherever required. For use at San Francisco a 30-ton Gantry crane, with 400-ft. runway, will be installed to facilitate unloading heavy freight from gondola cars.

Engine terminal improvements in the form of reinforced concrete rectangular engine houses are being constructed at Tracy, Mojave and Indio; 100-ft. turntables have been installed at Tucson and Yuma, Ariz., and Dunsmuir, Cal., replacing 80-ft. turntables and permitting the operation of heavier power.

At Sacramento the company has recently completed an electric furnace and steel foundry and a brass foundry. Authority has been granted for the following additions: At Sacramento a spring shop, planing mill, 2-story general store building, reinforced concrete building for oil and paint storage; at Oakland, Cal., a laundry building; at San Francisco, Bayshore Shops, an emergency hospital, dry lumber shed, boiler shop; at Los Angeles a concrete oil house; at Tucson, Ariz., boiler and tank shop. A two-story building at Portland, Ore., is being remodeled for use as up-town ticket office and waiting room for electric lines.

TRESTLE FILLING—TUNNEL IMPROVEMENT

An extensive program of trestle filling is being followed. At Albany, Ore., over Willamette River, a swing bridge and two approach spans of steel construction with concrete piers, will replace wooden Howe truss. Three miles of deck of the Salt Lake trestle is being rebuilt as part of plan to rebuild deck of entire 12 miles of this trestle within four years.

Separation of grades at state highway crossings is underway at Red Bluff, Pittsburgh, Guadalupe, Cal.; Ashland and Tolo, Ore.

On line over the Tehachapi, tunnels are being enlarged to standard section and timber lining replaced with concrete. This work is proceeding on a progressive plan

Length of the 18 tunnels on this line aggregate 8,200 ft., of which 4,100 ft. have been enlarged and concreted; line c ange will get rid of two tunnels aggregating 1,200 ft.

To expedite movement of trains, passing sidings are being extended and new ones constructed at many points on the system, aggregating 74,000 ft.

Three freight piers are being completed at Oakland Pier to handle transpacific and coastwise business. This is first unit of waterfront development plan.

At Port Costa, Benicia, Vallejo Junction and South Vallejo, complete renewal of the docks and wharves with creosoted timber is under way because of recent appearance of the teredo in the waters of Carquinez Straits following a period of drought.

Lines in Texas and Louisiana

IMPROVEMENTS and extensions on the Southern Pacific Lines in Texas and Louisiana that will tend to increase transportation capacity include an extensive program of ballasting and relaying of heavier rail; bridge renewals for use with heavier power; a belt line at Dallas, Tex., and additional running track and line improvement at El Paso, Tex.

Work is now under way gravel ballasting 42 miles of track from Kaufman to Dallas, Tex., and preparations are being made to ballast 245 miles of main line and passing tracks with burnt clay between Kaufman and Voth, Tex., to permit increase in average freight train speed. Burnt clay will also be used for ballasting 213 miles of main line and passing tracks between Humble, Tex., and Shreveport, La, and 52 miles on the Fort Worth branch.

Heavier rail is being laid on some 290 miles of track—90 lb. replacing 80 lb. and 80 lb. replacing 60 lb.

Work is now 50 per cent complete in adding over 6 miles of track to the Englewood yard at Houston, Tex., and constructing 1½ miles of second track on freight cut-off from Galveston division main line at Baer Junction to Englewood yard. Construction of 9 miles of belt line at Dallas, Tex., to permit routing of through business without passing through city terminal, to facilitate interchange, is about 50 per cent complete and construction of 2½ miles of second-line track on primary main line from Union Depot, El Paso, to the Rio Grande River, together with line improvement, is nearing completion.

At Hearne, Tex., additional tracks and facilities will be constructed for light-car repair work. New 150-ton track scales at four points are being built to facilitate car movement with proper billing.

At Beaumont and Liberty, Tex., steel draw spans of 247 ft. and 225 ft. respectively will be replaced with heavier construction to permit the use of heavier power. Work on each has already been started.

A new water station with 120,000-gal. capacity concrete storage tank has been practically completed at Pecos High Bridge, Tex., and work has been started on another station with 65,000-gal. steel storage tank at Devil's River, to be completed at an early date.

New York Central Lines

IN ITS extensive improvement program of the past year and planned for the immediate future the New York Central Lines have given special attention to work giving direct and early results for increased transportation capacity to "get more cars over the lines." In addition to a program for rehabilitating rolling stock at a cost of $53,000,000, large physical improvements which will be begun this year, including the Castleton bridge over the Hudson River between Poughkeepsie and Albany to divert freight traffic and practically double the capacity of the line. Double tracking on the Big Four now under way calls for an investment of more than $3,000,000 and improvement of the Michigan Central in Detroit will cost about $1,500,000.

On the New York Central proper some $5,500,000 will be spent to relieve special situations including improved mechanical freight handling at terminals; additional yard tracks, cut-offs and sidings, mechanical coal-handling plants and miscellaneous terminal improvements. Work has practically been completed on the "subway" at Erie, Pa., at a cost of $190,000 and on the Youngstown viaduct and relocation of freight houses ($310,000). Elimination of grade crossings at Rochester, N. Y., at a cost of $650,000 is under way. At Rensselaer, N. Y., a coaling plant with ash pit and sand house is nearing completion ($365,000). In the electrified zone $880,000 will be spent for new electrical generating unit at Port Morris, N. Y., and a new 11,000-volt circuit to the 50th St. Station, New York City.

At Elyria, Ohio, $350,000 is being expended in grade-crossing elimination work at six points, and a subway at Wesleyville, Pa., is being built at a cost of $230,000. Additional yard tracks and a 200-ft. submerged cinder pit are being installed at Collinwood, Ohio ($110,000). Stock feeding and resting pens with new trackage at a cost of nearly half a million is nearing completion at Rockport, Ohio. At Detroit the renewal of the River Rouge drawbridge is practically complete at a cost of $270,000 and for raised tracks and subways work is started at three streets at an estimated cost of over $100,000.

Double Tracking on Big Four—Michigan Central

On the Big Four double-tracking work is under energetic headway on points between Lamb, Ohio, to Ansonia, Columbus to Arvenue, Briar to Beach Grove, Augusta to Whitestone, Winchester to Faunland, Templeton to Swanington, etc. Attention also will be given to the needs for new passing tracks and sidings to permit longer trains and to facilitate dispatching. Additional terminal facilities at various points, including engine terminal improvements, are under construction at an estimated cost of $1,500,000. Second track, relocation and bridges, Augusta to White stone, at a cost of $1,160,000 are more than half completed. Yard extension at Mattoon, Ill., and a new freight house at Muncie, Ind., will cost $250,000.

On the Michigan Central attention is being directed to the need of additional passing tracks and the enlargement of existing short sidings on the Canada divisions. Yard and storage tracks also are to be extended. These projects total ultimate expenditure of over $600,000.

The reconstruction of the River Rouge bridge at Detroit is now almost completed. The separation of eleven grade crossings, under agreement with the city of Detroit for joint expense, is well advanced.

Boston & Albany—Pittsburgh & Lake Erie

Drawbridges at Chelsea, Mass., and a new bridge at Westfield, Mass., have been almost completed at a cost of $530,000. The Pittsburgh & Lake Erie has completed enlargement of the Hazelton, Pa., yard at a cost of $175,000.

For additional coal-handling facilities, involving the extension of sidings, the Toledo & Ohio Central will spend over $200,000 and the Zanesville & Western and the Kanawha & Michigan, for similar traffic, will expend $300,000 on enlarged yards and engine terminals, together with one line revision to eliminate "pusher" service. For additional sidings and mechanical repair facilities the Cincinnati Northern will spend $100,000, and for betterment of terminals and sidings the Lake Erie & Western will spend about $250,000.

About half a million dollars will be expended by the Indiana Harbor Belt R.R. for additional terminal and freight-handling facilities. In this connection the New York Central has submitted to the Interstate Commerce Commission for its approval a project for the development of Chicago terminal freight service involving the lease, operation and ultimate purchase of the Chicago Junction Railway Company's terminal property, the inner belt line connecting with the Indiana Harbor outer belt line. The purchase price is set at $33,000,000.

The Rutland (Vt.) R.R. will spend about $60,000 to increase clearances.

Large work on the New York Central that is planned for the near future, but for which definite time of commencement has not been determined includes Cleveland Union Station, Buffalo terminal improvement, West Side Manhattan improvement, New York City (considered by the

railroad as inevitable at some future date), Cincinnati terminal improvement, Weehawken, N. J., water-front development, Albany, N. Y., station, additional grade and yard separation at Indianapolis, and a very large program of double-tracking and extension of yards and terminals at many points on the system.

Norfolk & Western Railway Co.

A COAL branch line of 18 miles at a cost of $2,000,000 and additional coal pier facilities at Norfolk at a cost of $800,000 are the principal improvements under way on the Norfolk & Western Ry. At Roanoke, Va., a new water supply is 75 per cent completed that will cost $223,000 and new engine-terminal construction will cost $1,000,000. Additional terminal and yard facilities at two points are being built at a cost of $1,510,000 and a tie-treating plant at Radford, Va., is being constructed at a cost of $500,000.

New Facilities for Growing Coal Traffic

The coal branch line on Pigeon Creek and Rockhouse Fork—a distance of 18 miles—is 60 per cent completed. A new 120-ton capacity car dumper is being constructed at Norfolk, Va., capable of dumping cars containing 120 tons of coal, with a total maximum length of 60 ft., and in addition present piers Nos. 2 and 3 are being electrified. The work will cost $650,000 and is 30 per cent completed. A trimming machine is being designed for application to pier No. 4 at an estimated cost of $150,000, and it is expected that the installation will be completed during the year.

At Bristol, Va., additional yard tracks and engine terminal facilities are nearing completion at a cost of $1,300,000, and at Norfolk additional yard tracks and rearrangement of tracks to expedite switching and dispatch of coal are 30 per cent completed, and the work will cost $210,000. Additional engine-terminal facilities at Roanoke, Va., including a forty-stall roundhouse, machine shop, power plant and several minor structures, are nearing completion at a cost of $1,000,000.

The water supply being constructed at Roanoke is 75 per cent complete and will have a 2,000,000-gal. reservoir and a pumping capacity of 6,000,000 gal. per day. The tie-treating plant at Radford, Va., will have a capacity of 1,000,000 ties yearly and is 50 per cent completed.

On the main line between Bluefield and Norton work is 75 per cent completed extending six passing tracks at a cost of $150,000. At Columbus, Ohio, work is nearing completion on a bridge to carry a freight-house spur across Pennsylvania R.R. yards at Cleveland Ave. at an estimated cost of $140,000.

No additional second or third track has been constructed along the main line. About 3 miles of unimportant branch-line track has been abandoned and taken up.

Erie Railroad Co.

IMPROVEMENTS now under way on the Erie R.R., in addition to rehabilitation and purchase of rolling stock, are estimated to cost approximately $1,200,000 and work contemplated in the near future, $1,400,000.

Work now under way includes: A freight house at Newark, N. J., for handling fruit business, capacity twenty cars, to relieve congestion at New York; new drawbridge at Newark to replace wornout structure; placing signal and telephone wires underground at Passaic, N. J.; replacing 70-ft. turntable with 100-ft. turntable to accommodate larger engines at Susquehanna, Pa.; shop improvements, additional roundhouse tracks, coaling plant improvement, including steaming devices to prevent freezing, a bridge over the Canisteo River for access to shops, and remodeling of purchased building for Regional offices at Hornell, N. Y.; remodeling passenger station and coaling plant improvements, including steaming apparatus, at Buffalo; coaling plant improvements and steaming apparatus at Salamanca, N. Y.; purchase of property for extension of railroad slag dump at Phalanx, Ohio; rebuilding coal crusher plant at Kent, Ohio; extending stalls in roundhouse to accommodate larger power, and extending ash pit facilities at Marion, Ohio; rebuilding freight station at North Tonawanda, N. Y., and building storage tracks in the vicinity of Youngstown, Ohio

Work contemplated for the near future includes second track at Akron, Ohio; new main track to provide switching facilities and car storage yard at Warren, Ohio; engine standing track facilities and additional yard track at Salamanca, N. Y.; additional tracks in west-bound yard, Meadville, Pa.; rearrangement, west-bound engine tracks, Kent, Ohio; repair shops, Kenmore, Ohio, 3 miles of double-track, Belfast, N. Y.; rearrangement of tracks to facilitate handling of ore cars, Sharpsville, Ohio; extending erecting shops, Susquehanna and Meadville, Pa., and elimination of grade crossings, Springwater and Warsaw, N. Y.

It is stated by the railroad that all expenditures have been made for the purpose of speeding up the operation of present facilities rather than for extensions, and that the plans for the immediate future are on the same basis.

Baltimore & Ohio Railroad Co.

AT THE close of Federal control the government had expended about $21,000,000 on the lines of the Baltimore & Ohio largely for yard and terminal extensions. When the railroads were returned to private management, however, some $3,000,000 was required to complete the work under way and since then the Baltimore & Ohio has arranged for further work aggregating some $5,000,000 to meet immediate requirements and to round out improvements already under way, involving a total expenditure for additions and betterments of approximately $8,000,000. The more important of these are:

Revision of a branch line and construction of yard for 400 cars at Locust Point, Baltimore, necessary for large new industrial development, at a cost of $995,000.

Completion of automatic signals between Willow Grove and Goehring, Pa., (35 miles) at a cost of $109,000.

Rebuilding of bridge across Allegheny River at Pittsburgh involving replacement of old bridge with new double-track structure capable of carrying the heaviest power and at a height of approximately 13 ft. above the old structure, at an estimted cost of $2,100,000.

Relocation of line and reconstruction of yard at Girard, Ohio, for industrial development, at a cost of $336,000.

Construction of a bridge at a new location and elevation across the Big Miami River at Lawrenceburg, Ind., at a cost of $1,980,000.

Relocation of main line and construction of roadbed for second track between North Dayton and Tippecanoe, Ohio, to conform to requirements under the Miami Conservancy improvement, at a cost of $475,000.

Miscellaneous expenditures incident to extensive program of bridge renewals, elimination of grade crossing of the National Pike at Claysville, Pa., etc., $2,045,000.

With the completion of improvements now under way the railroad company considers the property generally in well-balanced relation, with no immediately pressing requirements, but traffic is constantly developing and if it so continues, as expected, the company intends to perfect plans for handling such additional business through the enlargement of its divisional yards, the construction of additional main tracks through the more congested territories, and such other betterments as are necessary to meet the requirements as they develop.

Since the period of Federal control the Baltimore & Ohio has ordered new equipment, now being delivered, and has rehabilitated existing rolling stock, at a total cost of about $11,000,000.

Steel Shipbuilding in the United States

According to a summary prepared by the Bureau of Navigation of the U. S. Commerce Department, 334 steel vessels were building or under contract in private American shipyards on Nov. 1. Their total capacity is 1,206,486 gross tons, or something less than 4,000 tons average per ship.

Letters to the Editor

Water Important in Concrete Surface Conditions

Sir—Your editorial, "Unsightly Concrete Surfaces," in the issue of Dec. 16, 1920, p. 1161, states the problem so clearly that its answer is almost obvious. It is astonishing that there appears to be among engineers generally so little realization of the importance of producing concrete construction "of permanently good appearance," consequently so general a failure to grasp the cause of unsightly concrete.

Efflorescence or bloom, "characteristic patches and streaks of discoloration," surface cracking and checking, spalling and the many other surface ills which are responsible for the "distressing appearance" of so much concrete construction have a single underlying cause. The presence of water in the concrete, either through the natural absorption of rain and atmospheric moisture into the surface, or, and more serious and important, the percolation of water through the concrete to the exposed face.

The action of moisture is, in the main, three-fold: first, the dissolving of the soluble magnesium and calcium salts in the concrete and carrying them to and depositing them on the surface as efflorescence or bloom; second, by creating differential expansion—the expansion of concrete due to varying moisture content being considerably greater than that due to temperature changes—it starts cracks parallel to the surface at approximately the average depth of penetration of the moisture with resulting spalling; third, by sudden expansion on freezing it creates additional cracks and completes the work of deterioration already started.

On concrete building construction and most vertical concrete surfaces above grade it is a question simply of preventing the surface penetration of water. It must be admitted here that as far as the writer knows none of the methods at present generally in use are entirely satisfactory but it is felt that by the use of the right type of paint or colorless penetrative waterproofing application with particular attention given to the back of parapets and copings, quite efficient results can be obtained. The writer has observed instances where such handling of the problem has produced most satisfactory results for periods of from ten to twelve years.

On retaining walls and particularly on concrete bridge construction the problem is chiefly one of percolation of water through the concrete and is more serious and difficult. Its successful solution at the initial attempt is more vital. Here it is strictly a pressure waterproofing problem; to be solved, however, as the particular conditions demand. The point of real importance is that the need of real waterproofing efficiency and the need of producing this efficiency at the first try be generally recognized. In the writer's experience he has observed two essential characteristics beside waterproofness which a waterproofing system for this work should possess—a proved, effective life equal to that of the structure; elasticity under all conditions and variations in temperature.

In conclusion the writer seriously doubts if in concrete construction "there is any prospect of being able to make exposed surfaces of permanently good appearance without finishing treatment" or at least effective protection against water percolation. He believes, however, that "concrete construction that can honestly show its own face" will be produced when it is generally recognized that water is its worst enemy and must be thoroughly and efficiently guarded against.

ALLRICH S. HARRISON.

New York, Dec. 28, 1920.

Highway Situation Pictured as Seething Mass of Flux

Sir—Under date of Nov. 11, 1920, on the front cover of *Engineering News-Record*, you say: "The past year has been one of unusual confusion in the highway field."

This statement seems to be not only true (please do not infer that I think truthfulness rare in the *News-Record*) regarding the material shortage conditions to which you applied it, but also to the general and specific conditions covering practically the whole highway field. During the past year, from Dec 20, 1919, to Dec. 16, 1920, inclusive, the *News-Record* has published about 120 articles (45 of which were contributed) covering the "field" from administration to physical work, from research to finished product and from reconnaissance to maintenance.

Surely "the world do move." It is not over ten years ago that one of the then most widely known civil engineers in New York State told me that highway work was not engineering, but psychology. This man's statement was made from a knowledge gained as an executive officer of a large and growing state highway department—therefore entitled to consideration.

Either highway work has moved or you gentlemen of the McGraw-Hill Co. are publishing a psychological magazine under a false name and thousands of highway designers and builders are carrying misleading titles. What your reasons were for publishing any, or all, of the aforementioned articles is of no concern at present. As a psychological engineer I am more interested in what they contained and what builders of roads can get out of them.

After reviewing the year's offering as set forth in these articles, would it not be justifiable to paraphrase your quoted saying: The past year has been one of unusual flux in the highway field. Would not that statement fit the field as including administration, design, construction and maintenance as your statement fits the field of material delivery and its relation to the general work of highway building?

Such a review discloses the fact that the policies of one state are tabooed by the next and that a third considers the first two wrong; that the commission in one commonwealth demands the perogative of controlling its highway inspection from the "seats of the mighty" and that in another is willing to take a chance and let some of its subordinates look after the details; that one man speaking with authority states that "clay is a fluid" and all our text and hand books have entirely overlooked this important fact.

Again we are told that ditches are a wasteful expenditure of time and money and a detriment to an improved highway. Then we learn that ditches are better than tile (must we infer that ditches and tile are both of no value?) and next it is stated that ditches are so ingrained in the road fabric of the British Isles and the Continent that they cannot be separated therefrom.

Then we learn how much we should be paid, and "the great unrest" is intensified; next, that an important state is maintaining its roads by the use of clean screened gravel, unbound, and for years some of us have been attempting to obliterate the unbound spots from our roads; that a certain policy has just been inaugurated, but we know it was inaugurated at least four years ago; that a billion dollars has been made possible for highway work, but we realize this can be meant only as a small beginning when we multiply the cost per mile spent by some authorities by the number of miles needing improvement.

What have we learned, or what can we learn from these articles?

I have learned that the highway field covers the greatest construction program in the United States today; that its ideas and ideals are in a state of flux boiling and seething at a white heat; that the curent literature on the subject runs the gamut from grave to gay and from sense to nonsense; that every place has its own particular problems as well as many general policies which it must follow and obey and that the experience of any other locality or the theories of any other person can be used only in so far as they fit my particular conditions; that inexperienced men are formulating policies and propounding theories which cover as much typewritten space as those of experienced men.

If my primary object is to get my people out of the mud—if that is what

they demand—then the order to myself, as I review the *News-Record*, is: As you were! The final conclusion is, stay steady—there are enough others rocking the boat to prevent the trip from becoming monotonous. Because some fellow is building a Belgian block, reinforced-base pavement 30 or 40 ft. wide is no reason why I should be discouraged because I cannot do likewise. Neither shall I despise the fellow who is building gravel with H_2O for binder (maybe he is doing the best thing possible). Because the policy in Maine or Iowa differs from that in New York is not proof that the latter is wrong.

Centrifugal force, capillary attraction, the flow of water—these and other laws are the same adjacent to an improved highway as in other localities. Stay steady.

Would it not be interesting to you of the staff to learn how a review of the *News-Record's* offerings during the year just passed has influenced others who are engaged in this great, new-old line of work?

Wishing you a very hapy and a prosperous New Year I remain,

T. M. RIPLEY,
Division Engineer, New York State Highway Department.
Watertown, N. Y., Dec. 30, 1920.

Useful Dodges in Surveying

Sir—In your issue of Dec. 16, 1920, p. 1164, there is described by H. L. Thackwell a method of surveying by means of transit and stadia with the aid of a sketch board. This method was used by the writer about fourteen years ago in the location surveys for the Catskill aqueduct. Considering the surveying apparatus which was available at that time this furnished a very satisfactory method, although at the close of the work a single plane-table party was beginning to turn out better work at a lower cost than any of the transit parties.

Since that time the great improvements both in plane-table apparatus and in methods have so increased its superiority over transit and stadia methods that it seems strange to the writer that anyone should advocate the use of the latter for a topographical survey of any description, much less one involving a considerable area. The application to the plane-table alidade of the Beaman attachment makes it possible to read distance and elevation direct without the use of the slide rule, thus dispensing with any computations and making the process purely mechanical. Since with the plane table the location of the points is also mechanical, the speed is greatly increased and the probability of error is greatly reduced. It is possible to close traverses over considerable areas with the plane table and control is necessary only when the area becomes of some magnitude. In the writer's opinion the use of transit and stadia methods is justified only where plane-table apparatus is not available and where the size of the work will not justify its purchase.

In military work the plane table has supplanted the transit both for topographical surveys and for the problems of battery location. In civilian work we find the U. S. Geological Survey the greatest mapping agency in the world using nothing else.

If the duration of the survey is to be greater than six weeks it is the writer's opinion that the plane table will not only pay for itself but the results obtained will be very much better.

JOHN P. HOGAN,
New York Water Power Investigation.
New York City, Dec. 27, 1920.

Favors Higher Auto Tax

Sir—I wish to make a serious plea for a curtailment of expenditure for road building. One could very well argue for such curtailment at this time as a temporary policy since for a nation, as well as for an individual, there are times when it is advantageous to keep its assets in a liquid condition, and so one could even admit road improvement to be desirable and still consistently urge that none of it be done for awhile so as to conserve liquid assets.

But I wish now to go further and make a broader argument and insist that road improvements should not be made from funds raised by general taxation. Since the use of automobiles has become general the cost of building and maintaining roads has increased greatly. This increased cost, I maintain, should in justice be borne by motorists. And building and maintaining roads by general taxation does not place the burden there. Part of the burden falls on motorists, but an inadequate part.

To make this argument quantitative let us say that the cost of a road for a traffic of 500 automobiles daily is $20,000 per mile and that annual maintenance would be $500 a mile. Then with interest at 5 per cent the annual cost per mile of road would be $1,500 and the daily cost say $5, so that 1c. per mile would be the road expense for each automobile. If each automobile is run 5,000 miles in a year the charge against it to maintain the road should be $50 annually but no such tax is levied, the usual annual fee being $10, in some cases $5, so that the automobile owner pays only about one-fifth what he should.

But it may be said in answer to any such argument that the general prosperity throughout the country brought about by the use of automobiles is such that general taxation for road building purposes is amply justified. The recent severe decline in prices and resulting business depression has furnished a means of testing such an argument. Iowa is the state having most automobiles in proportion to population. The people of this state borrowed this fall from the Federal Reserve Bank of the Seventh District 245 per cent of its quota of the usual crop moving loans, while Illinois took only 84 per cent, Michigan 102 per cent and Indiana 86 per cent. Furthermore, South Dakota, which ranks seventh among states in regard to number of automobiles in proportion to population, is the state where banks have been failing.

A stiff tax on automobiles would benefit the United States. To hold up for awhile on road construction would also benefit.

JOHN WILKES,
Civil Engineer.
Nashville, Tenn., Dec. 27, 1920.

A Plea for Mathematical Forms

Sir—Referring to the article entitled "Simple Solution of Three Highway Construction Problems," by W. B. Walraven in *Engineering News-Record* of Dec. 16, 1920, p. 1172, the question I would ask the author is: Why should we abandon mathematical conventions when considering a problem in mathematics?

In his Problem 1 the author assumes the center of the circle at the origin of the rectangular coordinates in which case the mathematical equation of the circle is $X^2 + Y^2 = R^2$, and his axes are X and Y instead of H and V as given.

Instead of considering the center of the circle at the origin of the axes it would be more convenient, in highway curve problems, to assume that the P.C. is at the origin of the axes and that the tangent through the P.C. is the Y axis. The center of the circle would then be to the right or left of the origin and on the X axis. The arc to be considered may be in any quadrant. With this assumption the rectangular equation for the circle would be $Y = \sqrt{X(2R - X)} = n$ (in the article), and $X = R - \sqrt{(R + Y)(R - Y)} = 0$ (as given). We may then proceed along mathematical lines and determine the values of the other elements in terms of X and Y as also X or Y in terms of R, T, C, L, E, M and I or Δ.

As a second question: Why use the arbitrary idea of "degree of curve" on highway work, instead of the mathematical idea of radius of curvature? "Degree of curve" has little practical value in the location of highway curves and is an obstacle to a thorough working knowledge of the mathematics of the simple circular curve.

I find the same fault in the article by Walter H. Drane, "A Method of Setting Out Curves," appearing in the same number (p. 1176), in that the diagram of the curve is not presented as a mathematical graph. It should also be noted that $FA = 2R \sin \Delta/4$ and not as given.

This is a plea for adherence to mathematical forms and usages in the solution of practical mathematical problems.

I value these articles for the "Average Engineer," as engineering is mostly of the average variety.

JOS. A. KITTS.
Petaluma, Cal., Dec. 24, 1920.

HINTS FOR THE CONTRACTOR

Comparing Paint Costs

By A. H. Sabin
Consulting Chemist, National Lead Co., New York

If a paint costing $3.50 a gallon lasts 5 years, what is the value of a paint which lasts 4 years?

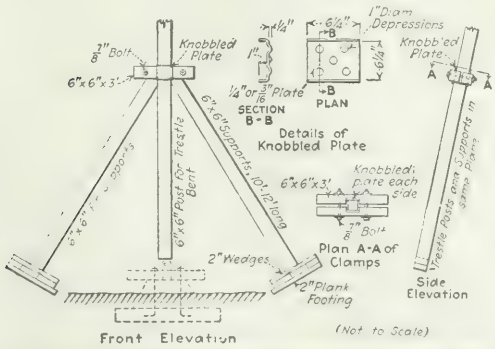
With labor at 75c. per hour it would cost $6 to apply it. Then the cost would be $9.50 applied, or $9.50/5 = $1.90 per year, = $7.60 for 4 years, per gallon of paint used. Deducting $6 for labor, the value of the 4-year paint, if it is to be on even terms with the 5-year paint, is $1.60. By similar calculation, with labor at 60c. it is $1.84; or with labor at 50c. it is $2; or with labor at 40c. it is $2.16.

If the $3.50 paint lasts 6 years, the values of the 4-year paint become 32c., 77c., $1 and $1.27. The 4-year paint would have to be given away if the $3.50 paint lasts $6\frac{1}{3}$ years on the 75-c. labor basis, or 6.9 years on the 60c. basis, or $7\frac{1}{2}$ years on the 50c. basis, or $8\frac{3}{8}$ years on the 40c. basis.

Simple Support for Trestle Legs While Replacing Footings

By Donald G. Coombs
Office Engineer, Braden Copper Co., Rancagua, Chile

SIMPLE supports for the legs of a high trestle, while renewing the concrete footings, are indicated by the accompanying drawings. The trestle was 1,034 ft. long and 168 ft. high over the river. Because of a land slide the piers for about twelve bents were dropped from 6 to 16 in. and moved laterally as much as 24 in. The piers were about 6 ft. square at the base and 3 to $3\frac{1}{2}$ ft. high, and to remove them and sink new footings to more firm ground entailed supporting the legs of the trestle bents in a safe manner without interfering with the progress of the excavation, etc. The sketch shows the method. But one bent was worked on at a time as a matter of safety, and the clamp shown was attached just below the second row of horizontal bracing. The trestle timbers were of Douglas fir, so that when the bolts were tightened the knobs on the plates bit into the timber sufficiently to prevent slipping. By means of wedges the posts were raised the few inches necessary to level the trestle and by being placed in the same plane as the batter posts no distortion occurred. With this device two carpenters and a few laborers took out the old piers from one side of twelve bents; excavated several feet for and poured new piers, and realigned the trestle at a cost of 20 per cent of the estimate.



CLAMP SUPPORT FOR TRESTLE LEG BEING REPAIRED

The work was done under the direct supervision of Dave Dupuis, general foreman, and the clamp and method were his idea. The writer was office engineer.

The Camp Commissary

SOMETIMES we feel that the last has been said on the camp commissary—not that camp commissaries cannot be improved but that we all know how they *should* be run if even the practice is not up to the theory. Yet an old hand in watching camp commissaries sends us the following comment:

"Napoleon said that an army 'marches on its stomach,' but even with a policy that places the importance of commissary as high as that it is doubtful if one of Napoleon's best mess sergeants could hold the job of supervising commissary in a modern construction camp. In military life court martial threatens the deserter. The modern laborer indulges a temperamental disposition and on the slightest provocation is ready to draw his 'time' and move on.

"The average quality of food served in construction camps has materially improved in recent years. The experienced contractor now regards it as necessary to hire capable chefs, expensive though they are, keep them well supplied with the best materials and sell the resulting high quality food to the men below cost—below a cost figured on wholesale prices. Costs are kept down because beef often is delivered on the hoof and butchered at the camps; other supplies are bought in carload lots. Meals such as are provided in these camps, when furnished to individuals by restaurants or boarding houses, have to be sold at a price that will cover high overhead waste, due to uncertain patronage, and a profit on the cost of food bought and prepared in a more expensive way. In fact, camp fare is often very much better than what the men get when in town.

"If camp fare is not excellent the contractor suffers from a high labor turnover. He soon learns just what he cannot afford to do in kitchen economies. On the other hand, where the food is regularly kept up to a creditable standard the men readily fall into the habit of taking its good quality and low cost to them as a matter of course. They easily find other matters to grumble about. In such camps, if a considerable percentage of the men speak the same language, it might be good policy to detail one of the 'mess sergeants' to prepare and post from week to week bulletins on the variety, particular kind or amount of foodstuffs received or to be received. These bulletins could give the name of the officer in the camp authorized to receive complaints about food and could occasionally show, by comparison of cost or otherwise, the advantages offered the men.

NEWS OF THE WEEK

New York, January 6, 1921

Engineering Council Activities Transferred to New Body

Beginning Jan. 3, activities of Engineering Council and the Engineering Societies Service (employment) Bureau were transferred to the American Engineering Council, of the Federated American Engineering Societies. The American Engineering Council now has an office in Washington at the McLachlen Building, 10th and G Sts., with A. C. Oliphant as acting assistant secretary in charge. This office is available for the member societies of Engineering Council. The service bureau is being maintained in the Engineering Societies Building, 29 West 39th St., New York City, with Walter V. Brown in charge.

Temporary Management Committee

Pending the development of a more permanent organization which may direct this activity of the American Engineering Council and which has had such a close relationship with the secretarial responsibilities of the member societies of the Federated American Engineering Societies, the secretaries of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been requested to act as a committee on management to conduct the service bureau until such time as a permanent organization under the American Engineering Council can be effected.

The committee on procedure of the executive board of the American Engineering Council, voting to take over the employment service, specified that the applicants should be arranged in two groups: First, "preferred," those who are members of member societies of the Federated American Engineering Societies; and, second, "ordinary," all others.

As a means of comunicating with the secretaries of the member societies of the federation, a bulletin listing positions open will be regularly issued.

The following committees of the former Engineering Council have been invited to act as committees of the American Engineering Council: Classification and Compensation of Engineers; Cooperation with American Institute of Architects; National Board for Jurisdictional Awards in Building Industry; National Service Department; New York State Government Reorganization; Patents Committee; Payment for Estimating; Russian-American Committee; Types of Government Contracts.

Engineer Made New York's Superintendent of Works

Governor Miller, the new Governor of New York, has appointed Charles L. Cadle, chief engineer of the Rochester Lines of the New York State Rys., as Superintendent of Public Works—in which capacity among other things he will have charge of the operation of the New York State Barge Canal. Prior to Nov., 1917, Mr. Cadle was electrical engineer of the Rochester Lines, Rochester, coming to Rochester from Cleveland, Ohio, where he had been for two years chairman of the Electric Railway Improvement Co. He has served as a member and also chairman of the Power Distribution Committee of the American Electric Railway Engineering Association, and has acted as chairman of the committee of the Engineering Association to confer with the Bureau of Standards on the Electrical Safety Code.

J. Waldo Smith Advises Water Board for San Francisco

When the people of San Francisco are asked to vote next February on the proposed purchase of the Spring Valley water system, as announced in the *Engineering News-Record*, Dec. 9, 1920, p. 1157, it is planned to include in the measure provision for a water board. The suggestion that such a board be formed came from J. Waldo Smith, chief engineer of the Board of Water Supply of New York City, while in San Francisco reporting on the Spring Valley Water Co. properties for the local Chamber of Commerce.

As tentatively proposed by the city attorney there would be a paid water commission of three members holding office for six years, whose duties would be to determine water rates, make collections and make all repairs and minor extensions. The board would have its own staff of engineers and would handle all repair and construction work costing less than $2,500. Larger jobs would be contracted. The construction of the Hetch Hetchy project would remain under the direction of the city engineer, but when that work is completed the board would take over its operation as well as that of the Hetch Hetchy electrical power system.

A. I. E. E. Convention

The seventh midwinter convention of the American Institute of Electrical Engineers will be held in New York City, Feb. 16-18, in the Engineering Societies' Building, 33 West 39th St.

The convention will include six technical sessions and visits of inspection.

Details of Am. Soc. C. E. Annual Meeting Announced

The sixty-eighth annual meeting of the American Society of Civil Engineers will be called to order at 10 a. m. Wednesday, Jan. 19, in the auditorium of the Engineering Societies' Building, 33 West 39th Street, New York City. The first session will be a business meeting devoted to the presentation of annual reports, election of new officers, appointment of nominating committee, reports of special committees and a discussion of proposed amendments to the constitution.

For the afternoon of Jan. 19 five excursions have been arranged in case the business meeting does not continue throughout the afternoon. In the evening the president's reception and dance will be held at Delmonico's, 44th Street and Fifth Avenue.

The morning and afternoon of Jan. 20 will be devoted to an inspection trip covering a variety of industrial activities in or near New York. Motor buses will leave the Engineering Societies Building at 9:45 a.m. sharp. At 12:30 p.m. the members and guests will be entertained at luncheon by the Metropolitan Life Insurance Co., after which there will be an address on "Human Engineering and Industrial Group Life Insurance" by Haley Fiske, president of the company. At the conclusion of this address there will be an inspection of the building, including a trip to the 650-ft. tower.

At 8:30 p.m. in the auditorium of the Engineering Societies Building there will be an address by a man of national prominence on "The Engineer, His Future and Relation to the Economic Life of America," followed by the usual informal smoker.

The committee on arrangements consists of J. P. H. Perry, chairman, Robert Ridgway, Ralph R. Rumery, George D. Snyder, and Herbert S. Crocker.

Winter Halts Efforts to Salvage Concrete Steamer "Polias"

On account of heavy winter weather the attempt to get the concrete steamer "Polias" off of the rocks at Old Cilley Ledge, near the southwestern entrance of Penobscot Bay, Me., has been abandoned, although it is announced by Aëronautical Equipment, Inc., the company to which the U. S. Shipping Board awarded the contract to salvage the vessel that hope of floating her has not been entirely abandoned. Inspection of the ship will be made in the spring and if conditions then appear as good as they were this summer the efforts to float the ship will be renewed.

Engineers to Advise on New City Charter for Nashville

The Nashville Engineering Association has appointed a committee of engineers to co-operate with attorneys who are to frame a new city charter for Nashville, Tenn. Besides W. T. Young, chairman, the committee members are: Hunter McDonald, C. S. Brown, B. H. Klyce, H. C. Hibbs, W. F. Creighton and T. L. Herbert.

Kansas Society Holds Annual Convention

Laws making the registration of engineers compulsory will be introduced in the Kansas Legislature at the coming session as a result of efforts by the Kansas Engineering Society. A legislative committee was appointed at the closing session of the society's thirteenth annual convention, which was held at Topeka, Dec. 16 and 17.

Interest in the problems confronting the profession brought out an attendance of 125 engineers. That the engineering profession is as important to the state's progress as any other was the declaration of resolutions adopted.

Chancellor E. H. Lindley, of the University of Kansas, was one of the principal speakers; his subject was "Human Engineering." P. F. Walker, dean of the school of engineering at Kansas University, explained in detail the industrial survey which is being made in the state. The survey is intended to show what community is in need of certain industries or what industry can thrive best in certain communities.

The society also voted its co-operation with the state chamber of commerce, local chambers of commerce and with the state board of health.

In addition to a report on sewage made by F. M. Veatch, the members listened to and afterward discussed reports from various other committees.

H. S. McFadden, Topeka, reported on highways; D. L. Hammond, masonry and concrete; W. E. Baldry and P. L. Brockway, on the use of paving materials; L. E. Conrad, on surveys, and C. A. Haskins, on water-works.

"Bridge Development in Kansas" was the subject of a paper read by F. W. Epps, of the State Highway Department.

Plans for organizing a Kansas section of the American Society of Civil Engineers were begun at a luncheon of the members of the national society attending the state convention. A committee appointed to perfect the organization includes Lloyd B. Smith, W. E. Baldry and L. R. Tillotson, all of Topeka.

The new officers elected were: Dean P. F. Walker, Kansas University, Lawrence, president; Lloyd B. Smith, Topeka, vice-president; J. M. Averill, Topeka, secretary; J. W. Mavity, Wellington, A. E. Noble, Norton, members state engineering council; Lloyd B. Smith, member of the American Engineering Council.

Survey of Government Departments Authorized by New Law

The Smoot-Reavis resolution providing for a survey of the executive departments of the Federal government has become a law without the signature of the President. The statutory ten-day period passed without the measure having been vetoed and it became a law automatically. An incident of the legislation was the loss of the bill in the White House offices.

Opinion is divided as to whether the President would have vetoed the measure had it been brought to his attention. A joint congressional committee will be organized under the bill. It is expected that Senator Smoot, of Utah, will head the committee. The bill provides for the employment of a representative of the committee to take charge of the immediate direction of the survey which is to be made.

Advises $18,000,000 Water-Works Extensions for Kansas City

The board of review, appointed on recommendation of George W. Fuller, of Fuller & McClintock, consulting engineers, New York City, to consider the report of the latter on needed water-works improvements for Kansas City, Mo. (*Engineering News-Record*, Oct. 28, 1920, p. 865) has made a report advising a water-works bond issue of not over $18,000,000 to be entrusted to a non-partisan board of not less than four members selected with a view to their fitness, the board to be guided by competent engineers. The Board of Review, consisting of Wynkoop Kiersted, chairman; Clinton S. Burns, of Burns & McDonnell; George A. Johnson, of Johnson & Bernham; Alexander Maitland, Jr., and John Prince, advises: An intake, pumps and purification works on the Missouri River, near the Platte-Clay County line in Missouri; a new high-service pumping station on Nicholas Ave.; pressure tunnels from the new river station to the present Turkey Creek high-service pumping plant and to the proposed new high-lift station in the East Basin. The board's report has been approved by George W. Fuller, of Fuller & McClintock and is said to meet with approval of the Mayor and the Fire and Water Board.

New York Section of Civil Engineers Advances Meeting Date

Normally the New York Section of the American Society of Civil Engineers meets on the third Wednesday. Because of the annual meeting of the society, however, the next meeting of the section will be held Jan. 12. This date was also announced in the original program and special attention was called to it because it does not follow the usual rule of the third Wednesday meetings. The subject to be discussed is "Water Supply and Sanitation."

Lethbridge To Have City Manager

A change from the commission to the commission-manager plan of government was authorized on Dec. 14 by the voters of Lethbridge, Alberta, Canada.

Highway Education Committee Appoints Director

C. J. Tilden, professor of engineering mechanics at Yale University, has been granted leave of absence for a year to accept the position of director of the highway and highway transport education committee, of which Dr. P. P. Claxton, United States Commissioner of Education, is chairman. The committee, which was formed last May at the invitation of the Commissioner of Education, in addition to Dr. Claxton, includes Thomas H. McDonald, chief of the U. S. Bureau of Public Roads; Col. Mason M. Patrick, Corps of Engineers, U. S. A.; Roy D. Chapin, president of the Hudson Motor Car Co.; W. S. Keller, president, American Association of State Highway Officials; H. S. Firestone, of the Firestone Tire Co.; Dean Bishop, of the University of Pittsburgh, and Prof. Tilden.

The work planned by the committee includes the compilation of economic, scientific and engineering data relative to highway construction and highway transport, and the distribution of these data to educational institutions.

Agree on $100,000,000 for Federal Aid Roads

As a result of an executive meeting of the roads committee of the House of Representatives at Washington, D. C., it was announced on Dec. 22 that Republican leaders have agreed upon an appropriation of $100,000,000 for federal-aid roadwork. This money, it is understood, will be appropriated on the same basis as previous federal-aid funds; that is, the amounts will have to be matched by an equal sum appropriated by the states and the funds are to be distributed on both a population and area ratio. If the following three years are provided for on the same basis, this appropriation will permit of the execution of road development work as planned in the Chamberlain bill.

Connecticut Plans Increase in Motor Vehicle License Tax

According to a recent announcement made by the motor vehicle commissioner of Connecticut, complete revision of auto registration fees is planned. It is possible that the revised schedule will be placed before the legislature early in its session which begins Jan. 5. Essential points in the revised schedule include an increase in all registration fees so that the total collected will be approximately $3,000,000 per year instead of $1,800,000, the total for the fiscal year ending June 30, 1920. A new rating for passenger cars on the basis of horsepower and speed is contemplated.

Paul L. Wolfel

With the death last week of Paul L. Wolfel, chief engineer of the McClintic-Marshall Co., of Pittsburgh, one of the foremost bridge engineers of the day passed away. He died at Philadelphia on Dec. 28, after an illness of several months.

Born in Dresden, Saxony, on April 19, 1861, Paul Ludwig Wolfel studied civil engineering at the Dresden Polytechnikum, graduating in 1885. Two years after graduation he came to the United States. Here he met C. C. Schneider, chief engineer of the Pencoyd Iron Works (A. & P. Roberts Co.), and entered the bridge and construction department of that company.

In 1890 Mr. Wolfel became assistant chief engineer of Pencoyd, and he occupied this position until the company was merged in the American Bridge Co., ten years later. One of the policies which he put into practice during this period and consistently adhered to in his later life was the development of young men who came under his direction. The apprentice course offered in the Pencoyd drafting room produced many engineers who credit their success to his early guidance. His interest in his fellows also revealed itself in many other ways, as in his becoming one of the founders and principal supporters of the Pencoyd Club. The important engineering works with whose design and construction he was connected during these ten years include the Pennsylvania R.R. bridge over the Delaware River at Delair, Penn., and the Atbara bridge in the Sudan, the latter erected by Pencoyd with its own forces.

Upon the formation of the American Bridge Co. in 1900 Mr. Wolfel was made chief engineer, Mr. Schneider becoming vice president in charge of engineering. In 1905, after a period of ill health, he became consulting engineer to the company, remaining in this position until June 30, 1908, when he resigned to assume the duties of chief engineer of the McClintic-Marshall Co. Marshall Williams, assistant to the president of the American Bridge Co., writes, "Mr. Wolfel's active connection with the Pencoyd Iron Works and the American Bridge Co. was ever signalized by a high type of intelligent administration. He was thorough in research, careful in analysis, honest in execution, fair-minded toward his colleagues, and evinced a brotherly interest in the men who served under him. As consulting engineer for the American Bridge Co. his outstanding work was done in connection with the company's part in the reconstruction of San Francisco.

Mr. Wolfel became chief engineer of the McClintic-Marshall Co. at the time of the construction of the Ohio River bridge at Beaver, Penn., for the Pittsburgh & Lake Erie R.R., of the New York Central Lines. This great structure was the first large cantilever to be built after the disaster to the first Quebec bridge, and unusual care was given to its design, fabrication and erection. Because of its magnitude and carrying capacity, unusual study was given to perfecting its details of construction, in which work Mr. Wolfel's experience and clearsighted constructive ability were invaluable. The Beaver bridge as a result marked a distinct advance in bridge engineering.

In the fabrication and erection of the 46 pairs of mitering lock gates for the

PAUL L. WOLFEL

Panama Canal, the largest ever constructed, Mr. Wolfel's guidance contributed to the successful completion of the work by the McClintic-Marshall Co., this at the time depresented probably the largest tonnage of structural steel work ever contracted for at one time.

Among the great bridges constructed by the company under his supervision were the viaducts and various crossings of the New York Connecting R. R. (Hell Gate line) on Long Island and in the Bronx; the Fratt bridge over the Missouri River at Kansas City, and the Sciotoville bridge of the Chesapeake & Ohio Northern Ry. over the Ohio. He was called as a consulting expert by the board of engineers appointed to decide on the type of construction of the second Quebec bridge over the St. Lawrence River.

Mr. Wolfel's work ever expressed his desire for the advancement of the art of steel bridge construction in excellence and stability. He enjoyed the confidence of the engineering profession to an unusual degree. Whatever was placed in his hands was treated with care, thoroughness and absolute integrity of purpose to achieve the best possible result. In his relations with [illegible] he pointed the way to a [illegible] and a high professional standard.

Hoover Represents Engineers on Commerce Committee

American participation in the International Chamber of Commerce became fully organized last week with the appointment of an American committee composed of 57 of the leading business men of the country. The engineering interests are represented by Herbert C. Hoover, president of the American Engineering Council of the Federated American Engineering Societies.

Want State Engineer for Indiana Drainage

The Indiana Department of Conservation will request the legislature to appropriate $30,000 for the maintenance of a state engineer and staff to supervise drainage and similar work in Indiana. The engineer would be required to provide information and to advise courts and county commissioners in regard to drainage projects and reclamation work. A bill has been prepared to create the state division of engineering as a part of the conservation department.

Automotive Engineers Announce Highway Session

At its annual meeting in the Engineering Societies Building in New York City next week the Society of Automotive Engineers on Jan. 13 will inaugurate a "Highway Session" as the first step toward co-operation between the automotive and the civil engineer in the solution of the highway problem. The program includes the following papers: "Government Highway Research," by A. T. Goldbeck, U. S. Bureau of Public Roads; "Variable Factors that Influence Highway Design," by H. Eltinge Breed, consulting engineer; and "Automobile Roads," by W. E. Williams.

Licensing Bill in Tennessee

At a joint dinner of the Memphis Chapter of the American Association of Engineers and the Memphis Engineers' Club on Dec. 20, given in honor of a delegation of state legislators, the lawmakers were informed of the contents of two bills prepared for introduction before the recent session of the legislature. One provides for a department of sanitary engineering in the state board of health and the other for the licensing of engineers and architects. Several prominent engineers and architects spoke in favor of both bills.

River and Drainage Conference

A joint conference of the Mississippi Valley Association and the National Drainage Congress is to be held Jan. 19 and 20 at the Harrington Hotel, Washington, D. C., to discuss means of promoting river regulations, flood control, hydro-electric development and drainage of swamp lands. It is planned also to take up these subjects with congressional committees and department heads.

Cement Producers and Employers' Association Under Fire

In winding up its investigation of the housing situation in New York City the Lockwood joint legislative committee, which ceased to exist Jan. 1 upon the expiration of the 1920 legislature, directed its attack against the cement producers, and against the Building Trades Employers Association, of New York City. Terra cotta producers were also under fire from the committee's counsel, Samuel Untermyer, evidence being introduced to show that there was an interchange of information in advance of bids among the nine members of the Eastern Terra Cotta Association.

Though the Lockwood committee ceased to exist, it is probable that a similar committee will be authorized by the new legislature, inasmuch as the report of Mr. Untermyer indicates that there are many alleged corrupt practices in the building industry still to be brought to light. It is possible, therefore, with favorable action for the continuance of the committee, hearings will again be resumed toward the middle of January.

Control of the cement field and price fixing on the part of the Cement Manufacturers' Protective Association, an organization of nineteen producers with a total annual output of approximately 28,000,000 bbl., were indicated in the testimony given before the committee. Testimony was also given to the effect that the association employed a complex card system wherein twenty-eight different forms were used and which furnished the basis for an alleged method of exchange of information among association members as well as among the members of other regional organizations. In addition, it was testified that six inspectors were employed to determine if prospective jobs needed as much cement as dealers had ordered. In accordance with contract forms submitted by manufacturers to dealers, the latter were forced to return all cement in excess of that actually used for any specific job.

Evidence was also brought out that upon a quarterly report of 630 transactions, ending Sept. 1, 1920, in Brooklyn, it appeared that in each of the sales, ranging in amount from 200 bbl. to 55,000 bbl. the price was in every case $2.65 a barrel. The testimony of the manufacturers was to the effect that cement prices were uniform, because cement is a standard product.

The attack upon the Building Trades Employers Association was directed against Otto M. Eidlitz, a member of the board of governors of the association, and a prominent New York builder. The committee's counsel introduced letters and minutes of the association in an attempt to show that as a result of the organization's close alliance with the Building Trades Council it dominated the building industry, forcing subcontractors and builders in general to seek membership in the association through its control (indirectly through the Building Trades Council) over the supply of labor. The association drew additional fire from the committee's counsel because of its failure to expel from the association those trade-association members whose alleged corrupt practices had been revealed by the Lockwood committee.

Sand Dealers Indicted by Federal Grand Jury

As a result of investigation brought out by the Lockwood committee, investigating housing conditions in New York City, indictments against fifteen firms and individuals alleged to have been in control of the sand and gravel situation in the New York district were returned by the Federal grand jury Dec. 29. Four firms and eleven individuals are included in those indicted for violation of the Sherman anti-trust law, the elimination of competition and conspiracy to monopolize the trade in a certain product.

The firms named are: the Goodwin-Gallagher Sand and Gravel Corporation, Manhattan Sand Co., Inc., Lenox Sand and Gravel Co., Inc., and the Colonial Sand and Stone Co., Inc., and various individual officers of these companies.

Brindell, Indicted Labor Leader, Refused Change of Venue

Robert P. Brindell, president of the Building Trades Council, New York City, and seven times indicted on charges of extortion and attempted extortion as a result of investigation brought out by the Lockwood committee on housing, has been denied a change of venue. The plea entered by Brindell's attorney, on which he sought a change of venue, was based upon the claim that his client could not get a fair trial in New York county because Judge Mulqueen, in General Session, had referred to Brindell as a felon.

Bethlehem Steel Company Reduces Wages

A general reduction in wages of from 10 to 20 per cent in all plants operated by the Bethlehem Steel Co., Baltimore, was announced Jan. 2 by its general manager. The decrease is effective Jan. 16. Wages of common labor will be reduced the full 20 per cent. In normal times the company employs from 5,000 to 6,000 men.

Foreign Firms Invited to Bid on Portugal Port Improvement

About $5,000,700 was recently made available for the improvement of the port of Leixoes (the seaport of Oporto) Portugal, says *Commerce Reports*. Work is to be begun soon and the present intention is to invite foreign bids, contractors to finance the work and to be repaid in bonds guaranteed by port receipts. Further information may be secured from the U. S. consular office at Oporto.

Cement and Hollow Tile Drop in Price

Cement dealers in the New York district announced a further decrease of 20 cents per barrel, without bags, Jan. 4. The drop is reported to be the result of keen competitive selling. Hollow tile also dropped slightly, as announced from the Perth Amboy, N. J., plant, the same day.

Brick on Order Only 41 Per Cent of That in Stock

According to a recent digest circulated by the Common Brick Manufacturers' Association of America reports received from 134 brick manufacturers in ten districts indicate that on Dec. 1, 1920, brick orders represented but 41.5 per cent of brick in stock. The total production of the 134 firms reporting is given as approximately 300,000,000 brick with orders for 123,000,000. The digest continues to say that the excess of 175 000,000 brick on hand over orders would not be serious if there were any demand, but this surplus will be increased rather than diminished during the next three months, as the small proportion of plants operating produce more than the current consumption.

A slight reduction in price is noted, averaging about $2 per thousand in the localities where lower coal prices have taken effect. In all other sections the price at plant remains the same as of Nov. 1.

New York State Builders to Hold Convention in February

The twenty-fifth annual convention of the New York State Association of Builders is to be held in Rochester, N. Y., Feb. 1 and 2, 1921. Rochester was chosen as the meeting place and the date for the convention was fixed at a recent meeting of the officers' conference of the association held in New York City. The association, through the officers' conference, has offered its services to the Lockwood Joint Legislative Committee which is investigating housing conditions in New York City, a special committee having been appointed for that specific purpose.

Abandon Large Co-operative Office Building Project

The Weaver-Crawford Corporation, New York City, has announced that owing to the continued money stringency and the sudden curtailment of business expansion it had not received a sufficient number of subscriptions to warrant the erection of the Park-Madison Building, which was planned to cover three blocks in the Grand Central Terminal area, announcement of which was noted in *Engineering News-Record*, Sept. 9, 1920. As its option with the New York Central R.R. for the blocks on which the building was to have been erected expires Jan. 11, 1921, it was not thought wise to proceed with the project.

Court Forbids Construction of Seattle Reservoir

In a decision handed down recently by the Superior Court, the city of Seattle, Wash., was enjoined from constructing the proposed second reservoir in Volunteer Park as an adjunct to the city water system. The case has been bitterly fought in the courts, suit to restrain the city having been brought by a group of Capitol Hill property owners who objected to the construction on the ground that it would be a menace to their lives and property and destroy the beauty of the park. The Capitol Hill district contains the most expensive and choicest residence property in the city. Hydraulic engineers from all sections of the country were brought to testify for the plaintiffs, and the city also spared no effort to obtain the most expert testimony.

Judge Clay Allen, in handing down his decision, maintained that construction of the proposed reservoir would create in the minds of the complainants fear as to the safety of their homes and that the project would become in legal effect a nuisance. Much of the expert testimony related to the probable amount of leakage from the proposed reservoir.

Shop Council Plan for Chicago Gas Company

According to a recent announcement made by the Peoples Gas Light & Coke Co., of Chicago, a "constitutional convention" of its employees is to be called to plan a system of co-operative management dealing with questions of pay, hours, rules, working conditions and any other debatable matter arising between employer and employee. The workers soon will hold a departmental election to select delegates to the convention at which a plan will be devised. One delegate for every fifty employees is allowed, the management having equal representation with the employes in the assembly. The plan at first is to be offered to the non-unionized departments, including about 2,500 workers, as the unionized branches have the usual contracts with the company. Later, opportunity will be given unionized departments to join in.

American Designed Machinery for Japanese Dam

A commission to design flood and outlet control machinery for the Uji River dam being built by Japanese power interests has been received by F. Teichman, consulting engineer, Boston, Mass. The dam will have a spillway crest with Taintor gates and two gate towers, each with an inner 12-ft. diameter cylinder gate (service gate) and an outer cylindrical emergency gate. Both gate towers will discharge into a 16-ft. diameter tunnel that serves as a bypass during the construction of the dam. The joint capacity of the two gate towers will be from 8,000 to 10,000 cu.ft. per second. The water will carry sand.

A. G. C. Announces Tentative Program for Convention

According to a tentative program recently announced for the second national conference of the Associated General Contractors of America, to be held in New Orleans, Jan. 25-27, inclusive, prominent discussion is to be given industrial issues in which the contractor is especially interested.

The morning of the first day of the meeting will be taken up mostly with routine. In the afternoon the contractors will break up into the various sections: Building contractors, highway contractors, railroad contractors and public works contractors. Special questions affecting these various fields which are to be discussed include the closed and open shop, Federal control of highway construction, the rehabilitation of the railroads, and interpretation of government contracts. On Jan. 27 at the morning session all divisions will consider compensation insurance. Other topics which will be discussed include housing, cement, railroad contractors' costs and the proposed Federal Department of Public Works. Various social features have been provided during the convention.

Denver Contractors to Join with A. G. C.

Denver contractors and engineers recently organized with a view to associating themselves with the Associated General Contractors of America. The Denver contractors will send representatives to the New Orleans meeting of the association, Jan. 25-27.

Road Contractors in West Virginia Form Organization

Road contractors from various sections of West Virginia and Ohio met in Wheeling Dec. 27 and organized the West Virginia Road Building Contractors Association. Temporary officers elected were: J. P. Mumaw, president, and T. J. Bartrue, secretary and treasurer.

Federal Building and Housing Bureau Proposed

Senator Calder, of New York, is the author of a recently introduced bill proposing the creation of a bureau of building construction and housing to be incorporated within the U. S. Department of Commerce. The bureau would function as a clearing house for all construction information.

U. S. Needs 1,250,000 Houses

According to recent estimates made by the civic development department of the U. S. Chamber of Commerce there exists a shortage of approximately 1,250,000 houses in the United States. It is also estimated that but 70,000 houses were built in the United States during 1919, while an even smaller number may prove to have been erected in 1920.

Hold Up Appropriation for Wilson Dam

By failing to include in the sundry civil bill any appropriation for the continuance of the work on the Wilson dam, at Muscle Shoals, on the Tennessee River, the committee on appropriations of the House of Representatives has precipitated an acrimonious controversy which promises to last throughout the session and may prevent the passage of the entire bill. The appropriation was withheld on the ground that the policy of the government with regard to this development has not been agreed upon. There is opposition to the proposed operation of the nitrate plants at Muscle Shoals. Those favoring the continuance of the work and the operation of these plants wield much influence and an effort will be made to override the committee and provide for sufficient funds to keep the work going.

Aid Skilled Help in Slack Times, Says Kansas Court

Employers of workmen in essential industries in Kansas must arrange to take care of skilled and faithful employees during times of depression, according to a recent decision by the Kansas Court of Industrial Relations. The decision was the result of a complaint brought by employees against the Topeka flour mills, which recently closed down to about half capacity as a result of the general depression in industry.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Jan. 19-20, 1921.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

The Western Society of Engineers' January program schedules ten meetings, among which are the following: Jan. 10, "Reducing the Cost of Steel Buildings," by R. Fleming, engineer, American Bridge Co.; Jan. 12, "Public Utility Rates," by A. S. B. Little, gas engineer, Illinois Public Utilities Commission; Jan. 14, "What Labor Expects of the Engineer," by Thomas R. Preece, vice-president, Bricklayers', Plasterers' and Stone Masons' International Union of America; Jan. 14, "The Tie Supply of the Future," by John Foley, for

ester, Pennsylvania System; Jan. 17, "Chicago City Water-Works, Past, Present and Future," by P. S. Combs, city engineer. On Saturday afternoon Jan. 8 the Young Men's Forum will hear Samuel H. Moore, director of welfare and pensions, Peoples Gas Light & Coke Co., on "The Engineer from the Human Standpoint," and on Jan. 22 Harwood Frost, president, Brown Portable Conveyor Co., will speak on "Engineering Literature—How to Write—What to Read."

The New Jersey State Association of County Engineers will hold its annual meeting at the Engineers' Club, Trenton, Jan. 25. There will be a business meeting and election of officers from 11 to 12 a.m. At the meeting commencing at 2 p.m. the following papers will be read: "Bridges for New Jersey Roads," by Charles A. Meade, bridge engineer, New Jersey Highway Department; "Some Facts Relating to Motor Vehicle Registration," by William L. Dill, commissioner of motor vehicles; "Testing and Laboratory Control of Large Highway Contracts," by R. B. Gage, chemical engineer.

The New England Waterworks Association will hold its annual meeting at the Copley Square Hotel, Boston, Jan. 12. The program calls for the annual address of the president and for reports from fourteen committees, the secretary and other officers and the tellers appointed to canvass the ballots for officers for 1921. Frank J. Gifford, Dedham, Mass., is secretary.

The American Concrete Institute announces that the annual meeting will be held at the Auditorium Hotel, Chicago, Feb. 14-16. The secretary of the Institute is Harvey Whipple, New Telegraph Building, Detroit, Mich.

The Iowa Engineering Society will hold its annual meeting Jan. 18, 19 and 20 at the Chamberlain Hotel, Des Moines.

Personal Notes

W. H. Fairchild, formerly city engineer of Galt, Ont., Canada, has been appointed manager of the Galt Public Utilities Commission.

William C. Barber, mayor of Joliet, Ill., has accepted the city managership of Dayton, Ohio, at a salary of $12,000 a year, succeeding James E. Barlow, resigned.

H. T. Carmichael, for the past seven years managing partner of Mason & Hanger Co., Lexington, Ky., has accepted a position as general superintendent, Kentucky Rock Asphalt Co., Bowling Green, Ky., in charge of future development of its 50,000-acre holdings.

Clyde T. Morris of Ohio State University has been appointed engineer on the building of the university stadium, which will seat 63,000 people and will cost $1,000,000. Charles Evan Fowler, New York, has been retained as consulting engineer on the foundations and river improvement.

Edward S. Clark, who has been in the employ of the city of Kalamazoo, Mich., for more than 13 years, during which time he has had charge of practically all branches of the engineering department, has been appointed city engineer.

Richard D. Parker, chief engineer of the Railroad Commission of Texas from 1909 to 1920, has been appointed chief engineer of the gas utilities division of the commission.

Louis A. Gueringer, for the past three years assistant engineer of the Railroad Commission of Texas, has been appointed chief engineer. He was for 20 years locating and constructing engineer for the Frisco and other trunk lines in Texas.

James P. Hays, formerly field superintendent in the Cleveland district for the Austin Co., has been promoted to superintendent of this district with headquarters in Indianapolis.

H. L. Newman has been appointed maintenance engineer of the Pittsburgh, Shawmut & Northern R.R. He has been with this road since 1906, recently in charge of all engineering, including valuation and location.

George Cottingham, Jr., formerly roadmaster Northern Pacific Ry., with headquarters at Carrington, N. D., has been appointed engineer maintenance of way, Eastern Division, Chicago, Great Western R.R., with headquarters at Chicago.

W. A. Hendry has been appointed chief water-works engineer of Waterloo, Iowa.

John Storm has been appointed engineer of the water-works plant of the Public Service Co. at Mattoon, Ill.

P. Y. K. Howat, civil engineer, president of P. Y. K. Howat, Inc., engineers and contractors of Annapolis, Md., has recently been instrumental in organizing a Rotary Club in that city. Mr. Howat was elected president; Henry P. Hopkins, an architect, vice-president, and Walter C. Munroe, another civil engineer, was made a director.

Melvin E. Hiet has accepted the position of engineer of Nowata County, Okla., in addition to his present position of engineer for Pawnee County.

Philip L. Pratley of Montreal, Canada, has been awarded the Telford gold medal of the Institution of Civil Engineers of Great Britain for his paper, "The Design and Erection of the St. John Arch." Mr. Pratley is at present in charge of the Montreal office opened some time ago by the Department of Railways and Canals in connection with the Grand Trunk arbitration.

P. J. Mundy has been appointed city manager of Radford, Va.

H. L. Wilson has been appointed city engineer of Johnstown, Pa.

J. E. Huber, district engineer, Illinois Department of Public Works and Buildings, Division of Highways, since 1913, has resigned to accept a position with the Western Wheeled Scraper Co., Aurora, Ill.

Thomas F. Kennedy, civil, sanitary and mining engineer, has entered private practice in engineering, associating with J. H. Rittenhouse & Son, consulting engineers, with offices at Scranton, Pa.

A. W. A. Eden, for five years assistant structural engineer with Westinghouse, Church, Kerr & Co., Inc., has accepted a position with the Harris Structural Steel Co., New York.

Obituary

Colin Campbell, president of the National Hoisting Engine Co., Harrison, N. J., died Dec. 26, at Newark. He was born in Scotland and was 67 years old. He learned the trade of machinist. In 1887 he came to America and worked for J. S. Mundy until 1903, when he entered business for himself.

Benjamin Holt, president of the Holt Manufacturing Co., died at Stockton, Cal., Dec. 5. He had been constantly engaged in inventive and creative work connected with caterpillar tractors, harvesters, and other machines originally invented by him, and being manufactured in the Holt plants. He was born in Merrimac County, N. H., Jan. 1, 1849. He went to California in 1883, at which time he and Charles H. Holt took up the manufacture of wagon wheels at Stockton, first under the name of the Stockton Wheel Co. In 1892 the Holt Manufacturing Co. was incorporated at Stockton. Benjamin Holt was the inventive genius of the organization, and his name has become known throughout the world as a pioneer in the design and building of new types of agricultural and road machinery. Due to his work the caterpillar was established as a commercial success and was available for military needs with the outbreak of the war in 1914, when it was adopted by the Allied Governments for artillery and supply transportation. Those tractors brought about the creation of "tanks," and Benjamin Holt has been given credit as the inventor of the caterpillar tractor, which made the tanks possible.

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Engineer to Run Barge Canal

IT IS the intention of Governor Miller, of New York, to advocate a constitutional amendment which will consolidate the offices of the state engineer, superintendent of public works and the commissioner of highways. This is a logical step, comparable to the movement for a federal Department of Public Works, for the co-ordination of all the engineering work of the state. Meanwhile the governor has done all he could toward this end by appointing an engineer as superintendent of public works. The duties of this office are various, but among the most important is the operation of the Barge Canal. This is a traffic problem which has required the direction of a competent engineer for many years. So far the canal has been a dismal failure, for reasons which the various previous superintendents have not hesitated to express. Mr. Cadle, the new superintendent, now has a great opportunity to show what an engineer—and a railway engineer at that—can do with canal operation and to demonstrate what the differences are between an engineering and a lay administration of a transportation unit.

Kansas Industrial Court Decision

MUCH ado was made in the Western papers a short while ago when the flour mill owners of Topeka were haled before the Kansas Industrial Court on charges of restricting output in order to keep up price. The action was acclaimed as evidence that the court's jurisdiction would be used impartially, that it would condemn combinations of capital just as quickly as it would combinations of labor. It had been attacked in the labor world as an instrumentality for working the will of capital. The decision in the Topeka flour mills case has now been handed down, and the mills are entirely exonerated. The evidence showed that their production had been decreased because of a falling off in demand, and that it was entirely justified. The court did take occasion, however, to lay down the principle, so generally conceded that there seemed no reason for emphasizing it, that "skilled and faithful employees should be given such treatment as will enable them during the period of limited production to support themselves and families." The decision should have educational value with the agitators.

Peak Load Construction Plants

PROVISION of equipment on the theory of conducting construction in a series of peak performances between delays met successfully the problem of building the automobile body factory described on p. 82. Ordinarily peak load plants are economically unjustified. Neither can they be adapted to any considerable number of operations. To consider them otherwise than emergency measures at this time is warranted only by the fact that rail movement of construction materials has been unreliable. If train schedules are to be maintained in operations where large concentrations of material are required contractors must provide means to overcome interruptions to continuous operation because of irregular rail deliveries. Such provision can be made. The important fact to be observed, as disclosed by the article on p. 82, is that multiplication of construction equipment proper is not alone sufficient. Rail transportation must be aided directly by supplying cars, and on occasion locomotives. A task so formidable lies within the power of only very large construction organizations to accomplish. Its cost is warranted only in exceptional instances.

Parks and Water Power

ONE important amendment, removing national parks from the provisions of the water-power act, has been introduced in Congress in several wordings. This is supported by the usual hysterical nature-lover propaganda, which in its most rabid form—and in this form it has had wide circulation—quite frankly would prefer a wilderness where two dozen men may hunt bear to a scenic reservoir which supplies power, light and water to half a million people. Somewhere between this view and that of the ultra-utilitarian who would dry up Niagara or pipe the Yosemite is a sane use of public water in the parks. The Federal Water-Power Commission is composed of three of the President's cabinet. Surely they can be depended upon to resist any unjustified raid on the country's natural beauties.

But if the scenery preservers are strong enough to force the park water powers out of the hands of the commission, it is to be hoped that Congress will, at least, make such a law as will permit utilization of such waters by congressional permits under the conditions of the water-power act and thus remove the old difficulties of possible revocation and inadequate return which restricted development in the past. Much of the most necessary and valuable power in the country is within the limits of national parks, and their development with proper precautions against vandalism is only a reasonable utilization of our national resources. Further than that, there are movements on foot to extend park areas into districts now under prospect for water power and thereby close up any further development in most necessary locations.

Blanket permission to use any and all power, and blanket prevention of the use of all power in wide areas which have nothing in common except that they happen to be in national parks, should equally be prohibited. A middle course is easy to pursue.

Secondary Boycott Illegal

ON JAN. 3 the U. S. Supreme Court declared the secondary boycott illegal. By the secondary boycott is meant persuasion or force to prevent the sale of the product of a manufacturer whom it is desired

to embarrass. In the case at issue the Duplex Printing Press Co., of Battle Creek, Mich., had refused to recognize a closed union shop and the International Association of Machinists (the machinists' union) not only called a strike at the plant but refused to set up Duplex presses throughout the country and by threats and persuasion endeavored to coerce union men and others against hauling and installing the presses. Other ways were also tried to prevent the sale of presses manufactured by the Duplex company. Such action on the part of the machinists' union was held to be a conspiracy in restraint of trade and the union was adjoined from continuing the illegal action. The union maintained that under the Clayton act it was exempt from the operation of those sections of the Sherman act which had been held to apply to unions in the Danbury hatters' case. The court held that there was nothing in the Clayton act "to exempt such an organization [a labor union] or its members from accountability where it or they depart from its normal and legitimate object and engage in an actual combination or conspiracy in restraint of trade." We have no doubt that popular judgment will approve the jurists' decision, for such a method, if legal, could well be used to ruin business enterprises utterly.

Thoughtlessness on Immigration

IT IS very easy to get the American people—or, at least, groups of Americans—excited. When emergencies arise our first impulse is to act, not to think. Just now a strong group wants a tariff prohibitive of the import of certain products, particularly food, without giving any thought to the vital importance of our export trade to Canada, the chief country that would be affected by the food clauses. Similarly, others are greatly excited over the prospect of tremendous immigration. They rushed to Congress and urged a bill to prohibit immigration for two years. The time limit has now been cut to one year, but the bill, nevertheless, is a response to the American impulse to act rather than to think. In this issue, p. 57, will be found some pertinent facts on the immigration situation. The 15,000,000 prospective immigrants, sometimes held before us as a bugaboo, could not be brought over in less than eight and a half years, while the 25,000,000 immigrants, the bugaboo erected by others, could not all get here in less than fourteen years. Moreover, the figures indicate that the total net immigration for the fiscal year ending next June will be about 700,000. Again, it needs to be emphasized that by rigid enforcement of present laws the undesirables—on mental, moral, physical, political and economic grounds—can be successfully kept out. The only urgent action needed, then, is to better our immigration service and enforce the present laws. It would not be contended, however, that our present immigration policy is satisfactory. The mere fact that the present agitation has made such headway is proof that we have not an immigration policy that is generally regarded as fixed or satisfactory. In fact, we need a very thorough study of the whole immigration problem to the end that we may lay down a sound policy based on adequate consideration of all the factors. Involved would not only be the qualifications for entrance and the machinery for enforcing immigration laws but also provision for guiding the immigrant until he becomes established in the new country. Less action, less hysterics and more thinking are needed on the immigration problem.

Highway Bridge Situation

SERIOUS concern has developed in some parts of the country over the condition of highway bridges. Improvement of roads has outrun the improvement of bridges, and the problem presented by the tremendous highway construction program has been such as to make it impossible to give due attention to strengthening structures. Though these had long given satisfactory service, the rapid spreading out of heavy motor truck traffic has now gone ahead of the improved highway and has made even the remotest country-road bridge an object of concern. The gravity of this situation in New Jersey, for example, caused a newly appointed highway commissioner to resign a few weeks ago; as soon as he had opportunity to become familiar with the problems of his position he saw that the bridges of the state as a whole were in need of thoroughgoing revision, and he chose to avoid becoming involved in a situation of potential danger when funds to correct it were not available. A similar note of alarm was sounded about the same time by a number of state highway-bridge engineers who formed a committee of the American Association of State Highway Officials to consider the subject of bridge reinforcement. On the other hand, M. W. Torkelson sets forth in an article printed on page 61 of this issue that Wisconsin's situation is very much better. He introduces his discussion of bridge renewal and reinforcement by a thoroughly reassuring statement that present—and immediately prospective—road traffic does not menace the integrity of the state's bridges. Possibly the contrast finds an explanation in a difference of conditions between the East and the Middle West, since there is reason for believing that New Jersey is not alone in facing a large bridge reconstruction program. Some inquiries as to this point have been begun by *Engineering News-Record;* the facts which they will reveal will be published as soon as available.

Federal Highway Appropriations

IT IS intimated from Washington that the proposed appropriation of $100,000,000 each year for the next four years for federal aid for highway construction is likely to be cut down. This is the less serious because there is so much money still unexpended from the previous appropriation. The essential feature is to get Congress to recognize by a substantial appropriation the necessity for continuity in the federal-aid scheme, so that when conditions are again favorable the $100,000,000 annual appropriation may be restored. This will not be a popular view with those who believe in "no compromise" and who maintain that whatever other economies are effected the road building schedule should not be interfered with. It is entirely true that one can show with pad and pencil that every dollar judiciously expended in highways yields a profitable return to the community, but, as was emphasized in this journal several weeks ago in discussing the necessity for federal economy, there are times when the best business judgment demands a husbanding of resources. Such a time now faces the federal government. Nevertheless, the strong presentation of the needs for highway construction in this country made in support of the $400,000,000 program was fully justified. Otherwise Congress might not have gained an adequate idea of the part that highway improvement should play in the federal government's program.

TO BE assured, however, of a continuance of federal appropriations for highways those interested in roads must present a united front. It seems likely that there will be a confusion of counsel. There are those who contend for a national system, built and maintained exclusively with federal funds. There are the federal-aid advocates, who believe in the present plan. Another group—composed of farmers—wants federal aid to extend to the county as well as to the state systems. Still another group would like to see federal appropriations for road work entirely abandoned, which would be nothing short of a calamity. State highway department organization, generally, has not yet reached the stage where it can proceed without the backing of federal money. Should this confusion of counsel reach Congress it may be eagerly welcomed by those who want an excuse for making no appropriation. Under the circumstances the reasonable ground for compromise is on the federal-aid plan as now operated. It is established. It has won general confidence. It has the backing of state highway departments in every part of the country. It stands midway between the "national" plans and no appropriation whatever.

AS JUST intimated, the federal-aid plan has won wide approval. Operation has disclosed no major direction in which change is needed. There is one amendment, however, that is desirable; namely, to require that the sum equivalent to the federal grant be appropriated by the *states themselves* and not by the counties. In some sixteen or seventeen states the counties, not the states, match the government's funds. The result is that all the county money, as a rule, is spent on the primary system, which is essentially of state-wide importance, leaving no money for the important secondary system, which should be the county's main—if not sole—responsibility. Another serious result of this practice is that cities escape from paying for the road system in fair proportion to the wealth that they gain from an improved state-wide highway system. From both standpoints the practice of shifting the financial load to the counties results in unsound highway policy. This the federal government should not countenance or encourage. A provision should therefore be introduced in the next appropriation bill making the states themselves appropriate the local quota to match the federal funds. In some states constitutional amendments will be needed. But, as shown repeatedly when highway issues have been at stake, such amendments can be secured.

Street Traffic Control, an Outstanding Engineering Problem

WITH exception of a few cities, street traffic control is in the hands of the police. This has been a gradual growth from the days when the only road rules required were right-hand running and superior rights at crossings, to the present-day vogue of the traffic policeman and block signals on our busy thoroughfares. The situation now is fast getting beyond the police power, which can only regulate. It has become an engineering problem.

The crowded and dangerous streets of even our small cities, the difficulties of travel on them by foot, in automobiles, and in street cars, and the consequent effect of these difficulties upon real-estate values and upon retail business, to say nothing of the comfort and safety of the people, make this the big municipal problem of the next ten years. Its solution calls for something more than merely directing such traffic as chooses to use the streets. It has become a problem of traffic distribution and removal, strictly comparable to that which the street-railway and rapid-transit engineers have long attacked.

Obviously, the trouble is due to the automobile. A city of 100,000 today has more vehicles moving downtown per capita or per street than a city of 1,000,000 ten years ago. The per-capita street-railway travel has probably increased but little, so that any city's rapid-transit difficulties are due to its increased size and not to new factors. But the automobile is a new and serious element, and the self-driven automobile, which means in most of our cities the parked automobile, is the real disturber.

This parking evil, so common in all but the largest cities, must be attacked more vigorously. When automobiles are lined up on either side of a 40-ft. street which already has two car tracks, it is not surprising that congestion results. This condition must be recognized as impossible. If the occupants of downtown offices must run their own automobiles, some other place than the city streets must be provided to care for them. Anti-parking ordinances, unpopular as they are, will have to be insisted upon.

Such regulation and a more rigid insistence on the duties and powers of the traffic policeman are within the power of the police. Greater rigor in the enforcement of traffic laws will also help much, but there must be further steps which only the engineer can take.

Studies must be made of street-travel routing, just as studies are now made of street-car routing. One-way streets are a great help. Boulevards can be cut from outlying districts which will bring travel to distributing centers clear of the main traveled routes in the city itself. Just this thing is now proposed for Seattle, where a new street is contemplated which will have no grade crossings and which will serve the farm and industrial districts to the south. Through routes may be provided in or around the city whereby travel from one suburb to another on the opposite side does not have to go through the heart of town or along streets used by those reaching the center of the city itself. In other words, the distributing of traffic recommended for transit lines in these columns some weeks ago must extend to vehicular travel. Finally, it is only a question of a short time in a number of our larger cities, at least, before under- or over-crossings will have to be provided. 34th St. and Fifth Ave., and 42nd St. and Fifth Ave. in New York must come to this soon; at Third and Market Sts., in San Francisco, the city engineer has already designed a subway crossing for pedestrians. There are a dozen other cities where such passageways should be built as soon as costs are more favorable.

All of these steps present engineering problems. The trouble is that they have not been commonly applied to city traffic because the engineer has been too willing to assume that that is merely a matter of public welfare and so outside his bailiwick. The serious congestion in our downtown districts and the mounting death list of our streets makes it a public duty for the engineer—and particularly the city engineer—to insist on being heard and to begin reforms which will lead to safer and more bearable street conditions.

Groundwater Pumping and Hydraulic Excavation for Beach Hotel Foundation

Column Footings and Basement Story Below Water Level Constructed in Open Pits Kept Dry by Well-Point Cofferdams—Piling Eliminated—Site Pumped in Sections by Local Groups of Wells—Ejector and Dredge Excavation

SUCCESSFUL application of groundwater lowering to foundation work in fine sand for two hotels on the beach at Atlantic City, N. J., during the past year has demonstrated the easy practicability of founding structures along the beach at considerable depth below tide level, and promises to lead to a distinct change in local building practice. In past beach-front construction at Atlantic City, buildings have been carried down only to water level, just below street level, and have been supported on pile foundations. The new Ritz-Carlton Hotel, now under construction, and a just completed extension to the Ambassador Hotel, however, have basement stories carried 10 to 25 ft. below water level by the help of well-point pumping. With this deep construction the columns and walls could be founded on spread footings directly on the sand, while important constructional advantages were gained not only in the elimination of piles but also in the increased space and the more efficient arrangement of interior, resulting from the presence of a basement story.

Groundwater lowering was used for the foundation work of the extension to the Ambassador Hotel late in 1919. The Ritz-Carlton work, done during the past fall season, was carried out by the same contractor with a more highly developed method, described in the following. In both pieces of work the sand was excavated in the open, *without sheeting*, to depths exceeding 15 ft. below mean tide, without difficulty or delay, in spite of the fact that in the latter case the work was located within 100 ft. of the water's edge. This result was made possible by encircling the work by lines of driven wells, pumping down the water and in the sand to a level below the floor of the excavation. The fineness of the sand and its stability when dry made the method particularly effective, as the pumping capacity required was moderate, changes in groundwater level were relatively slow, and the excavation stood with vertical banks that showed no tendency to crumble.

Under municipal building regulations of Atlantic City, structures on the beach front must be founded on piles. When the landward extension of the Ambassador Hotel was designed (the existing portion occupying the boardwalk frontage of the site), pile footings were designed for the walls and column bases below the basement floor, at 15 tons per pile on 2-ft. spacing, or the equivalent of a little less than 4 tons per square foot of footing area. However, as the excavation developed the firm nature of the sand, it was decided by the architect's consulting engineer, H. G. Balcom, that the piles could be omitted, thereby not only saving cost but eliminating the slight settlement that it was feared would result from building upon jetted piles. This change was allowed by the local building authorities, the more readily as the work to be done was not directly on the boardwalk, being in a measure protected from the ocean by the front portion of the building, which rested on piles. Later, when the same architects designed the Ritz-Carlton Hotel, a few hundred feet to the north, Mr. Balcom again proriences at the Ambassador site, and this was finally allowed by the building inspector in spite of the fact that the work fronted directly on the boardwalk. The loading used was $3\frac{3}{4}$ tons per square foot, as in the case of the Ambassador extension (where the footings were not changed in size after it was decided to omit the piles). However, extra precaution was taken to secure a high degree of scour protection at the beach frontage of the building, partly by constructing a pile and plank bulkhead about 20 ft. in front of the building, and partly by carrying the front wall footings to a depth of 8 ft. below basement floor or about 22 ft. below water level.

FIG. 1 WELL-POINT COFFERDAMS IN RITZ-CARLTON FOUNDATION WORK, ATLANTIC CITY

In applying well-point pumping to the Ambassador, a single "cofferdam" was constructed around the whole site by encircling it by a ring of wells pumped as a single unit. The Ritz-Carlton work is distinguished by extensive subdivision of pumping and construction work through the use of many local rings of well points constituting separate "cofferdams." This expedient permitted progressive working from one end of the site toward the other, gave remarkable flexibility and

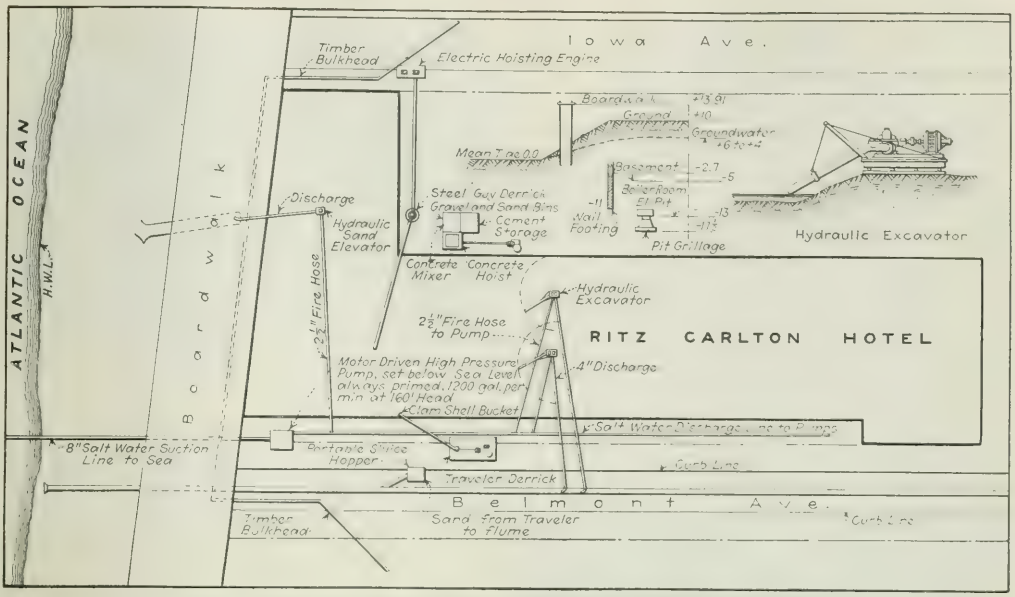


FIG. 2. SITE AND PLANT LAYOUT, RITZ-CARLTON HOTEL FOUNDATION

adaptability to changing conditions, and, together with the practice of lowering the groundwater in successive stages by using several tiers of wells as excavation proceeded, gave marked economy in both plant cost and pumping cost.

A general view of the Ritz-Carlton foundation work is given in Fig. 1 herewith. The plan Fig. 2 gives the layout of the principal fixed elements of the construction plant, but not of the wells, and shows the shape of the building and its relation to the beach front

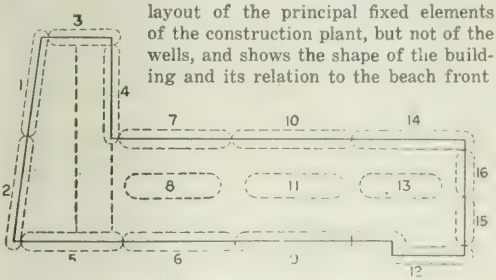


FIG. 3. WELL-POINT LAYOUT

The relative elevations are indicated by a diagram sketch above the plan. Groundwater is several feet above mean tide, and receives its supply from the land rather than the ocean. The soil is sand to indefinite depth, in practically horizontal layers, varying somewhat in characteristics, but in the upper 15 or 20 ft. of uniform fine grain, practically all passing a 50-mesh sieve. The supporting power of this sand was demonstrated by a loading test carried out on the floor of the excavation at the Ambassador extension site (see *Engineering News-Record*, Nov. 4, p. 890). A sand bin was framed around four upright 12 x 12 corner timbers, whose ends rested on the sand floor; a total load of 47½ tons produced 1½-in. compression, but no further settlement occurred when the final load was left on overnight; even allowing the groundwater to rise up to the pit floor by reducing the pumping did not produce more than 0.001 ft. additional settlement. The test was considered to show the assumed footing loads to be conservative.

The plant shown in Fig. 2 includes a traveling clamshell used in excavating for the wall footings along the Belmont Ave. side of the building, a derrick for clamshell excavation and handling materials, a concreting tower, a water-supply pumping plant, a sand ejector, two movable sand-pumping plants, and a sand discharge flume. The timber bulkhead shown on the ocean side of the site was built as a safeguard against any abnormally high water reaching the excavation and flooding the pit. The well points and the pumping plants for them are not shown.

A small-scale sketch indicating the layout of the various sets and rings of well points and their sequence is given by Fig. 3. As the numbering shows, work was carried on progressively from the boardwalk end to the rear end of the site, and at any one time only such a length of well line was used as the work in hand required. Sometimes an incomplete ring was sufficient, as at the footing shown in Fig. 4, but generally the wells formed a closed ring around the section to be constructed.

The wells consisted of lengths of 1½-in. pipe fitted with well points 30 to 36 in. long wrapped with 60-mesh screen, which were jetted down into the sand at intervals of from 3 or 4 ft. to as close as 18 in., usually closest in the lowest tier. The cap of each well pipe connected by 1½-in. wire-covered hose to a 4-in. steel pumping main, to which were connected one, two or more (up to four) electrically-driven pump units of capacity from 75 to 200 gal. per min., discharging by pipe line to the beach. Each of these units was mounted on a platform so as to form a portable unit that could be shifted around by the derrick, as may be seen in Fig. 1.

In jetting down a well point, a 1½-in. jet pipe supplied with water at 40 lb. pressure was pushed down into the ground and moved around or churned as necessary to loosen up an area large enough for the well pipe; the well pipe with point was then dropped into the soft sand loosened up by the jet.

Generally the points were put down to depths of 10 to 20 ft. However, the details of the well-point work throughout, as to depth, spacing, pumping capacity, and the like, were fixed as experience dictated, the system adapting itself very flexibly to any required changes. When a particular area of the site was to be excavated to a lower level, for example, a ring of points was sunk around the area, at possibly 4-ft. spacing, to 5 or 6 ft. depth, and pumping and excavation started simultaneously. If these wells did not draw down the water rapidly enough, or if the ground proved wet in excavating, a set of points was jetted down intermediate between those already in. If the pumps were not able to hold the vacuum another pump was cut in. Hose and pipe connections were checked up for tightness frequently, this being vital to good results. When the excavation was down 4 or 5 ft. a set of points was

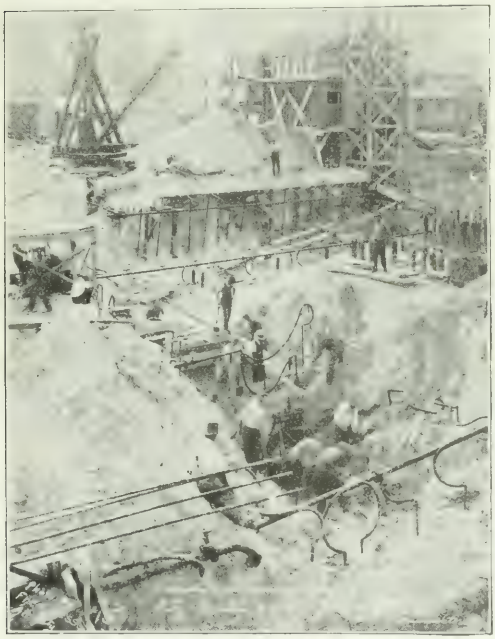


FIG. 4. COLUMN FOOTING EXCAVATION PROTECTED BY PARTIAL RING OF WELLS

jetted in around the bottom of the pit to lower the water level farther, excavation then continuing inside this smaller ring.

On the whole, experience at this site was that the groundwater level could be lowered 10 ft. in about 4 hr. (with 10 to 12 ft. of lift and about 30 ft. total raise from foot of well to discharge). The return of the water was relatively slow, so that when pumping was stopped it would be half an hour before water came up through the floor of the excavation. The pumpage is fairly represented by the experience with the longest

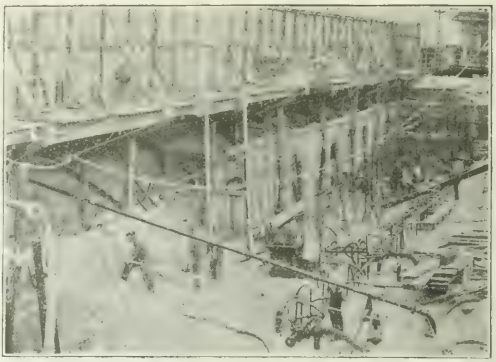


FIG. 5. JET AND EJECTOR EXCAVATING SAND AT FRONT WALL (SECTION 2)

continuous line of wells used in the whole job, that existing at the time the footing excavation for the front and short side walls was in progress. At this time the total length of the line of wells was something over 300 ft., and the pumpage averaged 300 gal. per min. A vacuum of 12 in. to 20 in. mercury was carried at the pump. This was at a distance of less than 200 ft. from the edge of mean tide.

Work was started at the beach end of the site, first on the right-hand half of the front wall, the other half being started (Fig. 5) only after the deep wall footing of the first half had been constructed and the principal hazard of interruption of the pumps was over. Then the side wall and part of the rear wall of the L were taken in hand, then a section of the opposite or Belmont Ave. wall. When the next sections of side wall were started, the entire front section was cut off by a line of wells and general excavation over the forward portion, which had previously been started, continued down to floor level. Underdrains, concrete base, waterproofing and final concrete floor were then put in, which took care of further drainage in this section and released the wells and pumps.

Construction of the column footings, comprising steel grillages set on waterproofing on a concrete sub-floor in a pit excavated below basement level, was carried out in each instance as a separate operation after the basement excavation was down to grade. The detail arrangement in each such minor piece of pumping depended on the circumstances existing at the time, on whether one, two or more column footings were taken in hand simultaneously, and the like, as may be seen by comparing Figs. 1 and 4.

Some complications occurred in excavation at the rear wall. Here an adjacent dwelling house, only 10 ft. away from the wall, had to be protected from settlement, and this rear wall was sheeted—the only sheeting in the work. Here also occurs the deepest point of the excavation, as the boiler pit is located at the rear wall and a group of cantilever foundations had to be put in below the pit floor. With some complications, however, this work was carried out by the same procedure applied elsewhere on the site.

Hydraulic Excavation—About three-fourths of all the excavation was done by the hydraulic method, using two different types of plant: water-jet ejector and suction-dredge. A single ejector was used for the larger part of the beach-front L (Fig. 5) while the rear or body

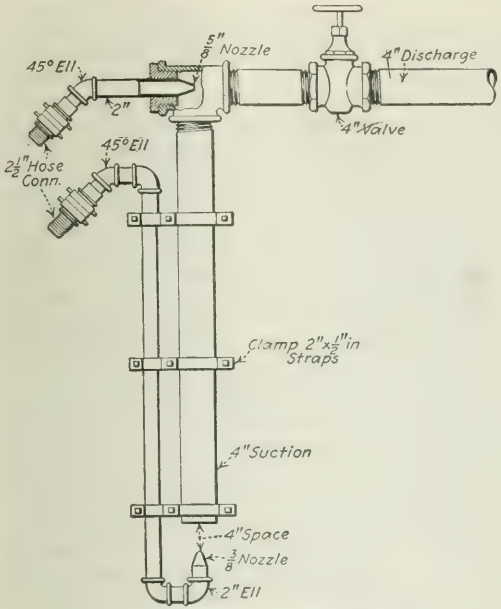


FIG. 6. SKETCH OF EJECTOR RIG

of the site was excavated by two dredge-pumps.

The ejector, Fig. 6, comprised a 4-in. riser pipe, a 2-in. water jet pipe turned up in the lower end of the riser and ending in a ⅝-in. tapered nozzle, and a similar horizontal jet in the tee at the head of the riser pipe, facing toward the discharge pipe. A total of 5,000 cu.yd. of sand was removed by this ejector. Water at 150 lb. pressure was supplied to it by a 2½-in. hose from a booster pump drawing from the 8-in. delivery main of a salt-water pumping plant installed alongside the building site, below sea level.

Practically all the ejector work was done at full depth, requiring 15 to 27 ft. of lift. After the deep front wall had been put in (about 10 ft. deep below basement floor level) in inside and outside forms set in hand-excavated trench, the basement excavation itself was started with the ejector working at floor level just inside the wall. Hose (Fig. 5) supplied water to wash sand to the sump in which the ejector worked.

While the excavation of the front half of the L was in progress, the side and rear walls were not yet completed (note sequence of well-point working in Fig. 3), and during this period a line of points was maintained through the middle of the L, protecting the front half from the groundwater coming from the land side. Later, a line was put in at the rear of the L to permit excavation of the second half.

Under the conditions, the performance of the ejector necessarily varied over a wide range, but at its maximum it delivered 15 cu.yd. sand per hour, representing a burden of 17 per cent of the water discharged.

More definite performance figures are given for the two dredges. They worked at an output of 15 to 20 cu.yd. sand per hour each, when carrying sand as high as 25 per cent of the water; this was a heavier burden than the average, however, 10 to 15 per cent being more generally obtained.

Each of the two dredges (Fig. 7) consisted of a motor-driven centrifugal pump of normal capacity, 200 gal. per min. at 1,100 r.p.m. speed, mounted on a platform carried on skids, and a downward sloping suction pipe held and manipulated by suspension from a swinging wooden jib on the back of the platform. The suction could be swung through a full semicircle, and one dredge was able to work a strip 30 ft. wide, excavating to 10 to 15 ft. depth below skid level. The two dredges, working abreast of each other, covered the width of the excavation, and moved back from front to rear, in two successive lifts. Their work was supplemented along the Belmont Ave. side by clamshell digging done by a traveling derrick at street level.

Each dredge pump had a pair of agitator jets alongside its suction head, supplied by a 2½-in. fire hose from the force main of the salt-water pumping plant already mentioned. It discharged by 4-in. steel pipe to a wooden V-shaped flume carried on trestle along Belmont Ave. to the beach. As the slope of the flume was necessarily quite flat, auxiliary jets were placed in it at various points, to keep the sand moving.

Rapid work was made possible by these construction methods and devices, supplemented by an efficient central concreting plant delivering from a 60-ft. hoisting tower. The work was practically all done in four months, August to December. Steel erection could be begun in the front half of the building while the footings in the rear half were still under construction. At present two-thirds of the steelwork is up. Concrete encasement coated with waterproofing was built around the columns up to groundwater level, though the underdrain system under the basement floor is designed to keep

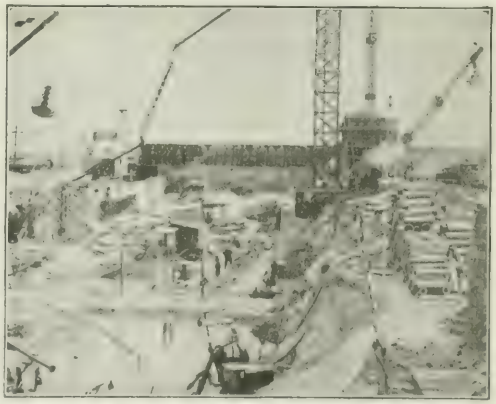


FIG. 7. EXCAVATION BY HYDRAULIC DREDGE

both concrete and steelwork dry. The pump discharge from the underdrain system will be used for service water in the hotel. Drinking water, however, will be obtained from the city supply.

The Ritz Carlton Hotel was designed by Warren & Wetmore, architects, under the personal direction of Julian Holland of that firm. H. G. Balcom is consulting engineer. The Thompson Starrett Co. is the general contractor. The foundation work was sublet to James Ferry & Sons, Inc., James V. Ferry of that company having planned and carried out the substructure work, assisted by William Shappell as superintendent and George W. Schusler as engineer.

Observations on a Pacific Coast Trip

By Frank C. Wight
Associate Editor, *Engineering News-Record*

Los Angeles the Crowded

In December, before the big rush of tourist travel began, railroads in Los Angeles reported that there were 2,000 more people coming into town each day than leaving it. This seems incredible, for with its amazing growth of 81 per cent in the decade 1910-20 the daily increase was only seventy, but any one who tries to walk on the downtown streets of Los Angeles or to patronize its street car-system will readily believe it. More people are "milling around" there than in any other large city in the United States. How much of this is due to local custom, which, according to some, rules that every one should walk Broadway at least once a day, how much to the justly famous and occasionally mentioned climate which beckons one to outdoor exercise, is hard to tell. But the folks are there pushing and weaving by each other from curb to show window as though every day were circus day and the parade about to pass.

These street crowds are but the obvious manifestation of the phenomenon of Los Angeles, a city practically without industries, except the making of motion pictures and the pumping of oil, which partly by territorial acquisition but mainly by influx of new residents jumped from 319,198 in 1910 to 576,673 in 1920, and from seventeenth to tenth place in the list of American cities. There are plenty of other signs of growth—new office and theater buildings under construction at practically every downtown corner, a building permit record for November second only to New York's, row after row of new bungalows in the outlying districts, increased bank clearings, increased water consumption, increased gas and electricity consumption, and a sewer system which has absolutely reached its limit of capacity—all these confirm the census statistics and warrant the enthusiatic predictions of the somewhat dazed residents. Los Angeles is booming almost as much as its press agents are trying to make the country believe it is.

Industries Must Be Developed

The whys and wherefores of this boom have no particular engineering significance. It is true that many of the newcomers are non-producers, retired merchants and farmers to whom the perennial outdoor possibilities and the bustle and excitement of the busy city equally appeal. It is probable that the main business of the big crowds is buying from and selling to each other, with the ramifications of collecting, storing and distributing that such merchandising requires. As such the enormous population increase appears anything but healthy and its end not far away, for the congestion due to such rapid growth would soon discourage further growth from among the comparatively leisure class. So for the future Los Angeles must look to a greater industrial development. It is not enough for it to be a market, it must become a manufacturing center.

There are signs of such a development. The great Goodyear plant is always pointed out to critics; but, unfortunately, that plant was completed just at the recession of the automobile boom this year and has never functioned as intended. It is there ready for business, however, with a cotton-producing country at its back door, rubber sources across the Pacific, and with a climate and adjacent farm lands which should offer all the attraction in the world to labor. Some of these advantages apply equally to other industries, particularly the appeal to labor. To listen to the Angelenos, a workman should be willing to work only for his keep, just for the privilege of having his own year-round garden and no coal bills. Certanly one cannot go through a bungalow colony or travel along the San Fernando valley on a December day without recognizing some basis for these claims. The Pacific Coast market is limited, however, and the Pacific foreign market subject to many forces other than the ability to produce. There is still room for many more industries in the Los Angeles district but Los Angeles will not reach the magnificent proportions it forsees until these Pacific markets grow. Then Los Angeles will grow with them, on a more substantial base than it is now building.

But whatever the cause or the prospects of the Los Angeles boom, its existence gives rise to many engineering problems. You cannot pile several hundred thousand people into a city in a decade without making it difficult to take care of them properly in the meantime. Fortunately for the city, proper foresight has insured an adequate water supply, which, while not completed, can be added to annually well ahead of the demand. Such additions are constantly under way; new dams and reservoirs in the distributing system are under construction, old pipe lines are being replaced and new irrigable areas are being opened. It is an old saying in the Southwest that water is king; it is more than that, it is life itself, in Los Angeles. To the visitor from a humid country the most notable thing in the aqueduct system is the intermingling of the domestic and irrigation service. The same mains that bring the water to the houses distribute it to the fields, and as the city moves toward the fields the irrigation supply is turned over to domestic use. Water in this country is not merely something to drink or to wash in.

Sewage Situation Serious

But if the water supply is cared for, the sewage is not. As noted in a separate article soon to appear, the situation is most critical, and the citizens who have twice by popular vote refused to consider it must be forced into action. It is publicly predicted by the city engineer that by next spring sewage will be standing in Los Angeles streets and that all new houses and probably some old ones will have to build cesspools. It is rather strange that in the new plan for disposal there is not more said about utilizing the sewage for irrigation. In a country where every drop of water counts it is surely wasteful to pour all the city sewage into the ocean. The subject, of course, is not a new one in Los Angeles and the city engineers probably know more about the prejudice against sewage utilization than any one else. At the same time they are now up against an emergency which requires an immediate remedy and does not permit of the necessary public education and longer study that some irrigation disposal of sewage would require. Some day, though, a means of utiizing the sewage flow must be found.

The traffic situation in Los Angeles is intolerable. This is another sequel of the rapid growth that requires engineering attention. It is not only because so many people afoot or in vehicles move around the city, but they are so regardless of traffic rules. On Broadway, for instance, there has been installed a new system of block

signals which shift to "Stop" and "Go" simultaneously along the whole street. Theoretically it is a good scheme; practically the signals are inconspicuous and the policemen do not enforce their observance. The "jay walkers" scoot across the street at their own volition and peril, and motorists take special delight in evading both signals and policemen. Engineers can do little to educate both people and police, but they can offer the first solution of any traffic problem—that is, to distribute the causes of congestion. To that end the city engineer is planning boulevards around the center of the city to remove from downtown the many vehicles which go from one suburb to another on the opposite side of the city, a very considerable part of the traffic in Los Angeles, which has suburbs practically completing the circumference of the city.

Planning is also being done for more highway tunnels and better ventilation of the existing ones, and the utilities commission engineer is trying to rearrange the street-car routes. Downtown Los Angeles was never intended for a big city. The sidewalks and streets are too narrow, and the street-car layout prepared on the principle of having every car pass every store. To remedy these evils requires a revolution, not only physical but also in the minds of merchants and citizens. This is too much to expect an engineer to accomplish, but constant hammering on the possible cures which an engineer can make will in time have some effect. Two people a day are being killed in the streets of Los Angeles; there is no pleasure in getting around in the business district. Sooner or later the people will realize that safety and comfort are worth more than the advertisement of the overcrowded street.

Mexican Interests Great

With all of the building and enlargement going on in Los Angeles there is, of course, a great deal of work for the engineer, but the engineers living there have more to do than merely to take care of the city's needs. The city is the center for the Southwest, just as San Francisco is the center for the West in general. As far East as New Mexico and well down into old Mexico extends their field; and water power and irrigation, as in the other big Western cities, are the main things that interest them. Mexico, particularly, is a live field, much more live than most Easterners know about, though it is a Mexico which differs from the oil-field district of the Gulf or even the mines of the interior. It is that country rich in agricultural possibilities which lies south of California and which is as far separated physically from the city of Mexico as it is from Minneapolis. All it needs for its development is a stable government and the aid which the engineer can give. Both are apparent on the horizon. The prospects are that the next ten years will see irrigation development south of the line comparable to anything which exists in the States, and Los Angeles will be the main center from which the work will be directed.

At the recent General Contractors' dinnner in Los Angeles one of the city's leading bankers made a speech. Whatever it started out to be about, it soon reached a not altogether unexpected subject—the beauties and wonders of Los Angeles. "There are those," said the speaker, "who will tell you that the future of Los Angeles is restricted by its lack of water. I have been hearing that cry for thirty years, but I notice that as we grow we always manage to get the water we need. Nor do I worry about the future. If the people of the United States are so attracted to this garden spot of the world [*loud cheers*] that they come here to the number of two or three million, as they unquestionably will in the next three decades, then I know that the Mulhollands and the Lippincotts of that time will find water for Los Angeles if they have to pipe it here from the Penobscot."

This quotation—as nearly accurate as memory can recall the spoken thoughts of an Angeleno talking of his own town is submitted not as a warning to the State of Maine of the proposed invasion of its water rights, or even as a tip for prospective business to pipe and pump makers, but because it seems to be a perfect example of the Los Angeles spirit. There is that touch of super-enthusiasm which, unfortunately for Los Angeles, has made its boosters a byword in the rest of the country; but there is also the acknowledgment of basic conditions, and faith in the solution of difficulties which must carry the city ahead to success.

The Status of Immigration

No Cause for Hysteria—Selective, Not Restrictive, Measure Recommended, but Enforce Present Law First, Says General du Pont

ILL-CONSIDERED statements from public men based upon hearsay or speculation, rather than upon facts, are the basis, says General Coleman du Pont, chairman of the board of directors of the Inter-racial Council, for what fear there exists that "our native civilization" is in danger of being "blotted out by the succeeding layers of immigration from Europe." Disregarding official immigration figures, the authors of these statements, continues General du Pont, endeavor to impress upon the public the need for a closed-door policy by asserting that 25,000,000 prospective immigrants are awaiting the opportunity of entering the United States. This he refutes by the statement that, under the best conditions, and with the present transportation facilities, it would take fourteen years to bring 25,000,000 people from Europe here.

Rigid enforcement of the existing immigration law, with additional legislation—if found necessary by a non-partisan commission that can study the situation dispassionately and scientifically—"that will provide for the effective distribution of immigrants, an intelligent policy of assimilation, and the establishment of proper facilities for those entitled to naturalization," is the view of General du Pont. He believes that, were the laws as they stand to be enforced by an adequate staff, the class of immigration that the United States would receive would be wholly of good moral character, physically sound, mentally competent, self-supporting and opposed to violence and revolution."

In answer to the argument, often advanced, and particularly now, that unlimited immigration would mean greatly increased unemployment, a lowering of the standards of living, and destruction of the wage scale, Gen. du Pont has the following to say:

> There is a great deal of exaggeration about the volume of immigration now pouring into America. Misapprehension prevails as to the relation of the present immigration to the existing market for labor. The statement has been made in the House of Representatives that unless the "flood gates are closed, the standards of living will be lowered, unemployment already estimated at two million men will run rampant and the wage scale destroyed."

It is a significant fact that for the fiscal year ended June 30, 1920, the total permanent increase in the alien male population of the United States was merely 9,877. According to the analysis of the official figures of the Bureau of Immigration, 10,000 more aliens left for, than came from, the countries of Europe for that fiscal period, and the bulk of the total increase in our immigration alien population came from Canada and Mexico. The United States lost 102,000 emigrant laborers and gained 49,185 skilled, 9,063 professional people, 12,500 farm laborers and 31,000 servants.

An immigration official has been quoted as estimating that the immigrants who will have come to this country before Jan. 1, 1921, will number more than 1,200,000. Yet for the five months—July, August, September, October and November, 1920,—a total of 472,859 immigrants arrived in the United States, according to records of the Department of Labor, and during the same period, 181,505 persons left the United States. This leaves a balance in favor of immigration of 291,354 for the five months. All other statements to the contrary, notwithstanding, it is made evident by these official figures that we will not have as large a net immigration as during 1914, when the net immigration was 769,276.

The following are the figures on total immigration and total emigration from July 1 to Nov. 30, 1920:

	Total Immigration	Total Emigration	Total Immigration
July	83,959	39,505	44,454
August	86,500	43,800	42,700
September	98,400	31,200	67,200
October	101,000	33,000	68,000
November	103,000	34,000	69,000
	472,859	181,505	291,354

The average net immigration per month beginning with last July was 58,271. If this average should hold for the remainder of the fiscal year of 1921, the total net immigration would be 699,252, which would be less than the immigration for 1913 and the immigration for 1914.

As to the immigration bill that recently passed the House of Representatives, and is now before the Senate, Gen du Pont asserts that "it fails to apply scientific principles to immigration." Its passage, he declares would result in the exclusion of able-bodied, unskilled workers, "in the face of the fact that we received in 1920 proportionately fewer unskilled immigrant workers than in any recent year of normal immigration." Further discussion of the bill leads him to the following conclusions:

We must realize that what we are now experiencing is a business slump due to temporary conditions that need no discussion here. These conditions must necessarily disappear, else we have come to a sorry pass. And when these conditions have been removed, and provided the bill to restrict immigration has been made law in the meantime, we may witness a shortage of unskilled labor that may cripple the manufacture of goods for export and tax our capacity to meet the demands at home. Such a proposal is economically unsound, and if public opinion is enlightened on the subject it will not become a law.

Enforcement of Existing Law

If undesirables are getting into this country, the blame rests, says Gen. du Pont, with enforcement officers, inasmuch as the existing immigration law specifically names classes that must be barred because of mental incompetence, moral laxity, physical weaknesses, political radicalism and economic dependence.

Through the raising of a cry that all classes of immgration must be barred because of the danger of poisoning our native civilization, Gen. du Pont believes that a most effective barrier to the Americanization of the foreign element already here is being set up. Calmer council should prevail, he advises, and if immigration and the foreign born must be discussed, they should be discussed dispassionately.

Policy of Inter-racial Council

The position of the Inter-racial Council as regards immigration is thus set forth by Gen. du Pont:

The Inter-racial Council is not opposed to limiting the volume of immigration to America, if, after a conscientious and liberal-minded investigation, that step is found to be in keeping with the best interest of the nation.

Such an investigation should be instituted at once and carried out under the direction of a non-partisan commission who will look over the field both in America and in Europe, studying the subject from all of its angles, scientifically, and with a view to evolving constructive policies. Immigration is too important a subject to permit of our rushing pell-mell into a program of restriction without proper consideration of the consequences of our legislation.

The council recommends principles of legislation which will consider selective immigration as one important aspect, and yet but a single aspect, of immigration. It suggests legislation that will provide for the effective distribution of immigrants, an intelligent policy of assimilation, the establishment of proper facilities for those entitled to naturalization, who, in large number, find very great difficulty in securing the privilege they have honestly earned. All these should be integral parts of a single policy. We cannot continue to interpret immigration in terms of prejudice and intolerance. It is a question of patient study and investigation, for it is closely bound up not only with our industrial prosperity, but with our civic and social development as well.

Engineering Conditions in Alaska

In his annual report to Congress, Secretary of the Interior Payne has the following statement regarding Alaska:

Ties and rails on the government railway in Alaska are now laid to mile 264. When completed the standard-gage line will extend from Seward to Nenana on the south bank of the Tanana River, 412 miles from Seward, with a standard-gage branch of 38 miles leaving the main line at Matanuska Junction (mile 151) to the Chickaloon coal mines, with a spur of 3 miles on this branch to the Eska coal mines.

Fifty-four miles standard gage are under operation from Healy (mile 358) to Nenana (mile 412), leaving a gap of 94 miles between Gold Creek (mile 264) and Healy. From the north bank of the Tanana River (North Nenana), a narrow-gage road of 54 miles is in operation to Fairbanks. From Happy station on this line, 7 miles south of Fairbanks, a narrow-gage branch of 32 miles extends to Chatanika. Total mileage in operation, 445; total when completed, 540. The clearing on the gap is practically completed, and approximately 40 miles of grading done. The entire road, including the 3,000-ft. bridge over the Tanana River at Nenana, should be completed and in operation by the end of the summer of 1922.

The Chickaloon coal mine is being operated for the Navy. A shaft of 600 ft. has been sunk and working levels opened. The coal is a fine quality of bituminous, as good as Pocahontas. The vein is irregular, and it is not possible to estimate with accuracy the amount of this coal. Eska is 20 miles west of Chickaloon. There the coal is low-grade bituminous, and is being mined by the Engineering Commission for the railroad and for domestic needs. Two leases have recently been made here to private parties. All the coal must be washed; a washing plant is in course of construction. Lignite coal in abundance is found south of Nenana, and is being mined for railroad and domestic purposes. Two private companies are operating in this field.

Organize the 13th Engineers

The 13th Regiment of engineers is being organized at Camp Humphreys, Va. The nucleus for this regiment was found in the first battalion of the 5th Engineers.

Trend of Highway Development —A Survey

California's Practice

THIS IS THE TENTH *of a series of staff articles on the highway situation. It deals with various problems concerning both design and construction of pavements, stressing particularly some rather unusual conditions that have arisen in California since the construction of California's system of the thin-slab, carpet-top concrete roads for which the state is noted.*

This review is the more interesting because there will shortly be issued three reports of investigations of California's highways—by the U. S. Bureau of Public Roads, by the California State Automobile Association and by the Southern California Automobile Association. The investigations made by engineers for the automobile associations were brought about as a result of criticism of the state's highway policy and methods. The points in controversy are not touched on in this review, since they will be fully discussed in the forthcoming reports.

The eleventh article of the series will appear in next week's issue.—EDITOR.

CALIFORNIA'S pressing highway problems relate both to design and to construction. The design problems arise from the uncertainty of the highway loads of the future, while the construction problems are not merely those due to high freight rates and to high cost of labor and materials, but to the securing of a sufficient number of competent contractors to handle the program that should be put under way in order to extend to the people as quickly as possible the benefits to be derived from the $40,000,000 bond issue, recently approved. Next season between $6,000,000 and $10,000,000 is to be expended on state road work and about $12,000,000 on county road work, provided enough contractors are available to carry out this extensive program. Some of California's problems are therefore akin to those in other states. Any inquiry into California's highway problems must concern itself with the thin-slab, carpet-top concrete road, for which the state is noted, and to the service rendered by that design.

UNFORESEEN CONDITIONS

One of the greatest uncertainties in planning new roads in California is the question of what heavy traffic, or other unforeseen conditions, will develop on the road after completion. California's experience has given the state some indication of traffic to be expected on improved highways. For instance, the rice industry which sprang up suddenly in the Sacramento Valley after the construction of the highway system brought the paved highways of this district three unseen problems: (1) Excessive motor truck loads; (2) irrigation water standing for months at a time, thereby saturating the sub-base; and (3) alkalis (leached from the soils) that attacked the concrete.

The state law limits loads to a maximum of 800 lb. per inch width of rubber tire, but trucks delivering from the rice fields and from other farming districts, state officials report, frequently operate with 1,000 lb. or more per inch width and often carry 8 tons per load. An effective patrol system for preventing these infractions of the law has not yet been devised.

From the danger of standing irrigation water it has been possible to afford some protection by special drainage ditches along the shoulders.

The question of what should be done to protect the concrete from the action of alkali, however, is still unsolved. This is suggested as a topic on which investigation by the U. S. Bureau of Public Roads would be of great benefit. The use of an asphalt base under the concrete is being planned and where the presence of alkali is suspected particular pains are taken to secure a dense concrete so as to exclude, in so far as possible, the alkali-bearing water. Irrigation of the sort required for rice culture has brought out alkali salts in districts where they did not before appear in injurious quantities, and, in some instances, where their presence was previously unsuspected.

CONCRETE CONSTRUCTION

Probably two-thirds of the concrete placed on the California state highway system consists of a 1:2½:5 mix. In the last two years the standard mix has been changed to 1:2:4 at an additional cost of perhaps $1,000 to $1,500 per mile. A. B. Fletcher, chief engineer of the highway commission, expresses some doubt as to whether the additional strength secured in this mix justifies the added cost, under the circumstances. On concrete bases the California commission has favored a thin asphalt-oil top, about ⅜ in. thick, on the theory that this prevents raveling and by the cushioning effect reduces the shock and impact on the necessarily rigid concrete base. However, little of this "black top" has been placed in recent years since the advance in cost of labor and materials has put it beyond the reach of the commission's funds. The cost in place has increased from 8 or 10 cents to 20 cents per square yard. Under present conditions it is believed that a 1½ to 2-in. asphaltic top may be more economical than this thin top, and the viewpoint of the commission now is that a goodly percentage of the concrete base to be laid under the present schedule should have this thick black top or wearing surface. Where this will be used is a question that will have to be determined by the kind and amount of traffic, foundation conditions and thickness of concrete base.

CONSTRUCTION FEATURES

The black top is not ordinarily used for repairing concrete pavements which have suffered from excessive traffic or from a combination of heavy wear and weakened foundation conditions. The only remedy recommended for this condition is the placing of an additional layer of concrete on top of that already in place. In fact, the commission when referring to the concrete work, is always careful to speak of it as a base rather than as a pavement. It has always been the intention to place an additional thickness of concrete on some of the thin base roads when traffic and financial conditions warranted it.

The black top is used as a latter, additional thickness, however, on certain pavements subjected to an unexpected amount of traffic but which have not been damaged fundamentally. The customary way of placing it in these cases is to build a concrete shoulder, 2½ ft. wide, on each side of the roadway. These project to a height of from 1½ to 2 in. above the roadbed and are topped with a black top, usually a Topeka mix, from 1½ to 2 in. in thickness. This topping extends the full width of the roadway between shoulders. This construction gives a black center with white border strips (the shoulders are not oiled).

The commission is now definitely committed to the practice of using reinforcing steel in all concrete bases, and a minimum concrete thickness of 5 in. The steel is used on the theory that even a slight amount of it will prevent cracks from widening and thus keep cracked slabs from breaking down.

California is believed to be an exception to other states in that its main highway system includes many stretches where there is heavy travel through uninhabited territory. As a result, there is found hard surfacing where the adjacent territory would call for cheaper construction. For example, 40 miles of the Ridge Route between Bakersfield and Los Angeles was without habitation when the route was built, yet this road was made 20 ft. wide and was paved with a concrete base throughout, the materials being hauled to the job 40 miles by motor truck. Most of the main trunk highways have now been built and under the new $40,000,000 bond issue a large amount of the work will be on laterals.

Effect of Freight Rates

Freight rates have considerable effect upon road construction inasmuch as materials have to be hauled long distances by rail. Along the coast from Monterey Bay to Los Angeles, for example, the absence of gravel deposits and commercial rock quarries has necessitated the shipment of crushed rock as far as 200 miles. The present freight charges are approximately three times the pre-war rates, because in those days the state enjoyed special rates on road materials which were about half the normal freight rates. Now, no special rate is allowed. Because of the frequency of long hauls, the policy has always been to make every effort to develop any good local sources of supply. However, deposits of suitable materials near the jobs are comparatively rare in California, and there has been nothing to do but pay the high freight rate.

During the construction season of 1921 slow cement deliveries and car shortages will not be factors, it is believed. Some difficulty was experienced during the past construction season in securing cement, but car shortages and scarcity of labor, the two chief causes, are no longer feared. During the war all available cars were taken from the Western rail lines and it does not appear that the coast supply of cars has been drawn upon since then. Meantime, freight shipments have decreased, so the cars available have been able to handle easily the business that is offered. Unlike the Central and Eastern states, California does not have to give up a large number of cars to assist in the transportation of winter coal supplies.

Day-Labor Construction

A sufficient amount of labor is now available in the state, but the average cost exceeds $5 per 8-hr. day, and during the summer months the better class of labor is attracted to the canneries and orchards. Moreover, under the existing state policy all highway work done on the day-labor plan can be performed only by American citizens. Indirectly, this has increased labor costs on state road work. An average of about 500 convicts is employed in remote districts, and the results of several years' experience with this class of labor have been particularly good. However, the maximum number of convicts available for this kind of work is about 750 to 800. The total cost of feeding, housing, clothing and equipping them is about $2 per day, or less than 40 per cent of the common-labor wage. State highway officials assert that convict labor is far more efficient than the average common labor of today.

California's experience with day-labor work has proved, according to an announcement recently issued by the highway commission, that contract work is the more economical way of carrying on highway construction, and that it can thereby have a greater volume of work under way. Therefore, the commission undertakes work by day labor only when the job is too small to warrant advertising for bids, or when no fair bid is tendered. During the early period of state highway construction, approximately 80 per cent of all work was done by contract. War conditions, with a consequent increase in the prices of materials and wages, influenced the state highway commission to assume more work on a day-labor basis. During the past season work done under contract and by day labor was about equally divided in volume. With resumption of active construction under more normal conditions, the commission hopes to do less day-labor and more contract work.

Though California has experienced many difficulties in pioneer work of concrete roadbuilding and though her problems, herein presented, have called for a measure of resource in solving them, highway engineers all over the country doubtless are more interested in one problem of California's more than any other—the service value of thin-slab, carpet-top concrete roads under intense motor vehicle traffic. That particular question is the subject of inquiries on the part of three organizations referred to in the introductory paragraph of this article. These reports are expected to add greatly to the published data on California's highway practice.

Earthquake Causes Surge in Sewer

THE accompanying diagram taken from records of an automatic gage shows effect of the June 21, 1920, earthquake on the flow in the main outfall sewer of the city of Los Angeles Cal. The record shows the variation in the depth in feet in the sewer, which reaches its maximum each day about noon. At that time on JJune 21 it had reached a height of 4.18 and was steadily decreasing until shortly after 6, when the earthquake occurred. The surge which then resulted is shown by the vertical line reaching from a point 4.37 down to a point 2.82. This was practically instantaneous, as shown on the gage, and apparently had no effect on subsequent flow.

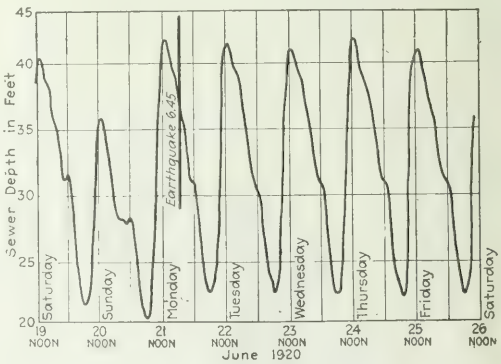


DIAGRAM SHOWING EFFECT OF EARTHQUAKE ON FLOW IN OUTFALL SEWER, LOS ANGELES, CAL.

Assuring Safety in Old Highway Bridges

Bridge Danger Often Exaggerated, But Conscientious Supervision Necessary—What Loading Should Be Provided For—Experience With Failures—Floor Repair

By M. W. Torkelson
Bridge Engineer, Wisconsin Highway Commission, Madison

THE effect of modern highway traffic on existing bridges has of late been the subject of much speculation and in some quarters appears to have caused a very large amount of alarm. The recent progress report of a committee of the American Road Builders Association on this subject opens with the statement "it has been estimated that more than 80 per cent of the highway bridges are a distinct menace due to either of two things, original construction not strong enough for modern traffic demands, or deterioration." While the writer does not wish to belittle such danger as actually exists, he cannot but feel that this statement goes far beyond the facts and is liable to cause unnecessary alarm. He is willing to concede that he is not familiar with conditions in the more densely populated Eastern States, yet his experience does include a metropolitan area, where the loads to be carried are probably as heavy as they are anywhere, though possibly the traffic is not as dense as in certain localities in the East. It is not contended that our bridges are of the strength they should be; it is admitted that some of them are dangerous, but to say that 80 per cent of the bridges are a distinct menace is to make a statement that does not appear to be warranted by the facts. It makes it appear that any man who goes out on the road with a good-sized truck is in danger of losing his life or his property, or both, and suggests that we should make extensive repairs on practically all of our older bridges.

Bridge Problem Not Primary

Reliable statistics are necessary to prove the truth or error of the statement quoted. Records of highway traffic and highway accidents do not, to the writer's knowledge, exist. But experience extending over more than twelve years shows that accidents due to failures of highway bridges, either in whole or in part, form no more than a very small portion of the total number of accidents occurring on the highways. It is true that weak bridges constitute one source of danger; but bad alignment, narrow embankments, railroad grade crossings, lack of enforcement of traffic rules and many other causes of accident which might be cited are far more serious. In the writer's experience during the time quoted he does not know of more than a dozen or fifteen bridge failures in the state. During the same period accidents on the highways due to other causes, resulting in great damage to property and loss of life, have occurred by the hundred. How then can the condition of our highway bridges be held up as a distinct menace? Or, if it is a menace, why should not greater attention be paid to rectifying these other conditions which are much more destructive?

Nevertheless, there is a problem which must be recognized and faced. Provision must be made for motor trucks, which are with us now and which will continue to come in ever-increasing numbers. Where one truck now travels the main road there will in all probability be ten within ten years. The problem is to take care of this truck traffic until such time as all of our old bridges can be replaced with new structures of adequate strength. This does not mean that we should undertake to strengthen all old bridges, or that we should embark on an extensive repair program. Repair work is expensive, and even when repairs are completed the usual result is still an old bridge that nobody wants. If extensive expenditures are incurred they should be for new work.

Live Loads for New and Old Bridges

The individual load for which we will have to provide will probably not be much greater than at present. The law in Wisconsin requires all steel, iron or concrete bridges to be built of sufficient strength to carry safely any load which may be driven or propelled thereon of *not more than 15 tons.* Under the unusually rigid assumptions of the Wisconsin Highway Commission as to distribution of load, the bridges designed under this assumed loading are of ample strength to carry 20-ton tractors. To date the only loads which have approached the limit are the traction engines which are in general use for threshing purposes. These tractors, while not considerable in number, exist throughout the entire state, practically, and almost any bridge is liable to be called on to carry one. Though they travel at slow speeds, not more than 2 or 3 miles per hour, yet they are almost invariably equipped with heavy lugs which cause considerable impact.

The writer does not believe it likely that this weight is going to be exceeded in trucks, except in rare instances. We must consider that there is a reasonable limit to truck weights that must be observed, otherwise we will have a parallel to the well-known competition between the safe manufacturer and the burglar. If the weight of trucks is permitted to be increased to the limit as soon as the roads are surfaced with improved pavements, the weight of trucks will be increased, the pavements will again be inadequate, and the vicious circle will continue. Plainly, this cannot be tolerated. Though heavily laden trucks travel at higher speeds than traction engines they run on smooth rubber tires which, even though solid, tend very much to decrease impact. The tendency of the time is more and more to pneumatic tires, which again will tend to reduce impact. Under the circumstances, the writer is forced more and more to the conclusion that the truck of the future will not greatly exceed in capacity the truck of the present time.

Fixing up our old bridges to last ten or fifteen years longer does not mean that we must spend large amounts for indiscriminate repairs. The extent to which a weak bridge should be repaired will depend very largely upon where it happens to be and what traffic it is called on to carry. If it is located on a byroad where heavy loads pass only at rare intervals, it should remain untouched until all of the bridges in the same class located on the *main roads* are repaired. "Repair," furthermore, does not mean that the bridge should be brought up to the standard of new construction. There

can be no argument about the necessity of first-class design for new work; ample provision for the future should be made. But where the problem is one of caring for traffic for a few years only we need do no better than our everyday experience shows us is necessary to carry the loads.

Facts About Failures

Since the object in mind is the prevention of bridge failures it is important to study just how failures occur. While the writer has no accurate statistics at hand it is his belief that most failures occur only after there have been indications of danger unmistakable to any man who is competent to be in charge of the highway work for a county. In two failures involving fatalities which have come under the writer's observation this was especially noticeable.

In one of these, where the failure occurred through the buckling of a T-chord pony truss, the truss stood for months, badly out of line and steadily getting worse, while carrying a severe load at frequent intervals. The writer personally warned the driver of the tractor under which the bridge later collapsed, in the presence of the town chairman, but the warning went unheeded and after a few more trips the bridge collapsed, killing the driver and his fireman. In another case, where a long single-span bridge fell into the river, the failure was due to the collapse of an improperly built abutment. The deterioration in the masonry had been observed as much as four or five years before the accident occurred, and there had been talk about relaying the masonry and fixing up the bridge. But through the inertia so common in our public officials nothing was ever done.

In other cases, where there have been failures in bridge floors examination after the failure has shown that a majority of the joists was rotten from end to end, the wonder being that they carried even their own weight, to say nothing of heavy loads. This condition could easily have been detected in advance; any experienced construction foreman taking the trouble to look under the bridge floor would have been in a position to detect the danger and to suggest the remedy.

Failures in Steel Bridges

In the writer's experience failure in members of steel bridges are extremely rare; he knows of only four, and fortunately none of these resulted in accident. One, a clean break through a main member consisting of four good-sized angles, occurred during erection. Probably this was due to imperfect metal, all four angles in the member having been cut from the same imperfect section. In another case a lower-chord member in the center panel of a 40-ft. pony truss failed about four years after erection. This was also due, in the writer's belief, to bad metal in the member, but the break was detected and the bridge supported on falsework before any harm resulted. The other two failures were in eyebars with welded heads, clean breaks through the welds. In one of these cases, where the matter was brought to the writer's attention, he was instrumental in getting a new bar installed, the remaining bar carrying the load in the meantime. In the other case the second bar of the pair carried the load over a considerable number of years and no harm resulted.

The failure of trusses as a whole is also very rare. The only cases of failure of this kind of which the writer has knowledge are two or three T-chord pony trusses and the single long truss previously mentioned. But this latter involved no fault of the truss itself; the abutment was built of shapeless igneous rock, laid up with no more natural bond than there would be in a pile of pumpkins, with but very little mortar and that of poor quality. All of the other truss failures of which the writer has knowledge have occurred in unbraced T-chord pony trusses, and in these cases the trusses invariably got badly out of line and remained in this shape for long periods before the truss went down. The incipient buckling was plain warning of coming trouble, but was ignored.

Floor Failures

It also seems that actual failures of steel floor system members are few and far between. In the early days, about 1908, when Wisconsin first interested itself in bridge construction, the writer was frequently called upon by local officials to get up bridge plans and was required to justify these in competition with plans proposed by bridge contractors. In those days the most frequent debate was with reference to the size and number of floor joists. The state department's plans usually called for 9-in. joists where the plans previously in use had specified 6-in. joists. The writer remembers frequent arguments with bridge men with reference to these so-called heavy steel joists, and the statement was made by these men, in good faith, that they had never known of an instance where a steel I-beam had actually broken under a load. There had been some instances where the drive wheels of traction engines had broken through a floor, letting the axle down on the steel joists, but the joists (so it was reported) invariably held. Since that time the writer has heard of only a single case where any rolled steel beam has failed under a load, and that failure occurred in a 10-in. beam in a bridge with 16-ft. roadway. The traction engine causing this failure was said to weigh in the neighborhood of 15 tons; the break was described as a clean, bright break, indicating no flaw.

The writer believes that by far the most usual cause of bridge failures is the failure of wooden floor joists or floor planks. Previous to about 1900 the majority of steel highway bridges were built with timber floor joists and many of these bridges are still in service. These floor joists naturally rot most rapidly on the upper side. It has been frequent practice to turn these old joists, putting their straight side up and leaving the badly rotted side, full of old spike holes, each with the adjacent area badly rotted, on the lower side, where it is called upon to take tension. This procedure makes it possible to lay down the new floor planks on a straight surface, but it certainly does not make the floor any stronger. Many old joists thus remain long after their period of usefulness is over. In the writer's opinion they cause more bridge accidents than all other causes combined.

Floor Repair the First Step

From the foregoing it appears that the most necessary thing to do is to have careful examinations made of our bridge floors and the proper remedies applied to such bad conditions. This applies to short spans as well as the long spans. If the bridge is short, not more than 30 or 40 ft., the problem of repair is simple in nine cases out of ten: throwing out unsound joists and replacing them with joists that are sound. If the trusses are

weak, it is usually possible in these short spans to place supports under the panel points. In timber pile trestles repairs consisting of the replacement of rotten timber are a comparatively simple matter. The deck can be removed, caps taken off, and new piles driven where necessary, without any great skill being required.

In case of a combination timber truss bridge the problem is more serious. There is no type of bridge, in the writer's judgment, so dangerous. Rotten timber may exist in a vital spot undetected, and it is beyond the power of any man to say whether or not an old bridge of this type is safe. But there are instances where such bridges have stood up and carried traffic for years after having sagged appreciably under their own weight, probably due to slight rotting and subsequent crushing of timber at the ends of compression members.

In nine cases out of ten steel bridges, even those built more than 15 years ago, are of ample strength, in so far as the trusses are concerned, to carry modern loading, the weak point usually being the floor system. If the floor joists are of timber a careful examination of them should be made, piece by piece, by an experienced timber man. If a considerable portion of them are in good shape it may be wise to reinforce the floor by replacing the joists which have rotted to a serious extent and to increase their number. In case many of them are in bad shape it probably will be wisest to replace them with steel joists spaced not more than 27 in. between centers and of proper size for the length of panel. Usually the trusses are not of sufficient capacity to carry a reinforced-concrete floor and have any live-load capacity left, but a laminated floor of 2 x 4-in. planks laid edgewise, protected by a bituminous wearing surface, will, if given reasonable maintenance, give service during the remaining life of the bridge. If the floor beams are weak there are ways of reinforcing them. Usually, however, serious weakness, if any exists, will not be in the beam itself, but in its connections. It is a comparatively simple matter to design auxiliary yokes by which these end connections can be reinforced and the capacity of the beam itself thus be greatly increased.

Sometimes there is serious corrosion in certain members of the bridge at the floor line. Usually this condition is worst in the end posts, but sometimes it is present in the web members, and the writer has seen it even in the lower chords. If serious corrosion exists near the end of any member the repair is usually a serious matter, involving supporting the bridge on falsework and replacing the corroded member. But if the corrision is a sufficient distance away from the end connections to give grip to the splice it is usually possible to design a splice reinforcement to the corroded member which will give the bridge its original strength and which can be installed without interrupting traffic.

Dealing With Weak Trusses

To attempt to strengthen the trusses of steel bridges is usually useless. The expense is generally great and the result a patched-up old bridge which is not worth what it costs. It would be better in a majority of cases to scrap the old bridge and build a new one. If the span is short or obstruction to the stream not serious it may be possible to introduce supports under the panel points, in effect converting the bridge into a trestle. This procedure also is relatively expensive, and it would be better in a majority of cases to apply the money toward the construction of a new bridge.

Much unnecessary loading is put on highway bridges through impact caused by improper approaches and rough bridge floors. Just so sure as a rough bridge floor will cause a large amount of shock, stressing the bridge far beyond a static load of the same weight, so will removing the causes of impact tend to relieve the bridge. The laminated 2 x 4-in. floor protected with a bituminous wearing surface, heretofore referred to, can be made so smooth that loads will roll across with little if any impact, and the approaches to any bridge can be placed in such condition that the loads will roll upon the bridge smoothly and not, as is often the case, land on it with a bang that can be heard half a mile away.

The writer's program can be summed up in a few words: Find the really bad places and make them safe. This does not mean the repair or reinforcement of all old bridges indiscriminately, but the searching out of those glaringly bad places so plain to be seen once looked for, which cause nine-tenths of our failures, and the replacement of rotten materials with sound materials where this will result in a reasonably adequate structure. Where reasonable repairs will not result in substantial improvement a new structure should be built. Where a structure gives plain signs of distress these should be heeded promptly, not ignored. Experience shows that if this is done bridge accidents will practically disappear.

But this requires eternal vigilance. There must be someone on the job whose business it is to look out for these warnings and apply the remedy without delay. We must act, not procrastinate.

In Wisconsin the supervision of all bridges on the state trunk highway system is in the hands of the county highway commissioner, who is directly in charge of all county construction and maintenance. He in turn is under the direction of the state highway commission, which is authorized by law to require the reconstruction of any bridge or culvert deemed dangerous. It is a portion of the county highway commission's engineers on maintenance work to make frequent examinations of all drainage structures, and to recommend and cause to be executed such repairs and betterments as may be deemed advisable. The state highway commission has received very loyal support from the county officers, and through their co-operation more than a thousand of the worst structures are being replaced yearly with permanent structures of high type. At the present rate of accomplishment we expect to keep ahead of our traffic problem, keep bridge failures down to a minimum and have all of our seriously weak bridges on important routes replaced in ten years with adequate modern structures.

Cement and Base Metals Now Lead

Speaking at a recent meeting of the Portland Cement Association Dr. George Otis Smith, director of the U. S. Geological Survey, said:

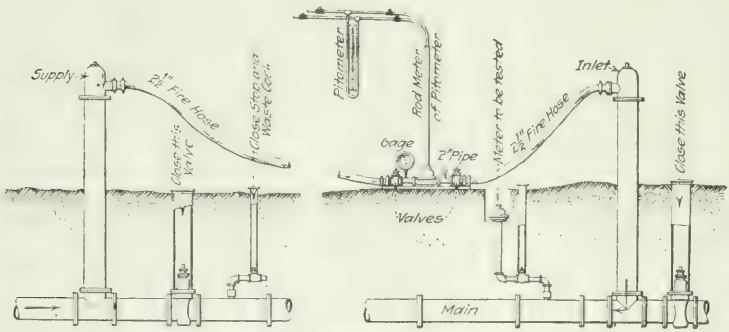
We are apt not to pay enough honor to the humble but useful things of life. The dominant position of our country in a world of industry and commerce is due largely to our wealth in the essential minerals, and the statistical record of the growth of our mineral industry shows how the baser metals have taken the leadership from gold and silver. Indeed the non-metals, once of subordinate rank, now far exceed the metals in value of annual output

Test of Large Water Meters in Place With a Pitometer

By Frank D. Danielson
Assistant Engineer, Village of Glencoe, Ill.

When service meters have measured about 400,000 cu.ft. they usually under register and must be removed for testing and repair. Meters up to and including the 2-in. size may be removed readily and checked for accuracy at the shop, but larger meters are heavy and it is often impracticable to remove them from their setting in vaults. For testing large meters in place at Glencoe, Ill., a pitometer was used as shown by the sketch.

The pitometer was set up near the vault containing the meter to be tested. The rod meter of the pitometer was inserted through a corporation cock on a 2-in. galvanized-iron pipe about 6 ft. long. A valve attached to the pipe on each side of the pitometer assisted in the control of the water while the apparatus was being placed. To each end of the 2-in. pipe was attached a length of fire hose which reached to neighboring hydrants.



PITOMETER SET-UP FOR TESTING LARGE METER IN PLACE

For such use of the pitometer and fire hose, instead of tapping the main, the location of hydrants and valves must conform to certain conditions. Sometimes it became necessary to connect hydrants which were located more than a block away from each other. The losses occurring in such extended hose lines together with that from the mains included was first determined as stated later. One hydrant must serve as the source of water supply and the other as the inlet to a section closed off in the street main from which the meter to be tested is fed. This closed-off section is easily obtained by shutting one valve anywhere between the supply hydrant and the service pipe to the large meter and another valve back of the inlet hydrant. All stop and waste cocks on service pipes leading from the segregated section of the main street must also be closed, except the cock to which the meter to be tested is attached. The pipe to which the meter under consideration is attached must be closed in the residence served. The lawn faucet can then be opened to allow a stream to pass which has been measured both by the meter and pitometer.

The water measured was fed from the supply hydrant through the pipe containing the pitometer orifices into the inlet hydrant to the segregated section. The loss in the system which must be credited to the meter when comparing its discharge to that of the pitometer had to be determined. To do this the stop and waste cock near the meter under investigation was closed and a reading of the deflection of the manometer taken. If there was no waste the deflection was zero, since all flow past the pitometer orifices had been stopped. If a slight deflection in the U-tube was shown the computed discharge was added to the meter reading to give the net discharge.

Before starting to make meter and pitometer readings water was allowed to pass through the set-up for a short time to assure the proper working of the whole system. When the pressure gage attached to the pipe near the pitometer showed a constant reading the flow was considered uniform. Time was taken for the passage of a definite volume of water through the meter. When the indicator of the 1-cu.ft. dial read zero, the time was recorded and a reading made on the manometer. The flow continued until the prescribed number of cubic feet had passed through the meter, when the time was again noted. During this interval the U-tube deflection was read frequently and the mean taken in computing the velocity of flow and the discharge. Comparative discharge determinations were made with several different-sized streams flowing from the lawn faucet.

Having determined the amount which a meter registered either above or under (the former was never found) 100 per cent, the following formula may be used for finding the correct change gears:

Ratio of required gears equals $(A \times R)/(B \times 100)$, in which A equals number of teeth in gear on register spindle, B equals number of teeth in gear on stuffing box spindle, R equals per cent registered with above gears. Tables from the meter companies are available which give the ratio and diameters of change gears.

From the work carried on in Glencoe the writer feels confident that a high degree of precision in testing large meters with a pitometer can be easily attained.

Engineer Salaries

From a wide variety of sources covering the entire country the averages of engineering salaries as reported in the *Professional Engineer*, the official publication of the American Association of Engineers are as follows: Tracers, $150 a month; detailers, structural, mechanical and electrical, $185 to $210 (a few companies pay up to $230 a month for experienced men); designers on all classes of work, $250 to $300 a month; estimators and checkers, $300 to $350 a month; rodmen and levelmen, $150 to $180 a month; instrumentmen, $175 to $250 a month; assistant engineers, $200 or more; map draftsmen, $200 a month; surveyors, $175 to $200 a month; research engineers, $200 to $300 a month. The salaries vary somewhat depending upon class of work and location of the position, on which depends cost of living. Temporary positions average 25 per cent more than permanent position.

Alternative Outlets for Sewage Pumping Station

Gravity Flow to River—Pumping to River or to Sewer—High and Low-Level Conduits to Junction Chambers

COMPLICATED sewer outlet connections are required at the new Calumet sewage pumping station of the Sanitary District of Chicago, owing to the provision of alternative means of discharge for both dry-weather and storm-water flow. Thus the flow may be diverted west to the high-level Calumet outfall sewer connecting with the Calumet-Sag drainage channel, or south to a low-level emergency outfall leading to the Calumet River.

Both sewage and storm water will enter the north end of the pumping station by a large sewer of horseshoe section 17½ ft. wide and 14 ft. high, and after passing through a screen chamber will enter the basement of the station, which forms the suction chamber, as described in *Engineering News-Record* Nov. 4, 1920, p. 872. A depressed portion of one side of the floor forms a channel for dry-weather flow. Electrically-driven centrifugal pumps discharge into a storm-water basin on the west and a dry-weather basin on the east side of the station.

Two double-barrel conduits lead from the side and end of the storm-water basin to junction chambers at the heads of the Calumet sewer and the river connection respectively, as shown in Fig. 2. The curves are made with a radius of 46 ft. on the center line between the conduits. Two single conduits lead from the end of the dry-weather basin to the same junction chambers, but entering these chambers at a lower level. One of the conduits is straight, except at the connection to the junction chamber, while the longer one has curves of 12 ft. radius. The plan and profile of these four conduits are shown in Fig. 2.

A horseshoe section is employed for all conduits, 8 x 8 ft. for storm water and 7 x 7 ft. for the dry-weather flow. Two interesting features are the double-deck junction chambers and the intersection of the single and double-barrel conduits. From the details of the Calumet sewer junction chamber, Fig. 1, it will be seen that a reinforced concrete monolithic structure some 70 ft. long, 24 ft. wide and 28½ ft. deep includes the chamber with its curved double-barrel connection at the upper level and its straight single-barrel connection at the lower level. Provision is made for stop planks to close the ends of the three conduits.

Hydraulically-operated sluice gates in the discharge basins at the pumping station will control the direction of flow in the several conduits. Each basin will have

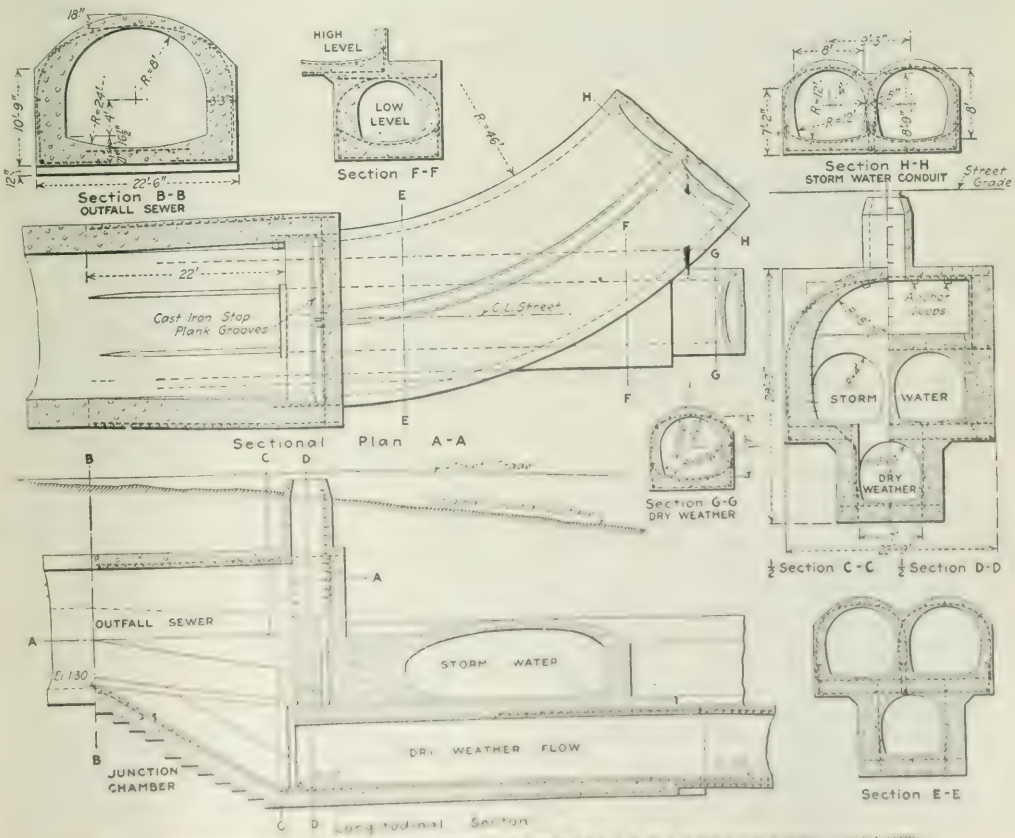


FIG. 2. [illegible] OF HIGH AND LOW LEVEL CONDUITS

gates at the discharge conduits and at openings connecting with the suction chamber, so that when the river is low a gravity flow can be maintained through the station. When the river is high, the gates to the suction chamber will be closed and the sewage pumped then to the high-level or low-level discharge conduits, as may be desirable.

These outlet connections and the substructure of the pumping station were designed by S. T. Smetters, assistant bridge engineer of the Sanitary District of Chicago, under the direction of C. R. Dart, bridge engineer, and E. J. Kelly, chief engineer.

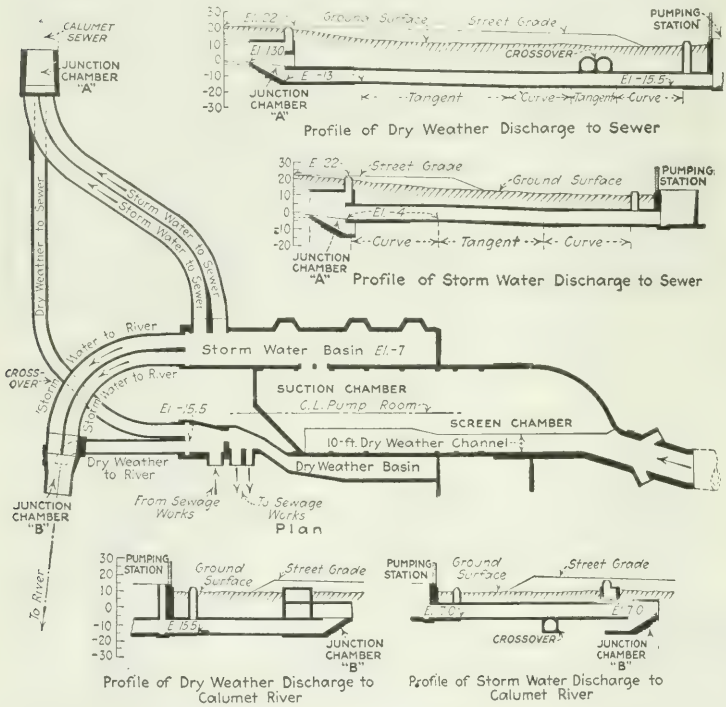


FIG. 2. SEWAGE PUMPING STATION WITH ALTERNATIVE MEANS OF DISCHARGE

Neighborhood Group Plan for Cleveland

A neighborhood center and group plan for the Brooklyn section of Cleveland, Ohio, has been tentatively approved by the City Plan Commission of Cleveland. This is described as "the second link in a chain of community or civic centers proposed for various localities in Cleveland" which are designed "to perform the same service for local communities as the downtown group plan does for all Cleveland." The Brooklyn neighborhood center "calls for two rather massive buildings, one on either side of Pearl Road at the southerly end of the Brooklyn-Brighton bridge overlooking Big Creek Valley." There would be landscape development between and near the center and some street widening is proposed. The community center plans for Cleveland are being worked out by Robert H. Whitten and Frank R. Walker, advisors of the City Plan Commission.

Employment Service of A. A. E.

By E. B. Miller
Assistant Secretary in Charge of Employment Service, American Association of Engineers

For the eleven months of 1920 ending Nov. 30, the employment department of the American Association of Engineers was instrumental in placing 2,970 men in new positions at an aggregate annual salary of over seven million dollars. There were 7,000 openings received to which 31,000 men were referred. If this service were rendered by professional agencies the fees paid would have amounted to about one-third of a million dollars.

During November 717 vacancies were received to which 3,506 men were referred and 312 men placed. The greatest demand for the month was for engineers in the industries, that is, mechanical engineers, mechanical draughtsmen, production managers and industrial engineers. The least demand was for construction engineers, superintendents of construction and general civil engineers. This showing was natural because little construction has been in progress for several months. Recession and hesitation in business are becoming more prominent daily; as a result, the number of technical men out of employment is increasing. The condition is not, however, alarming as it has been manifest in practically all preceding years of record, since there generally is a year-end pause. A resumption of activity in the engineering field normally comes about quickly after the first of January. Indications are that considerable construction will be under way soon and that exceedingly favorable conditions are ahead.

SERVICE RECORD FOR NOVEMBER, 1920

	Positions Received		Men Referred		Men Placed		Applicants for Employment	
National office	..	483	...	2,944	..	179	...	1,382
Chicago	42	...	126	...	25	...	138	....
Twin Cities	30	..	69	....	31	...	40	....
Pittsburgh	7	...	15	...	0	...	10	....
Seattle	13	...	42	....	6	...	15	....
Detroit	3	...	4	...	2	...	7	....
New York	53	...	112	...	26	...	75	....
El Paso	16	...	28	....	10	...	20	....
Washington	8	...	13	....	6	...	5	....
San Francisco	10	...	20	....	2	...	5	....
Chattanooga	6	..	12		1	...	4	...
Los Angeles	33	..	70		14	...	36	..
Philadelphia	4	...	12		0	...	6	..
Portland	14		30		8		15	
Toledo	5	244	9	562	2	133	5	381
Total November	..	717	...	3,506	..	312		1,763
Total Oct.	..	694	...	3,357	..	301		1,602
Total Nov. 1919	..	400		1,490	..	145		470

The average salary, $201, is $2 less than last month. The total monthly salary o all positions filled was more than $63,000, with a saving to members if commercial agencies rendered this service, of $37,000.

One of the features of the employment service is the

monthly review of engineering conditions through which a classification of salaries is made for different positions in different localities both of men available and men wanted.

Horizontal Diaphragm Increases Surge Tank Capacity

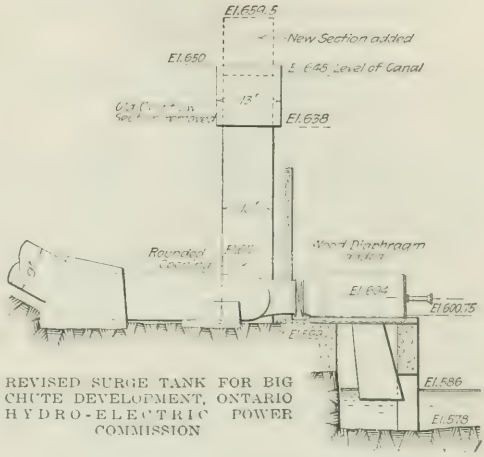
Added Penstock Threatened To Overtop Tank, but Surge Is Throttled Down by Plate With Small Opening

IN ADDING to the capacity of a small hydro-electric power station at Big Chute, Ont., the Hydro-Electric Power Commission of Ontario has saved considerable time and money in the surge tank reconstruction by adding a horizontal diaphragm to throttle down the surge rather than to build the tank high enough to take the unrestricted flow. The original installation of the plant consisted of three 1,100 hp. units supplied by a 9 ft. diameter penstock 100 ft. long. A second penstock of the same size was added to supply a new unit of 2,300 hp. and was also connected to the first penstock. Some provision obviously had to be made for the regulation of the water column in the penstock for loads thrown off the plant.

In the original development the surge tank was 10 ft. in diameter, with its top at El. 650 or 2 ft. above canal water level. In addition to the 51 ft. straight shaft there was an upper 12 ft. section 13 ft. diameter for overflow and provided with a 10-in. drain leading to the tailwater. Even under the old load conditions it was found as the load on the plant approached full capacity that spilling from the tank occurred for full-load shut down.

Studies were then made to determine the best means of caring for the extra surge when the new load was added. First a calculation was made to find the elevation to which it would be necessary to carry the 10-ft. diameter tank in order to prevent any spill-over for full load drop. The governors were assumed to close the turbine gates in three seconds. The result of this calculation is shown on the accompanying diagram with water levels plotted against time. It is seen that the water would rise to El. 670.1 and the tank would have to be carried beyond this elevation to prevent spilling.

Calculations were then made to determine the effect of blocking up the tank, either totally or partly. It was found that if the tank was entirely closed off that for governor time of two seconds, or less, the pressure rise in the pipe line and wheel cases was prohibitive and,



REVISED SURGE TANK FOR BIG CHUTE DEVELOPMENT, ONTARIO HYDRO-ELECTRIC POWER COMMISSION

of course, there was no rise of water level in the tank. For partial blocking of the tank less pressure rise would result but a rise in the water level would occur. After several calculations it was found that if the tank were partially blocked, leaving an opening with a net area (gross area multiplied by coefficient of discharge) of 12 sq.ft. that a pressure rise quite within safety of the penstock and steel casing would occur and that the water level would rise only a small amount of the rise occurring for a tank with no restrictions. The results of the calculation for this condition for governor closing times of two and five seconds are also shown on the diagram.

The necessary changes were then made to fulfill this condition. The tank was raised 11.5 ft. to El. 659.5, the plates from the original 13 ft. diameter overflow section being used, and the restricted opening was made by inserting a wooden bulkhead in the tank at El. 612.0. This bulkhead was 12 in. thick and had an opening 18 in. x 8 ft 10½ in. in plan, which with the rounded openings shown made an effective opening of 12 sq.ft. With this device the rise in the tank is kept well below the top and the back pressure in the pipe line within safe limits.

THEORETICAL RISE IN SURGE TANK UNDER DIFFERENT GOVERNOR TIME IN SECONDS

British Road Work Aids Unemployed

New road construction amounting to almost £1,500,000 has been undertaken by various British cities in co-operation with the government as a means of providing work for the unemployed. Details of the plan received from its English information service by the Bankers' Trust Co., of New York, indicates that the British Ministry of Transport will bear 50 per cent of the cost of such work and will loan to municipalities the remaining amount for five years, repayable in annual instalments. Ex-service men receive preference among applicants for employment at the road work but all are required to submit to one week's registration.

State Road Survey Methods and Costs in Missouri

Work on 6,000-Mi. Program by State and Private Engineers—Field Methods—Maps and Plans—Progress and Cost

BY SKILLFUL co-ordination of work done by state forces, by contracts with local surveyors and by agreements with county engineers, the Missouri State Highway Department is keeping the cost of surveying its 6,000-mi. road system within the $100 per mile prescribed by law. This cost includes complete plans as well as field work, the latter now averaging about $60 and the former $25 to $30 per mile. Beginning in 1919, surveys of 4,072 mi. had been completed by August, 1920, and arrangements made for surveys of 856 mi. more.

A Missouri road law which became effective in March, 1919, provided for a state highway system of 6,000 mi. and required that a survey of the entire system should be made within three years. The law authorizes the state highway engineer to have surveys, plans and estimates made either by his own forces or under contract with private engineers and surveyors, the cost of contract work not to exceed an average of $100 per mile and to be deducted from the state-aid allowance of $1,200 per mile to the counties. The state highway engineer may also accept surveys, plans and estimates (complying with state and federal requirements) which have been made by county engineers or other local authorities without cost to the state, in which case no deduction is made from the $1,200 per mile.

All of these methods are being employed in order to have the program completed within three years. To carry out the work of the highway department effectively the state was divided into six divisions, each under the charge of a division engineer whose duty it is to confer with the local authorities, view and lay out state roads, and supervise surveys and construction.

Surveys by State Engineers

Six survey parties, one in each division, were organized by the department in 1919, each party reporting to the division engineer and to the chief of surveys and plans. These parties were in the field from Aug. 1 to Dec. 1, 1919, and resumed the field work on May 1, 1920. A party is made up as follows, each member being paid the salary noted and allowed subsistence in addition: Chief of party ($160 per month), draftsman ($130), transitman ($125), levelman ($110), head chainman ($80), rodman ($80) and truck driver ($75). The rear chainman, axman and stakeman are hired locally and are paid at the local rate, varying from $3 to $4.50 per day. The above organization is varied according to local demands and efficiency. In open country a recorder is added to the party and sometimes it is necessary to operate two level parties.

The chief of party is responsible for the work, obtains subsistence, handles the payroll and expenses and reports progress weekly on a postcard form, shown herewith, to the division engineer and to the chief of surveys and plans. He presents a monthly report on salary and expenses. Instructions as to the route he is to survey are received from the division engineer. Questions of organization and operation of the parties are taken up with the chief of surveys and plans.

The draftsman keeps the alignment and profile notes plotted to date in pencil, inking the plans only when he has caught up with the transit and profile parties. This allows the chief of party to inspect his work and to check the field data daily. The transitman takes all notes that might affect the planning of the road with reference to alignment and drainage. The "lining in" of the chainman is performed usually by the truck driver, who is instructed in the rudiments of handling a transit; he also brings the instruments forward and provides the back sight, using the truck for conveyance. The levelman sets bench marks and runs profiles and cross-sections. In level country the addition of a recorder to a level party has often increased the volume of work over 25 per cent.

The party lives in towns along the routes. It is equipped with a motor truck for conveyance, a light transit, two range poles, two 100-ft. steel chains, one set of pins, one tape repair outfit, one level, two level rods, three 50-ft. metallic tapes, one field chest, two collapsible drawing tables and other supplies for field and office work.

With this organization the average field work is from 1 to 1¼ mi. per day. From May 1 to Aug. 1, 1920, the average was 30 mi. per month per party. In 1919 the parties did not equal these averages, as they were newly organized and many of the men had had little experience. Six miles is the maximum transit line that has been run per day. Four miles is the highest record of cross-sections, these sections being taken at each station and oftener. For the completion of the plans the state highway department maintains a small organization at headquarters throughout the year and brings in certain members of the field parties during the winter.

Independent Surveys for State Roads

Contracts with private firms stipulate that they are to make the survey, prepare plans and estimates, provide five sets of blueprints, and upon approval of the plans to deliver all the original tracings and field books, for a stipulated price per mile not exceeding $100. The contracts provide for partial payment as the work progresses. For a small mileage where the work is easy, survey contracts have been let as low as $85 per mile. In several places where the survey is difficult and where the contractor's price is more than $100, the local authorities pay the additional cost, which ranges from $10 to $25 per mile.

County courts, special road districts or other local authorities often enter into contracts with private firms for the survey of state roads. In many instances also the county highway engineer makes such surveys and plans without cost to the state. All such work, however, must be done in accordance with the requirements of the state highway department and the U. S. Bureau of Public Roads.

Under all these independent methods of making surveys, the persons in direct charge of the work report to the division engineer. He accompanies them over the route before the survey is started, shows them the relocations that are desired and outlines to them the manner in which he thinks problems should be attacked. He also provides them with the instructions for making surveys and preparing plans, as issued by the department. These embody and enlarge upon the points covered by the regulations of the Bureau of Public

Roads. He furnishes also a set of Missouri standard specifications and standard culvert and bridge designs, besides giving information as to the type of road contemplated. Contracting engineers report their progress to the division engineer, who in return reports monthly to the chief of surveys and plans.

Character of Road Surveys

A location survey is made in the field, preliminary lines and paper locations not being accepted. All curves are run in on the ground, thus avoiding many equations of stationing. The transit party locates the center line of the proposed road, rounding all corners to a minimum radius of 150 ft., locating topographical features, fences, telephone and power poles, rock outcrops, streams, culverts, bridges and drainage. Notes are made of drainage areas, property owners and other information useful in making an engineering study of the road. This transit line is required to be so made that it can be followed readily during construction. All points of intersection are referenced and as many land ties as possible, the latter to allow of right-of-way descriptions. In general the surveys follow the existing roads, but relocations are made to avoid heavy grades, railway crossings, unnecessary drainage and crooked alignment.

The level parties are required to set bench marks at each ½-mi., to take cross-sections at every station and as much oftener as the breaks in the ground demand, paying particular attention to the elevation of rock outcrops, bridge floors and flow line of streams. Cross-sections are taken for at least 20 ft. each side of the center line and to a greater distance where necessary. These cross-sections are taken with a wye or dumpy level, the distances from the center line being measured with a tape.

Exceptions to the above methods are made occasionally when the survey is an entire relocation in very rough country, as in the mountainous district of the state. On bridges of over a 10-ft. span a survey is made of the site and furnished to the bridge department with a report on standard form. The field parties are instructed to determine the size of openings for drainage structures in the field, choosing the state standard to be used. For larger bridges, they take all high water marks and obtain as much information as possible concerning the present structures. They also estimate the drainage area carefully, in which work the U. S. Geological Survey maps are valuable and are made use of when possible.

Maps and Plans

All plans conform with the requirements of the U. S. Bureau of Public Roads, including the use of 22 x 26-in. sheets showing the road section, plan, profile, cross-sections and special details of construction. For plans the scale is 1 in. to 100 ft. For profiles the horizontal scale is 1 in. to 100 ft. and the vertical scale 1 in. to 10 ft. Drainage structures are drawn on the cross-section, so that their lengths may be determined. Sections of the proposed road are drawn at the correct elevation on the cross-sections and the areas of cut and fill are given at each section, the yardage being given between sections. Details of construction are given on all special structures for which there are no state standards. The department endeavors to obtain plans that are complete in every respect for construction purposes, so that accurate estimates of the work can be made. It endeavors also to give as much information as possible that may be valuable to the contractor.

MISSOURI STATE HIGHWAY DEPARTMENT
SURVEY REPORT FOR THE WEEK

ENDING 19

	Station	to	Station
Transit line			
Level line			
Cross section			
Plans platted.....			
Profile plat			
Cross section			
Bridge survey			

Remarks

....

Chief of Party

POST CARD REPORT FOR SURVEY PARTY

Upon completion the plans are submitted to the division engineer, who makes a field check, particularly as to the locations and sizes of drainage structures, the grade line and location of the road, and the accuracy of the survey, requiring such changes and corrections as may be necessary. The plans are then sent to the office of the chief of surveys and plans, where a thorough check is made of the computations, the completeness of information, the estimate, and as to whether all the work called for in the estimate is shown on the plans. Particular attention is given to guarding against conflicting information. All the errors found are noted, with the changes asked for by the division engineer, and are furnished to the person preparing the plans so that proper revision can be made.

Progress and Cost of Surveys

By the use of the foregoing methods the state highway department has been able to make considerable progress. Prior to 1919 there were surveys of 379 mi. of roads that were incorporated in this state highway system by the present law. On Jan. 1, 1920, some 2,538 mi. of survey had been started, of which 2,141 mi. were surveyed, leaving a net of 1,761 mi. surveyed in 1919. On Aug. 1, 1920, the department had arranged for the survey of 4,928 mi. and had surveyed 4,072 mi., and complete plans for 1,731 mi. had been submitted. Of this total mileage under survey 1,872 mi. were covered by state contract, 1,299 mi. by state parties and 1,756 mi. by county contracts. Of the completed surveys, 1,421 mi. were made by state contract, 1,208 mi. by state parties and 1,501 mi. by county contracts. Of the plans submitted to the department, 551 mi. were prepared under state contract, 487 mi. by state parties and 693 mi. by county contract.

According to official information the cost of making surveys and preparing plans by state parties will not exceed $100 per mile. In 1919 the field work averaged $82.77 per mile, but the cost of completing the plans

made the total slightly over $100. The 1920 field work is costing about $60 per mile. As the cost for completing plans is between $25 and $30 per mile the total cost of the 1920 work will be less than $100 and will thus eliminate the deficiency incurred in 1919. All survey work, as well as road construction and maintenance, is under the direction of Alexander W. Graham, state highway engineer, and C. W. Brown, first assistant engineer. James R. Hancock is chief of surveys and plans.

Modified Vicat Apparatus for Study of Setting Time of Cement

By O. L. Moore
Chief Cement Inspector, Universal Portland Cement Company

For a closer study of the setting properties of Portland cement than is usually necessary in commercial testing it is desirable to have a series of readings taken at short-time intervals while the cement is setting. Such data may be studied as setting-time curves and in investigational work have an advantage over the usual initial and final setting-time data.

In order to obtain data of this nature relative to the effect of temperature, humidity, personal equation, etc., on our inter-laboratory test results we remodelled an old Vicat apparatus, shown in the accompanying cut. After some experimentation and changes in the apparatus quite consistent results are obtained, and we have been enabled to develop some interesting and instructive data in connection with the setting of cement. The principle consists in balancing the rod and needle by means of a beam and weight and determining the load necessary at time intervals to cause the needle to penetrate a definite distance into the neat paste.

The paste, prepared according to the standard methods of the American Society for Testing Materials in a Vicat mold, is placed on the platform, the needle brought in contact with the surface and the stop set for a ¾-in. penetration. Shot or preferably weights are added to the pan until the needle is brought to rest

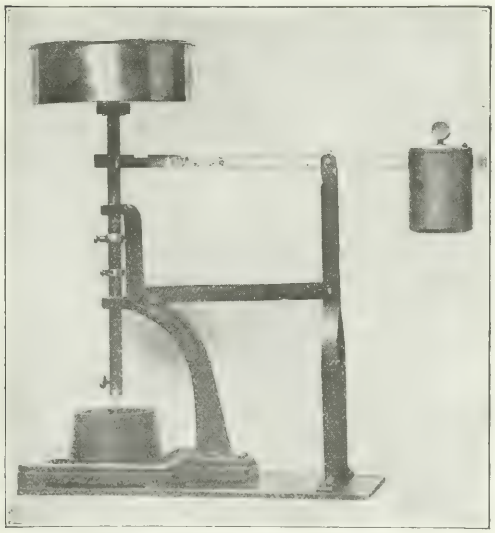


FIG. 1. SETTING-TIME APPARATUS

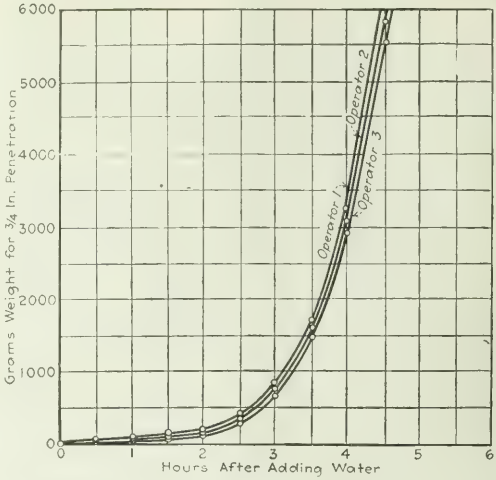


FIG. 2. EFFECT OF PERSONAL EQUATION ON SETTING TIME

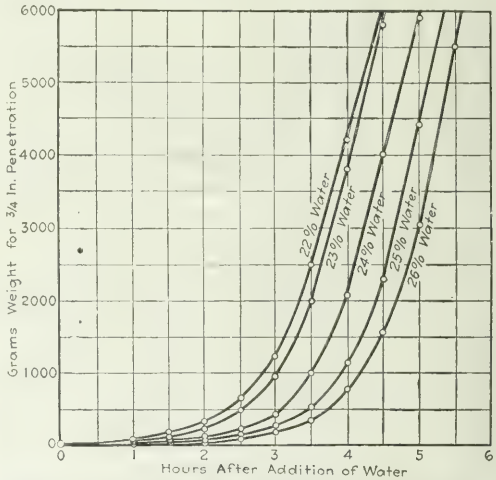


FIG. 3. ADDED PER CENT OF WATER INCREASES SETTING TIME

by the stop. The time and load is then recorded and the specimen returned to the moist cabinet until another reading is desired. Short penetrations give smoother curves than deep penetrations. For normally setting cement hourly readings are sufficient. The load may be applied in units of 50 gr. for plotting on small scales, and reaches the strength limit of the ordinary length of Vicat needle at about seven kilograms.

The accompanying charts have been selected as typical setting-time curves. They give some idea of the consistency of the data and the results which may be obtained with a little experience.

A Reminder of Old Times

The latest published report of the Water Department of Springfield, Mass., records the payment during the year of nearly $200,000 of 3½ per cent water bonds.

Belgian Standard Specification For Structural Steelwork

New Standards Association Has Adopted Draft Prepared by Structural Engineers For Home and Export Use

SPECIFICATIONS for design and fabrication of steelwork for buildings and miscellaneous steel structures were adopted by the Belgian Standards Association a few months ago by the approval of a draft specification prepared by the Fédération des Constructeurs de Belgique, in the course of studies carried out during 1916-1919. This specification, intended to control future structural work in Belgium for both home and export work, with the exclusion only of bridges, is published in the semi-monthly *Revue Universelle des Mines* of Nov. 1, 1920. It is of unusual interest for purposes of comparison with American practice and current specifications. An abstract of some of the leading provisions of the new Belgian standard is given in the following.

According to an introductory statement in the source quoted the object in framing the new specification was not to introduce innovations, but rather to express present-day Belgian practice, yet at the same time to favor maximum economy in construction in view of the high cost of materials. The effort toward economy appears in high working stresses, but safety has been assured in even greater degree by the reduction formulas adopted and by definite provisions for the design of latticed compression members, as also of details of construction in general, it is stated.

Snow, Wind and Live Loads

Snow is to be taken at 7 to 13 lb. per sq. ft. depending on altitude (from sea level to 2,300 ft. elevation). It may be disregarded for roof slopes of 50 degrees and over except where roof valleys hold snow.

Wind loads are to be based on a standard pressure of 20 lb. per sq.ft. (21 lb. within six miles of the coast), 41 lb. for general export, 51 lb. for tropical countries and 62 lb. for the most exposed locations, as the Indian Ocean, the Philippines and the Carolines. Normal pressure on inclined surfaces is $p_A = p_o \sin^2 (A + 10°)$, but the basal pressure p_o is computed from the standard figures previously given by applying to roofs the factor 0.6 for combination with snow, to walls the factor 0.5 for 50-ft. height, 0.75 for 50 to 66 ft. height, 1.0 for 66 to 82 ft. height, and 1.25 for heights above 82 ft.; 1.25 is to be used for walls of all heights in open country; in all cases the co-efficient 1.25 is reduced to 1.0 when truss and column are treated as a rigid frame. For monitors and for roofs resting on walls an uplift of 0.7 times the standard pressure shall be assumed.

Snow and wind loads may be reduced 20 per cent when considered in combination with other moving live-loads (as crane loads).

Floor loads ordinarily are to be assumed as 41 lb. per sq.ft. for dwellings, 62 lb. for offices, 82 lb. for public buildings, 25 lb. for flat roofs and for industrial use according to conditions. Where a structural element is loaded by two, three, four or more floors superimposed these shall be counted only at 90, 85, 80, etc., per cent of full value, but the maximum reduction shall be 50 per cent (this clause is stated to be taken from American practice).

Working stresses for structural steel are expressed in a form adapted to tension, bending and compression. For tension and bending they apply to net sections (rivet-hole deduction equal to rivet diameter), and for compression to "reduced" areas defined later. The values fixed are: 17,000 lb. per sq.in. in general, 14,200 for crane girders and crane girder columns, and 20,000 for minor framing of brick walls and gables. For shear 80 per cent of these values is to be taken. The figures apply to ordinary soft steel of 52,000 to 62,000 lb. ultimate and 20 per cent elongation, and may be increased for higher-strength metal.

For bolts and rivets (extra soft steel, minimum 51,000 lb. ultimate and 24 per cent elongation), shear may be taken at four-fifths the allowable stress for the connected parts, and bearing at two and a half times the shear. Tension on rivets and bolts is allowable at the stress figure fixed for shear; bolt tension is figured on *gross* section.

Cast iron may be stressed to 2,100 lb. per sq.in. in direct tension, 11,300 lb. (reduced) in direct compression, 4,950 lb. tension in bending and 9,900 lb. compression in bending. Wood may be stressed to 850 lb. in tension or compression with the grain, and 140 lb. in shear along the grain.

Compression Members

Compression members of solid-web section are to be proportioned for the basic unit stress applied to a section determined by reducing the gross section in the ratio of the ultimate column strength to 52,000 lb. per sq.in. The ultimate column strength is to be taken equal to 52,000 for length-ratio (l/r) less than 10; from the formula 44,000 — 162 l/r for length-ratio between 10 and 105; and for greater length-ratios from the formula 300,000,000 ÷ $(l/r)^2$. For combined compression and bending the separate stresses (based respectively on reduced and actual sections) are to be added.

In single-angle members the plane of buckling is to be considered parallel to the outstanding leg, but the moment of inertia of the member shall be reduced to 40 per cent for single-riveted connections and to 60 per cent in other cases to take account of eccentricity of loading.

Open-web compression members shall be computed in the same way as solid members, except that the buckling load shall be taken as $R_t = R_o R_o'/44{,}000$, where R_o is the ultimate strength of the column as a whole and R_o' the ultimate strength of the segment of member or rib between lattice connections; but if the ratio $R_o'/44{,}000$ exceeds 85 per cent the member may be proportioned as if a solid-web section. The strength of a rib segment R_o' is to be calculated for flexure in the direction of the least radius of gyration, and for a free length equal to the center-to-center spacing of connections between ribs.

Column shear is to be computed by the formula

$$0.03\ P\ (44{,}000/R_t - 1)$$

in which P is the axial load.

Column length l in the formulas is to be taken as the distance between panel points, except where buckling in the plane of the gusset plates is considered, when 0.8 of that distance is to be taken (except for angles with single-rivet connections).

Compression flanges of lattice girders are to be designed for a buckling length transverse to the girder

$$l = \pi \sqrt[4]{I\ a\ h^2\ 12\ I'}$$

in which I is the moment of inertia of the flange around its vertical axis, I' is the average moment of inertia of the verticals, a is the panel length and h is the depth of the girder. Plate girders without lateral bracing are to be designed in such a way that lateral buckling of the compression flange cannot occur.

Special Members

Trusses, purlins and jack rafters may be calculated as continuous girders or as cantilever girders when so built that they act accordingly. If lateral bending of purlins is not prevented by sag bracing or equivalent means, the stresses due to such bending shall be taken account of.

Members with eccentric tension are to be proportioned for a stress increased by 100 per cent, 40 per cent, or 25 per cent, if their end connections contain one, two or three rivets.

Deflections of sash members and girts shall not exceed 1/500th of the length.

Crane girders carrying power-operated cranes shall be designed for the braking thrust, which is to be calculated, but shall be taken as not less than 5 per cent of the load braked; this thrust is to be resisted by one girder. Crane girders may be calculated as continuous spans if detailed and supported correspondingly. When a column may receive load from three (or four) crane girders simultaneously the maximum reaction may be taken as 85 (or 70) per cent of that corresponding to simultaneous maximum loads. The columns shall be able to resist the lateral crane thrust.

Column bed-plates are to be designed for a maximum edge stress of 142 lb. per sq.in. for brick masonry, 255 for concrete, and 355 lb. for cut stone. The moment at the column foot taken account of in this calculation must correspond to that used in the design of the structure and in detailing the bed-plates, anchor bolts and footings. The maximum anchor-bolt stress shall be 14,200 lb. per sq.in. at root of thread.

Workmanship

The section of the specification covering workmanship provides for punched work exclusively. Perfect centering of rivet heads with body is not required, tests having shown this not to be a factor in rivet strength. Partial shop assembly is required when the fabricator does not erect. Material is to be wire-brushed before assembly, and is to be painted with red lead paint after assembly riveting. Faces assembled in contact are not painted.

For export work especially careful preparation of erection plans and erection marking is called for. Each box or bundle is to be marked with a strip of color indicating its contents. Boxes must not exceed 880 lb. in weight. Large pieces must be protected from injury in shipment. An excess of 10 per cent bolts and 20 per cent rivets is to be supplied.

When the weight of a piece is more than 6 per cent below the calculated weight the piece may be rejected. Payment is to be made according to actual weight up to an excess of 5 per cent over design weight. Pieces that cannot be weighed are to be billed at 3 per cent over the design weight.

Material and labor for seating columns on their foundations are to be furnished by the purchaser, according to the directions of the builder, except that sheet lead is to be furnished and placed by the builder.

Pavement on Curves Widened By Ring Method

By Edward H. Stelle
Assistant Engineer, Minnesota Highway Department

The method of widening pavement on curves detailed in the accompanying diagram is new and has several advantages over most other methods now in general use throughout the country. The method of computing the area and setting the forms may be clearly understood from a study of the diagram.

If additional width on curves is, or will be, required within the life of the pavement then it would seem logical to say that this width should be uniform for the full length of the curve. Many departments have adopted a method requiring the use of a lune placed either on the inside or outside of the circular pavement. Such a scheme gives a maximum widening at the middle of the curve, diminishing both ways to zero some distance from the point of curve and point of tangency. Such a lune is wrong in principle for it either adds too great a width at the middle or not enough near the beginning and end of the curve.

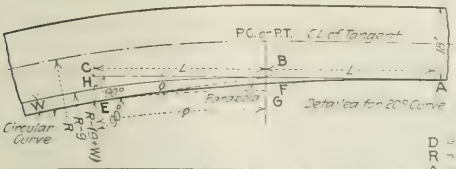
TABLE I. TABLE OF COMPUTATIONS

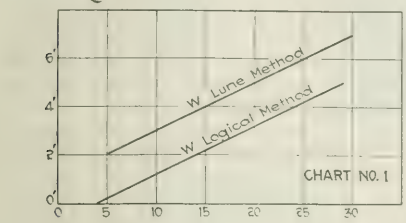
D	W, Ft.	R-9 Ft.	EB, Ft.	Θ	i, Ft.	K_1, Sq.Ft.	K_2, Sq.Ft.	K, Sq.Ft.
4½°	0 1	1264 240	15 901	0°43 9′	15 900	0.53	1 07	1 60
5°	0 2	1136 916	21 324	1°04 5′	21 320	1 42	2 84	4 26
5½°	0 3	1032 742	24 890	1°22 8′	24 883	2 49	4 97	7 46
6°	0 4	945 930	27 506	1°40 0′	27 494	3 67	7 33	11 00
6½°	0 5	872 474	29 533	1°56 4′	29 516	4 92	9 84	14.76
7°	0 6	809 512	31 162	2°12 3′	31 139	6.23	12 45	18 68
7½°	0 7	754 944	32 503	2°28 0′	32 473	7.58	15 16	22.74
8°	0 8	707 198	33 629	2°43 5′	33 590	8 96	17 93	26.89
8½°	0 9	665 069	34 588	2°58 8′	34 541	10.36	20 75	31.11
9°	1 0	627 620	35 415	3°14 0′	35 359	11 78	23 57	35.35
9½°	1 1	594 114	36 136	3°29 2′	36 069	13 23	26 49	39.72
10°	1 2	563 958	36 770	3°44 5′	36 692	14.68	29 43	44 11
10½°	1 3	536 675	37 332	3°59 3′	37 241	16 14	31 35	47.49
11°	1 4	511 871	37 832	4°14 3′	37 729	17 61	35 31	52 92
12°	1 6	468 465	38 685	4°44 2′	38 553	20 57	41 18	61 75
13°	1 8	431 737	39 383	5°14 0′	39 219	23.53	47 25	70 78
14°	2 0	400 256	39 963	5°43 8′	39 763	26.51	53 31	79 82
15°	2 2	372 972	40 450	6°13 6′	40 212	29.49	59 36	88 85
16°	2 4	349 099	40 864	6°43 3′	40 583	32 46	65 38	97 84
17°	2 6	328 034	41 219	7°13 0′	40 893	35.44	71 42	106 86
18°	2 8	309 310	41 524	7°43 0′	41 148	38.40	77 61	116.01
19°	3 0	292 557	41 789	8°12 8′	41 361	41.36	83 66	125.02
20°	3 2	277 479	42 020	8°42 6′	41 535	44 30	80 76	134.06
21°	3 4	263 837	42 220	9°12 5′	41 676	47 23	95 83	143.06
22°	3 6	251 436	42 395	9°42 4′	41 788	50 16	101 88	152.04
23°	3 8	240 112	42 549	10°12 4′	41 876	53 04	107 94	160.98
24°	4 0	229 733	42 683	10°42 4′	41 940	55.93	113 99	169.92
25°	4 2	220 183	42 801	11°12 6′	41 985	58 78	120 10	178.88
26°	4 4	211 369	42 903	11°42 7′	42 010	61 63	126 10	187.73
27°	4 6	203 207	42 992	12°12 8′	42 019	64.43	132 13	196.56
28°	4 8	195 628	43 069	12°43 0′	42 013	67 20	138 11	205.31
29°	5 0	188 572	43 136	13°13 4′	41 992	69.99	144 22	214.21
30°	5 2	181 986	43 192	13°43 8′	41 958	72 73	150 17	222.90

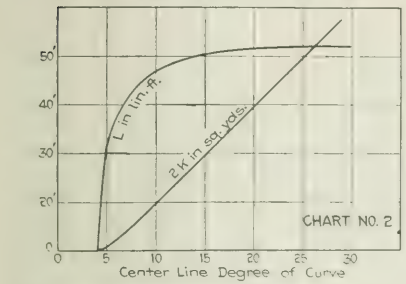
The ring method minimizes the disadvantages of most other methods, is simpler in theory and in practice, and results in a more economical distribution of the extra pavement. With a condensed set of tables the inside edge can be layed out efficiently with less experienced men, and the office work of obtaining the area is much less than with the ponderous formulas and computations involving a study of the probable errors, required to compute the area of a figure bounded by two circles having different centers and two short lengths of tangent. The results of computations for the ring method are readily adapted to tabulation on account of the fact that most of the functions are constant for each degree of center line curve regardless of the intersection angle. An explanation of the theory and practice governing the ring method follows:

Theory—(1) Values of W were aribtrarily assumed as sufficient to care for development of traffic conditions, and all computations depend on these assumed values.

(2) Widening Circle GEE'G' is concentric to center line







LEGEND

D = Degree of Center Line Curve
R = Radius " " " "
Δ = Intersection Angle of C.L. Curve
Φ = Angle of Transition = GBE
W = Additional Width of Pavement
L = Half Length of Transition
k_1 = Area of ABEFA
k_2 = " " BHEB
K = " " ABHEFA = $k_1 + k_2$
P = " " Circular Ring EHH'E'

Constant for each Degree of Curve of Uniform Width

FORMULAS

(1) $AB = BC - L$

(2) $EB = \sqrt{(R-9)^2-(R-9-W)^2} = \sqrt{2W(R-9)-W^2}$

(3) $\sin\phi = \frac{EB}{R-9}$

(4) $L = EB \cos\phi$

(5) $CE = 2W$ (Close's Approx.)

(6) $k_1 = \frac{(2L+W)}{2} \times \frac{1}{3} \frac{WL}{3}$

(7) $k_2 = \frac{(R-9)^2 \frac{\pi}{180} \left[2\phi - \sin 2\phi\right]}{2}$

(8) $k_2 = \frac{EB}{2}\left[W-(R-9)(\cos\frac{\phi}{2} + \text{vers}\frac{\phi}{2} + \text{vers}\frac{\phi}{8} \text{ etc.})\right]$

(9) $K = k_1 + k_2$

(10) $K = WL$ (Approx. Max. Error $\frac{1}{2}$ Sq. Yd. for 20° C.)

(11) $P = W\left[\pi(R-9-\frac{W}{2})\frac{\Delta - 2\phi}{150}\right]$

(12) Total Additional Area for one complete Curve $= P + 2K$

(13) Offset from Tangent CA to Parabola AFE at any Point a Distance x from $A = \left(\frac{x}{2L}\right)^2 \times 2W$

the engineer needs for a particular Curve is: The degree of center line Curve and a copy of charts No. 1 and No. 2. A simple computation with formula No. 13 gives the offset to the parabola at any point. The concentric ring can be laid out from the center line stakes.

Office. To compute area of additional width for any given curve, figure area of ring by formula No. 11 and add the value of 2K from chart No. 2.

Remarks—Assuming that additional width is necessary on curves it follows that this width is necessary around the *whole* Curve. This condition is more nearly attained by the "Ring Method," than by the "Lune Method."

The uniform width allows the use of the finishing machine for the entire Curve.

With the use of one additional table no figuring whatever would be necessary.

All tables and charts are adaptable to the "Lefax" Hand Book.

Chart 1, Fig. 2, shows the amount of additional width which was used as the basis for all the computations given. These values were arbitrarily assumed as sufficient to care for the development of traffic conditions but are open for discussion, study and experiment.

Curve, with radius R-(9 + W), and is connected with tangent AB by a parabola. BE is the only line through B tangent to Circle GEE'G'.

(3) Since W is assumed for each degree of Curve the dimensions and area between the parabola and line HBA are constant for each degree of Curve. The area of the circular ring is the only variable and the one computation necessary (Formula No. 11).

TABLE II OFFSETS TO PARABOLA

Deg of Curve	10'	20'	30'	40'	50'	60'	70'	80'	2 L.	2 W	Corr for 5'
4 5	0 02	0 08	0 18						31 80	0 20	0 00
5 0	0 02	0 09	0 20	0 35'					42 64	0 40	0 01
5 5	0 03	0 10	0 23	0 40					48 27	0 60	0 01
6 0	0 03	0 11	0 24	0 42	0 66				54 99	0 80	0 01
6 5	0 03	0 12	0 26	0 46	0 72				59 03	1 00	0 01
7 0	0 03	0 12	0 28	0 49	0 77	1 11			62 28	1 20	0 01
7 5	0 03	0 13	0 30	0 53	0 83	1 19			64 95	1 40	0 01
0	0 04	0 14	0 32	0 57	0 89	1 28			67 18	1 60	0 01
5	0 04	0 15	0 34	0 61	0 94	1 36			69 08	1 80	0 01
9 0	0 04	0 16	0 36	0 64	1 00	1 44	1 98		70 71	2 00	0 01
9 5	0 04	0 17	0 38	0 68	1 06	1 52	2 07		72 14	2 20	0 01
10 0	0 04	0 18	0 40	0 71	1 12	1 61	2 18		73 38	2 40	0 01
10 5	0 05	0 19	0 42	0 75	1 17	1 69	2 30		74 48	2 60	0 01
11 0	0 05	0 20	0 44	0 79	1 23	1 77	2 41		75 46	2 80	0 01
12 0	0 05	0 22	0 48	0 86	1 34	1 94	2 64		77 11	3 20	0 01
13 0	0 06	0 23	0 53	0 94	1 46	2 11	2 86		78 44	3 60	0 02
14 0	0 06	0 25	0 57	1 01	1 58	2 28	3 10		79 53	4 00	0 02
15 0	0 07	0 27	0 61	1 09	1 70	2 45	3 34	4 35	80 42	4 40	0 02
16 0	0 07	0 29	0 66	1 17	1 82	2 62	3 57	4 66	81 17	4 80	0 02
17 0	0 08	0 31	0 70	1 24	1 94	2 80	3 81	4 98	81 79	5 20	0 02
18 0	0 08	0 33	0 75	1 32	2 07	2 98	4 06	5 30	82 30	5 60	0 02
19 0	0 09	0 35	0 79	1 41	2 20	3 17	4 30	5 63	82 72	6 00	0 02
20 0	0 09	0 37	0 84	1 49	2 32	3 34	4 55	5 94	83 07	6 40	0 02
21 0	0 10	0 39	0 87	1 54	2 41	3 47	4 72	6 15	83 35	6 80	0 03
22 0	0 10	0 41	0 93	1 65	2 58	3 71	5 05	6 60	83 58	7 20	0 03
23 0	0 11	0 43	0 97	1 73	2 71	3 90	5 30	6 92	83 75	7 60	0 03
24 0	0 11	0 46	1 02	1 82	2 85	4 10	5 59	7 29	83 89	8 00	0 03
25 0	0 12	0 48	1 07	1 91	2 97	4 28	5 82	7 61	83 97	8 40	0 03
26 0	0 12	0 50	1 12	2 00	3 13	4 50	6 12	8 00	84 02	8 80	0 03
27 0	0 13	0 52	1 18	2 08	3 26	4 70	6 40	8 34	84 04	9 20	0 03
28 0	0 14	0 54	1 22	2 18	3 40	4 80	6 69	8 70	84 03	9 60	0 03
29 0	0 14	0 57	1 28	2 27	3 54	5 10	6 93	9 05	83 98	10 00	0 04

(4) Sufficient decimal places have been used in computing table to keep the limit of probable error within 0.01 of a lineal or square foot, as the case might be. It should be borne in mind that six place logarithmic and natural tables are not sufficient in some of the computations.

Practice—(1) Field. To [illegible] out forms for pavement all

Table II eliminates the necessity of any calculations in the field except for interpolation for offsets to the parabola for odd feet of distance from the point *A*. The author has computed a table of areas in square yards for rings (for each degree of center line curve) of one degree central angle and of one minute of central angle. With such a table the only computation necessary is that of multiplying the tabular value for the area of one degree of angle by the number of whole degrees in Δ — 2 Φ, multiplying the tabular value for one minute of angle by the number of minutes left in Δ — 2 Φ, adding the sum of these results to 2*K* (chart No. 2), and the result is the total additional area of pavement

Hand and Machine Tamping

Finishing and tamping machines are rapidly becoming a standard requirement for pavement construction of any magnitude. The manufacturers making these machines with adjustable tread, that is, the machines can be used on different widths of pavement by a simple adjustment. A curve widened by any means other than a concentric circle will have a variable width throughout the length of the curve and must be hand tamped and finished. The ring method obviates this difficulty largely since the greater part of the curve is of uniform width.

The parabola is of sufficient length to take care of the transition from a crowned section to a superelevated flat slab, and while shorter, serves as an adequate substitute for the transition or spiral curve required in railroad practice.

The above described method together with formulae and computations is offered for consideration, discussion and criticism.

Smoke Abatement Study and Plans at Salt Lake City

Proposed Ordinance Includes Residences—Expert Supervision—Nuisance Is Great with Small Coal Consumption

ALTHOUGH Salt Lake City, Utah, is not a great industrial point or a large railway center, and although its coal consumption and smoke production are low as compared with many cities, it is troubled with a very serious smoke nuisance due to a combination of local conditions. With a view to effecting a remedy, the city, in February, 1919, authorized an investigation by Sylvester Q. Cannon, city engineer, and this investigation was carried out for the period from Sept. 1, 1919, to May 1, 1920, under an agreement between the city, the University of Utah and the U. S. Bureau of Mines. The following information on the subject is compiled from a comprehensive report to the Director of the Bureau of Mines by Osborn Monnett, consulting engineer, Chicago.

The city's sheltered position in a valley bounded by mountains on three sides has a marked influence upon wind velocity. This velocity is lowest during the winter and the most unfavorable combination of meteorological conditions prevails during the months when heating plants are in use. Further, the temperature and wind are low in the early morning, which is the time of maximum smoke production. Smoke-abatement work in other cities is based generally upon day observations, as the wind is sufficient to disperse smoke produced during the night, but at Salt Lake City it is necessary to take into account the smoke production of both day and night.

Fuel Survey—Interest centers mainly in the survey methods and the proposed remedies, since the local conditions are not those generally encountered. In the first place a fuel survey was made to determine the amount and kind of coal used, and the amounts used for different purposes. The total consumption for the summer and winter of 1918-1919 was about 513,200 tons. A house-to-house inquiry conducted by Boy Scouts served to show the amount used by residences, the amounts for other classes of consumers being obtained by questions sent to the consumers. From the smoke standpoint the pronounced characteristic of Utah coal is its high percentage of volatile matter, as in general the smoke production increases with this percentage. Experiments made as a part of the investigation, however, showed that the methods of handling coals of high volatile content in cities of the Middle West are adequate for smokeless combustion of the Utah coal.

Smoke Chart Observations—Observations on the Ringelmann chart system, covering the various classes of smoke producers, were begun in September, 1919. The readings were taken for one-hour periods through out the day, so that in combination with the records of consumption by these different classes it was possible to figure the percentage of smoke made by each class for any desired period. Smoke producers were divided into five classes for the purpose of the report: (1) Industrial and large heating plants; (2) small heating plants; (3) locomotives; (4) residences; (5) miscellaneous. The first class included creameries, hospitals, industrial furnaces and boiler plants, laundries, office buildings and central heating plants. The second class included apartment houses, business places, churches, hotels, schools and public buildings. The percentages of city smoke for these classes were tabulated for the year, the six winter months, the six summer months and for each month. Classes 1 and 3 make a larger proportion of the total during the summer. Classes 2 and 4 make a larger proportion during the winter. The approximate percentage of coal used and total smoke produced for the six winter months, the six summer months and the 12 months from April 1, 1919, to March 31, 1920, are given in Table I.

TABLE I. CLASSIFICATION OF SMOKE AT SALT LAKE CITY, 1919–1920

Class	Oct.-Mar., 1919–1920 Per Cent of Coal Consumption	Oct.-Mar., 1919–1920 Per Cent of Total Smoke	Per Cent of Total Smoke Apr.-Sept., 1919	Per Cent of Total Smoke April, 1919 to March, 1920
1 Large plants	27	39 64	52 64	44 58
2 Small plants	11	12 08	4 80	9 04
3 Locomotives	7	13 18	27 11	18 38
4 Residences	48	27 35	12 04	21 83
5 Miscellaneous	7	7 75	3 41	6.17
Total	100	100.00	100.00	100 00

High smoke densities were shown by the average heating and industrial plants, due to three causes: (1) Lack of engineering supervision of the original installation; (2) high volatile content of the coal; (3) lack of supervision of operation by the city. In some cases the densities were 45 to 65 per cent, although, as Mr. Monnett explains, in cities where close smoke supervision has been in force for several years similar plants must run with a density of 2 per cent to be considered satisfactory. According to his report there is nothing in the service or conditions at Salt Lake City which make it impossible or difficult to obtain smokeless results. The quality of the coal is beyond control, but it is superior to that available in most of the Western States and the report remarks that the city is fortunate in having coal of this quality. Supervision of the installation and operation of plants are readily put under the control of the city government.

Atmospheric Pollution—Study of the pollution of the city's atmosphere by soot and other impurities was necessary, since the nuisance is so great in proportion to the coal consumption, owing to the low wind velocity in an enclosed valley. A city of equal size and equal consumption, but situated in a region of higher wind velocity, might show identical records on the Ringelmann charts and yet have very little smoke nuisance.

TABLE II. SOOT FALL IN WINTER MONTHS
(Tons per square mile per annum)

City	Soot Fall Min.	Soot Fall Max.	Soot Fall Mean	Coal Consumption Tons
Salt Lake City	15	980	250	510,000
Glasgow	.....	.....	1,325	3,250,000
London	58	426	260	16,000,000
Leeds	25	539	220	1,500,000
Hamburg	345	690	.....	2,000,000
Pittsburgh	595	1,807	.....	

Atmospheric pollution includes soot and ash from fuel combustion, gases from fuel combustion, and dust from non-fuel origin. The winter figures of soot fall are those of most importance in comparison with other cities where the smoke nuisance is not confined to one season and such figures for a number of cities are given in Table II. The report points out that in comparison with its coal consumption Salt Lake City ranks highest

on the list, even taking into account its smaller area.

When the smoke nuisance of Salt Lake City is at its height in winter the atmosphere is remarkably free from dust of non-fuel origin but contains relatively large amounts of soot and ash from coal fires owing to its color and finely divided state. Such material is a much greater nuisance, says Mr. Monnett, than the coarser and heavier dust. Thus, although the weight of solid matter in the atmosphere is not extremely high, the nuisance is great when considered in terms of soiling and damaging fabrics and architecture. Carbon dioxide and sulphur dioxide are negligible factors.

Supervision of new installations of coal-burning equipment is particularly necessary at Salt Lake City in view of the weather conditions. This applies especially to residences, even those of the smallest size. Mr. Monnett states that no city in this country includes residences in the provisions of its smoke ordinances, most of the ordinances exempting all heating plants smaller than those for six-apartment buildings. In his opinion no new residence building at Salt Lake City should be erected without having its plans for heating equipment examined by the smoke inspector as to the capacity of the furnace or boiler in respect to its load, the height and area of chimney, the flues, fireplaces, hot water heaters and other features.

Smoke-Abatement Ordinance—On the basis of the investigation, an ordinance for smoke inspection and abatement has been drafted to meet the existing conditions. In addition to including all residence buildings it gives a code of minimum head room and other conditions under which boilers may be set. It is stated that such a code has operated successfully elsewhere, although few cities include it in their ordinances. Mr. Monnett points out that one advantage of such a code in the ordinance is that it forestalls charges of favoritism against the inspector and insures that good installations will be provided in the future, as it eliminates the personal ideas of those enforcing the ordinance and thus prevents lowering of the standards.

Under the proposed ordinance a chief smoke inspector would be appointed by the mayor, with the consent of the city commission, at a salary of $3,000 per year. The inspector would appoint two deputies and two assistants at $2,400 and $1,800 respectively. No power or heating plant, chimney, etc., may be erected, altered or rebuilt until a permit has been issued by the smoke inspector after examination of plans and specifications which are to be filed with him and which must cover points of information specified in the ordinance. When the permit is issued, the inspector will notify the commissioner of buildings, who will see that the work is carried out according to the plans and specifications. Finally, the plant must not be operated until the smoke inspector has certified that it complies with the plans and specifications. Requirements as to boiler settings, flues, furnaces and stokers are given in considerable detail. A fee of $1 for filing plans and receiving permit is provided by the ordinance, but this may be remitted for institutions which are not operated for profit.

Smoke is to be considered "dense" when it is equal to No. 3 on the Ringelmann smoke chart as published and used by the U. S. Geological Survey. Emission of dense smoke for more than one minute from a locomotive, steam roller, derrick or pile driver is declared a nuisance, except for a period not exceeding six minutes in any one hour when the firebox is being cleaned or a new fire built. Emission of dense smoke from any chimney or smokestack, from the stack of a tar kettle or similar contrivance, or from any open bonfire, tank, vat or other receptacle is declared a nuisance, except for six-minute periods as noted above. Any such nuisance may be abated summarily by the smoke inspector, who will also prosecute for all violations of the ordinance. The fine on conviction of nuisance is from $10 to $100 for each offense, each day of such emission of dense smoke to constitute a separate offense. Permits from the inspector do not exempt their holders from prosecution for smoke nuisance.

It is provided that the chief smoke inspector shall be "an engineer qualified by training and experience in the theory and practice of the construction and operation of steam boilers and furnaces and also in the theory and practice of smoke abatement and prevention." The deputy inspectors must have the same qualifications as to boilers and furnaces and Mr. Monnett suggests that they should be chosen after an examination equivalent to that required in obtaining a license as an operating steam engineer. The assistant inspectors are not required to have an engineering training.

Control of the Smoke Nuisance—It is recommended that smoke abatement should continue under a systematic plan throughout the year, although the smoke nuisance is at its worst for only a short time. There is a large amount of necessary reconstruction work which can be done only during the summer, and at this time the installation of smoke indicators should be urged, so that the firemen may know when they are making smoke. This is important, as a great deal of smoke is made before daylight. In summer, also, negotiations may be opened with the railways for equipping switch engines and other locomotives with quick-opening blower valves, induction tubes, multiple-tip blowers and brick arches. Educational work must be taken up with the householders, to teach them the importance of clean chimneys and proper methods of firing.

Smoke observations should be made by at least one man during daylight hours in the spring, summer and early fall, in order that the department may keep informed as to plants which are making smoke and are liable to cause trouble later. As the heating season approaches, a policing or follow-up system should be planned in regard to the early morning firing, with regular visits to plants which make or are likely to make smoke at this time. As the season progresses, it may be necessary to put more men on this work, especially for the first few seasons.

As to the future policy of the smoke department, Mr. Monnett points out that the department should avail itself of improvements that may be developed in matters of burning coal. Thus, there is a possibility of the successful application of pulverized coal at some plants. For residences, it should be the policy to secure for new buildings the use of the best type of equipment available. In many cases the saving in attention required will soon cover the cost of installation and the fuel can be burned more economically and without smoke. In Mr. Monnett's opinion, the downtown district of Salt Lake City is an ideal situation for a central steam heating system and this would eliminate many of the worst smoke producers.

Wanted: Formulas For Design of Air-Inlet Valves

Neglected Feature of Pipe-Line Design Is Field for Experimental Investigation or Possibly College Thesis

By H. L. Thackwell
Hydraulic Engineer, Anaconda, Mont.

SO FAR as the writer has been able to discover there are no suitable formulas for the design of air inlet-valves for pipe lines. The only formula which we have seen is an empirical one given in the American Civil Engineers Pocket Book, "One square inch in area for each diameter foot of the pipe," also $\frac{1}{24}$ of the area of the pipe. This is obviously a mere rule of thumb, which if strictly followed, would lead to dangerous or extravagant design.

The controlling factor is not only the diameter of pipe, but with it the displacement in cubic feet per second, which causes a vacuum at the points along the pipe line which are intersected by a falling grade line. It can readily be seen that if a pipe line is entirely beneath the hydraulic grade line when the pipe is flowing 100 sec. ft., that when the flow drops to 50 sec. ft. the grade line will also fall and may, according to the profile, intersect a number of points along the line. At these points the pipe would not be full, and consequently a vacuum would be established unless suitable air-valves were placed at the points to equalize the air pressure on the inside and outside of the pipe.

The writer has derived the following simple formula for determining the required area of air inlet valves to equalize the air pressure under the above conditions.

$$A = \frac{Q}{1.35}$$

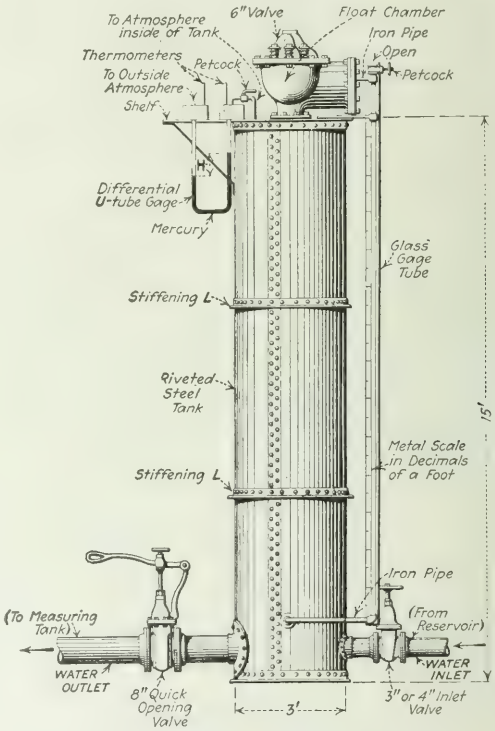
Where A = Area of circular orifice of air-valve in sq.in.
Q = Flow of water in sec. ft. at the time in hydraulic grade line intersects the pipe line.

This formula is not based upon experiment, but is approximate, having been derived from general laws on thermo-dynamics, with the assumption of a constant temperature of 62 deg. F. and isothermic compression. Obviously it does not take into consideration the resisting strength of a pipe against external pressure.

The writer suggests that this topic could be made the subject of a thesis, and that a reliable formula be derived by experiment.

In the accompanying drawing is a suggestion for the form of apparatus necessary to obtain the experimental data. The apparatus is essentially a steel tank 15 ft. long and 3 ft. in diameter, having stiffening angles occasionally to keep the tank from crushing under an external atmospheric pressure. At the bottom of the tank are two valves. One of these is an inlet water valve, while the other is a quick-opening outlet valve. At the top of the tank is mounted a Rensselaer No. 40 6 in. automatic cluster air-valve, combined with lever and float attachment for air-pocket" control. A mercury U-tube differential gage with thermometer attachments should be mounted at the top of the tank. At the bottom of the tank, at a point well away from the outlet valve, should be inserted a glass gage tube which would extend to a point equal in height to the top of the dome in the air-valve chamber. This gage should be connected to the valve-chamber by a small iron tube. Just above this connection should be placed a pet-cock; the short section of the tube extending above the pet-cock should be left open to the atmosphere. A metal scale should extend the full height of the gage tube. The rest of the equipment consists of a measuring tank and stop-watches.

The steps necessary to work the apparatus are as follows: First: Open the pet-cock at the top of the glass gage-tube, and close the pet cock between the tank and the U tube. Second: Close the quick-opening outlet-valve and open the inlet water valve. Allow the water to run into the tank until a spill is observed at the top of the glass gage-tube. Shut the water off at the inlet valve, and after the gage-tube ceases to spill, shut the pet-cock at the top of the gage-tube and open



SUGGESTED DETAILS OF APPARATUS FOR TESTING AIR INLET VALVES

the valve between the tank and the U-tube. Third: Read the U-tube gage and the temperatures, then quickly open the outlet valve and observe the volume of water in the measuring tank at each second of elapsed time. At these same time intervals the glass gage-scale should be read. Also the U-tube and temperature readings should be noted.

These data should be first taken with a cluster of six valves free to work, then with one valve blocked up so it will not operate under the atmospheric pressure, then with two valves blocked up and so on, until only one valve is in active operation. These data with the various calibrated sizes of air-valves could then be plotted up

as curves, and suitable formula derived to fit the curves in question.

Finally several sections of lap-riveted and wood-stave pipe should be tested to failure from external atmospheric pressure, caused by decreasing the internal pressure by a vacuum pump. Care must be taken in selecting the pipe of such length so that the end bulkheads will not materially strengthen the pipe against external pressure. The difference in pressure at the time of failure should be plotted against the diameters of pipes and suitable formulas derived to fit the curves.

The importance of this subject is not properly appreciated except by those engineers who have been engaged in the design of extensive wood-stave and steel pipe lines under a low head and variable flow conditions. Hydraulic engineers in general would be grateful to any one who would present a suitable exponential formula, which is based on a carefully conducted series of experiments.

Sacramento Adopts Cost-Plus Plan On Water Filter Work

By C. G. Gillespie
Resident Engineer, Filtration Division, Sacramento, Cal.

CONSTRUCTION is about to start on the water-supply portion of the Sacramento filtration plant following approval of legality, by the Superior Court, on a cost-plus-a-fixed-fee contract with a bonus and penalty clause and provision for an advance payment of 20 per cent of the fee. This portion of the project is expected to cost $1,035,200 and will be accomplished for about $600,000 less than the lowest lump-sum bid. It includes sluice gate, centrifugal pumps, steel force main and intake works, pumping station, motors, transformers, switchboards, traveling crane, etc. Before this form of contract was adopted endeavors were made to let the work on a lump-sum basis. The city's experience in this attempt is set forth in the following notes with the idea that it may be useful elsewhere when similar situations arise.

Lump-sum bids were first received on Oct. 14 on a basis whereby the bid could be made separately on each of several subdivisions of the general contract or on the work as a whole. The bidders were required to purchase to the amount of the bid submitted plus 15 per cent and at not less than par, bonds of average maturity yielding 4½ per cent. This requirement undoubtedly discouraged bidding, for in spite of a great deal of publicity through local and national engineering journals, by correspondence and by postponement of bids to allow seven weeks for bidding, only ten bids which could be considered were received. These included only two bids on the general contract and none whatever on three of the items offered for separate bidding. The general-contract bids so far exceeded the engineers' estimates that all were rejected and the city sought a cost-plus-fee contractor.

The invitation for cost-plus propositions prescribed that they should contain an estimate of cost representing the contractor's best judgment of what the cost of the whole work would actually be, and also a penalty and bonus provision. On this basis six contractors submitted propositions and one of these, the Coast Construction Co. of San Francisco, was selected on the recommendation of the filtration division engineers. An agreement was drawn up between this contractor and the city in which the principal features are as follows:

1. The contractor, as agent for the city, agrees to organize and supervise the work and secure its accomplishment in a prompt, efficient, economical manner.
2. The contractor submits a detailed estimate of actual cost amounting to $807,294.
3. If the actual cost, after adjustment due to changes in freight rates, wage scales or changes in the amount or kind of work, exceeds this amount, there shall be deducted from the fee due the contractor, one-half the difference between the actual cost and the adjusted estimated cost, but the deduction shall not exceed $41,055.
4. If the final cost of the work is less than the adjusted estimated cost there shall be added to the contractor's fee a bonus amounting to one-half the difference between the final cost and the adjusted estimated cost, but the bonus shall not exceed $41,055.
5. In the event of changes in the amount or kind of work at the request of the city the fee for personal service will be increased or diminished by an amount equal to 10 per cent of the amount represented by the change based on prices as agreed or on prices in the estimate.
6. The total fee amounts are to be paid in installments distributed over the construction period.
7. The resident engineer may withhold the payments on the fee for an amount equaling the accrued penalty at any date of payment of fee.
8. If the amount paid the contractor for equipment which he agrees to furnish exceeds $39,411 (approximately 7 per cent of the actual cost) all overplus shall be deducted from the fee.
9. The agreement contains a definition of just what the estimate includes and the contractor agrees to perform the work strictly according to the specifications on which lump-sum bids were submitted, these specifications being made a part of the contract. Expenses over which the contractor has no control, however, are deducted from the cost before calculating the penalty or bonus to be paid.
10. The contractor takes all other responsibility for the safe and economical handling of the work, performing it, however, to the satisfaction and subject to the approval of the city. No purchases or employment can be made without the approval of the city.
11. The contractor has the right to select his employees and to discharge them as he sees fit, but he must discharge any one whom the city designates as unsatisfactory.
12. No penalty or bonus is calculated on extra work.
13. The contractor is to keep an accurate record of the cost of the work as it progresses, showing the allocation or apportionment of all invoices or payrolls for the respective items of the work in detail as directed by the resident engineer.
14. Although not a part of the contract it is expected that purchases will be made by the contractor, subject to the approval of the city rather than by the city direct; the city to advance warrants on the basis of approved invoices and the contractor to submit receipts therefor.
15. Provision is made for termination of the contract by the contractor for certain specified reasons, as follows: (a) If the work be stopped by an order of any court or competent public authority for a period of three months through no act or fault of the contractor; (b) if the monthly certificates of payment and the payments are not made according to the contract.
16. The city has the right to terminate the contract on breach of contract by the contractor or at any time it is not satisfied with the manner in which he is conducting the work.

Pittsburgh Enlarged by Annexation

Following a recent favorable popular vote for annexation to Pittsburgh, Pa., Chartiers Township, with a population estimated as 12,000, became a part of Pittsburgh on Jan. 1. It is expected that other outlying communities will follow suit.

Reduction Table for the Stadia Arc

By Walter S. Dix
Hydraulic Engineer, with Thomas E. Murray, Inc., New York City

THE Beaman stadia arc, attached to the engineer's transit, accords the quickest means of obtaining elevations in both field and office. Only those vertical angles are used for which the differences in elevation are simple multiples of the rod interval. The outer graduated arc of the attachment is marked "Vertical" and the graduations, which read from 5 to 95, differ by unity.

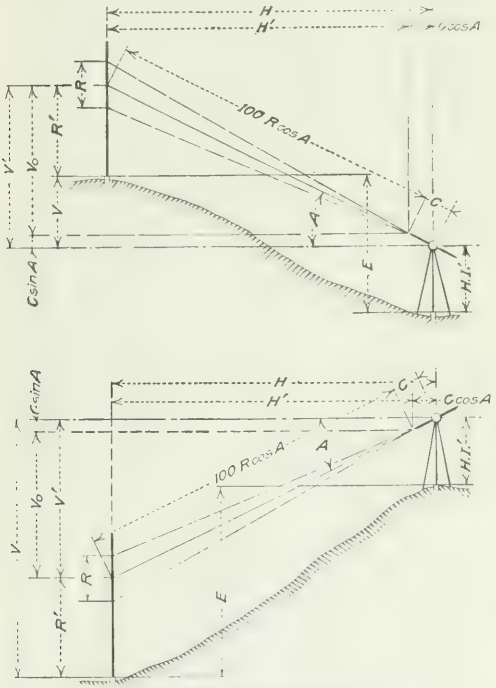


FIG. 1. USE OF THE STADIA ARC

Any number set opposite the index, after subtracting 50, equals the function $100 \times \frac{1}{2} \sin 2A$ of the angle A, at which the telescope is inclined. If, therefore, the "Vertical" arc reading is denoted by Av, and the rod intercept by R, then, in Fig. 1, the vertical distance

$$V_o = R\ (A_v - 50) \qquad (1)$$

This is plus or minus according to whether the telescope is sighted up or down, and is equal to zero when the telescope is level.

Also, the difference in elevations at the center of instrument and the point sought is, where R' is the height of rod,

$$V = V_o + C \sin A - R' \qquad (2)$$

The correction for stadia constant $C \sin A$ is plus or minus, corresponding to the sighting of the telescope up or down.

The reduction of the horizontal distance however, is not satisfactorily accomplished by means of the inner graduated arc marked "Horizontal," either in the field or in the office. Reading it in the field is difficult and consumes valuable time, due to the fact that there is a considerable radial space between it and the end of the index. Furthermore the graduations are the function $100\ (1 - \cos^2 A) = 100 \sin^2 A$, which gives the ratio of horizontal correction to the distance read as a percentage. It is difficult to make a correct interpolation between the graduations for a point opposite the index, corresponding to the setting for the "Vertical" arc.

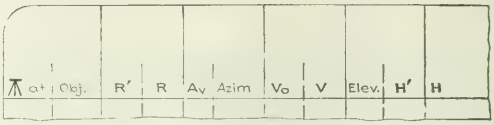


FIG. 2. FIELD BOOK RULING FOR USE WITH STADIA ARC

The accompanying table affords a more accurate and, with the aid of the slide-rule, a quicker method for determining the horizontal distance, H', in the diagram, which equals the function $100 \cos^2 A$. The horizontal distance between the center of instrument and the point sought is

$$H = 100\ R \cos^2 A + C \cos A \qquad (3)$$

Ignore the "Horizontal" arc and read only the "Vertical" arc number, entering it in the field-book in the column marked A_v. Opposite this number in the table is the corresponding value of $\cos^2 A$, which multiplied by 100 times the rod intercept will give the distance direct.

REDUCTION TABLE FOR FACILITATING USE OF BEAMAN STADIA ARC

"Vert" Arc No		Angle A	Cos²A	C sin A For C = 0.80	1.00	1.25	C cos A For C = 0.80	1.00	1.25
95	5	32-04.7	0.718	0.42	0.53	0.66	0.7	0.8	1.1
94	6	30-49.3	0.734	0.41	0.51	0.64	....	0.9	...
93	7	29-39.5	0.755	0.40	0.50	0.62	...	...	..
92	8	28-34.2	0.771	0.38	0.48	0.60	...	...	..
91	9	27-32.5	0.786	0.37	0.46	0.58	...	...	..
90	10	26-33.9	0.800	0.36	0.45	0.56	...	..	...
89	11	25-37.8	0.813	0.35	0.43	0.54	...	..	...
88	12	24-43.9	0.825	0.33	0.42	0.52	..	..	...
87	13	23-52.0	0.836	0.32	0.40	0.51	..	..	..
86	14	23-01.6	0.847	0.31	0.39	0.49	...	..	..
85	15	22-12.8	0.857	0.30	0.38	0.47	...	...	1.2
84	16	21-25.3	0.867	0.29	0.36	0.46	..	...	...
83	17	20-39.0	0.876	0.28	0.35	0.44	..	..	...
82	18	19-53.7	0.884	0.27	0.34	0.43		..	..
81	19	19-09.5	0.892	0.26	0.33	0.41	0.8	..	
80	20	18-26.1	0.900	0.25	0.32	0.40		.	
79	21	17-43.5	0.907	0.24	0.30	0.38	.	1.0	..
78	22	17-01.6	0.914	0.23	0.29	0.37	...	.	..
77	23	16-20.5	0.921	0.22	0.28	0.35	.	...	.
76	24	15-39.9	0.927	0.22	0.27	0.34		..	
75	25	15-00.0	0.933	0.21	0.26	0.32	.	...	.
74	26	14-20.5	0.939	0.20	0.25	0.31	.	..	..
73	27	13-41.6	0.944	0.19	0.24	0.30		..	
72	28	13-03.1	0.949	0.18	0.23	0.28	.	..	..
71	29	12-25.0	0.954	0.17	0.22	0.27		..	
70	30	11-47.3	0.958	0.16	0.20	0.25		..	..
69	31	11-10.0	0.963	0.16	0.19	0.24		..	..
68	32	10-33.0	0.967	0.15	0.18	0.23		..	..
67	33	9-56.3	0.970	0.14	0.17	0.22	.	..	
66	34	9-19.9	0.974	0.13	0.16	0.20	.	..	.
65	35	8-43.7	0.977	0.12	0.15	0.19		.	
64	36	8-07.8	0.980	0.11	0.14	0.18		..	.
63	37	7-32.1	0.983	0.10	0.13	0.16	.	..	.
62	38	6-56.6	0.985	0.10	0.12	0.15		..	.
61	39	6-21.2	0.988	0.09	0.11	0.14	.	..	..
60	40	5-46.1	0.990	0.08	0.10	0.13	.	..	.
59	41	5-11.1	0.992	0.07	0.09	0.11	..	.	
58	42	4-36.2	0.993	0.06	0.08	0.10	..	...	...
57	43	4-01.4	0.995	0.06	0.07	0.09		...	..
56	44	3-26.7	0.996	0.05	0.06	0.08		...	..
55	45	2-52.1	0.997	0.04	0.05	0.06		...	..
54	46	2-17.6	0.998	0.03	0.04	0.05	.	..	..
53	47	1-43.2	0.999	0.02	0.03	0.04	.	..	...
52	48	1-08.7	1.000	0.02	0.02	0.03	.	..	...
51	49	0-34.4	1.000	0.01	0.01	0.01		..	..
	50	0-00.0	1.000	0.00	0.00	0.00	.	...	..

Corrections $C \sin A$ and $C \cos A$, for use with equations (2) and (3) respectively are also given in the table, the former to two places in order to facilitate quick determination of the value in accurate work permissible with short shots if desired. These corrections may be entered interlineally in columns V_o and H' respectively in the field-book.

The rod intercept, R, and the rod height, R', are

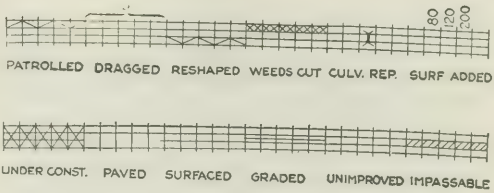
found in the usual manner employed with the Beaman stadia arc. The field entries are made in the first six columns of ruling adapted to the lefthand page of the standard field-book, Fig. 2. The remaining columns are for office calculations. Experience has proved this suggested form of field-book satisfactory, and the table has proved a great time saver.

Maintenance Estimate and Progress Report Forms

Estimates for State-Aid Highway Maintenance in Minnesota Prepared Ahead of Season for Each County

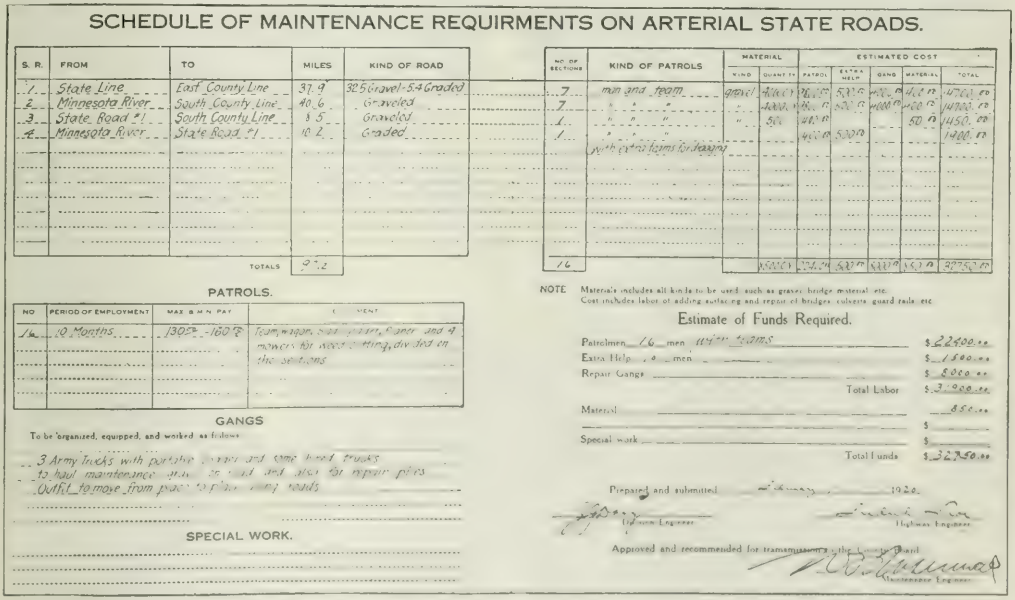
STATE-AID highway maintenance in Minnesota is apportioned on formal estimates and paid monthly on verified reports of work performed. In Minnesota the counties perform the maintenance work, employing the patrol system, which in 1919 was extended to all counties. In the 86 counties there are 12,362 mi. of state highway of which about 7,000 mi. are classed as trunk-line roads on which is put approximately 80 per cent of the total expenditure for maintenance. This expenditure for 1919 was $1,582,834, of which $676,609 was state aid. The expenditure for 1920 will be materially greater.

In preparing for the season's maintenance, an estimate is made for each county of the work which is to be aided by the state. The highway engineer for the state highway department and the engineer for the county board prepare the estimate by agreement and enter it on the form shown by the illustration. When approved by the division engineer and by the maintenance engineer, the estimate is transmitted as an order to the county board which is required to pass a formal resolution of adoption.



2. SYMBOLS FOR MONTHLY GRAPH RECORDS OF MAINTENANCE WORK

The form, two pages of which are illustrated, is a four-page document. On the first page is printed the order which is signed by the commissioner of highways and the chief engineer, and on the last page is printed the resolution of adoption signed and sealed by the county auditor. The form, therefore, is a document of original record with the force, virtually, of a contract between the state highway department and the county board. When the estimates of all counties are completed, the state highway department possesses, well in advance of the season's maintenance work, a complete mileage and cost summary of state-aid maintenance for the year.



SCHEDULE OF MAINTENANCE REQUIRMENTS ON ARTERIAL STATE ROADS.

S. R.	FROM	TO	MILES	KIND OF ROAD	NO. OF SECTIONS	KIND OF PATROLS	MATERIAL KIND	MATERIAL QUANTITY	ESTIMATED COST PATROL	EXTRA HELP	GANG	MATERIAL	TOTAL
1	State Line	East County Line	37.9	32.5 Gravel-5.4 Graded	7	man and team	gravel	4000 CY	9600 ft	500 ft	4000 ft	400 ft	14700 ft
2	Minnesota River	South County Line	40.6	Graveled	7	" " "	"	4000 CY	9600 ft	500 ft	4000 ft	400 ft	14700 ft
3	State Road #1	South County Line	8.5	Graveled	1	" " "	"	500	400 ft			50 ft	1450 ft
4	Minnesota River	State Road #1	10.2	Graded	1	" " " with extra teams for dragging			400 ft	500 ft			1400 ft
		TOTALS	97.2		16			$5000 CY	20400 ft	500 ft	8000 ft	850 ft	32750 ft

PATROLS.

NO	PERIOD OF EMPLOYMENT	MAX & M N PAY	DOCUMENT
16	10 Months	130 ft - 160 ft	Team, wagon, [illegible], planer and 4 mowers for weed cutting, divided on the sections

GANGS

To be organized, equipped, and worked as follows

3 Army Trucks with portable [illegible] and some hired trucks to haul maintenance [illegible] and also for repair piles
Outfit to move from place to place [illegible] roads

SPECIAL WORK.

NOTE Materials includes all kinds to be used such as gravel, bridge material, etc.
Cost includes labor of adding surfacing and repair of bridges, culverts, guard rails, etc.

Estimate of Funds Required.

Patrolmen 16 men with teams	$22400.00
Extra Help 10 men	$1500.00
Repair Gangs	$8000.00
Total Labor	$31900.00
Material	850.00
	$
Special work	$
Total Funds	$32750.00

Prepared and submitted [illegible] 1920.

Division Engineer Highway Engineer

Approved and recommended for transmission to the County Board

Maintenance Engineer

1. ESTIMATE FORM FOR STATE AID HIGHWAY MAINTENANCE IN MINNESOTA

Aid is paid on monthly records of work performed using a standard form. This form is a brown line print 36 x 9 in. folded to document size of 4 x 9 in. On two folds are certificates that the work recorded has been properly carried out, attested by the highway engineer and the division engineer; a certificate of claim for 50 per cent state aid by the county auditor; a statement of balance, and, finally, an approval for payment of state aid signed by the highway commissioner. On three succeeding folds is a tabulation of the work done on each road and of its cost. The remainder of the sheet shows a graph for each road indicating the work

done according to the symbols illustrated by the accompanying sketch. A brownprint for each month goes to each highway engineer, one for every county. When filled out and signed the print is returned to the state highway department, where it is audited and approved for state-aid payment. After this has been done a blueprint is returned to the highway engineer and another to the county auditor for their files of records.

These forms for estimates and monthly records provide a compact account of current maintenance work. W. F. Rosenwald is maintenance engineer and John. H. Mullen is chief engineer of the Minnesota Highway Department.

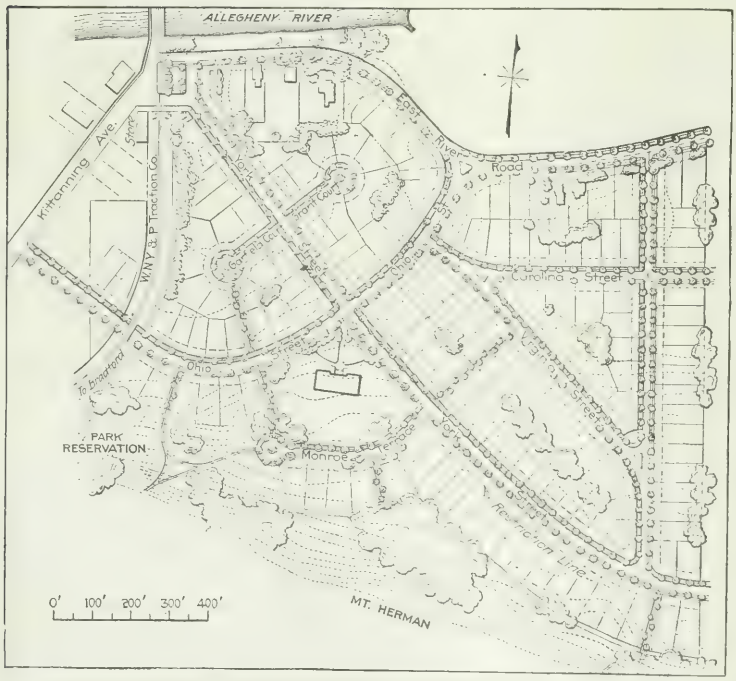
Housing Project at Olean, N. Y.

By John Nolen
Town and City Planner, Cambridge, Mass.

THROUGH the sponsorship of the Chamber of Commerce of Olean, N. Y., the Olean Housing Corporation has undertaken to provide well-designed houses on a layout embracing the best principles of town planning. E. W. Fitzgerald, secretary of the Chamber of Commerce, was instrumental in securing an advantageous site of about 40 acres extending from the foot of Mount Herman down to the south bank of the Allegheny River. The area has been named Seneca Heights, and is less than a mile from the business section of Olean.

In the grading scheme that has been prepared the steep hillside surface has been taken care of to assure as easy gradients as possible for the streets. A main avenue 50 ft. wide has been laid out southeasterly across the site. A public square has been provided at the junction of this avenue and Kittanning Ave., and midway on the estate a commanding position has been determined on for a proposed school. While the main thoroughfares are 50 ft. wide, the subsidiary streets are 42 ft. wide, and without exception all have planting strips 6 or 7 ft. wide for rows of trees. A feature of the plan is the grouping of residences around circular street terminations, which will give an air of homelike seclusion and quietude to the localities. A convenient access for pedestrians across very steep blocks inaccessible for vehicles is provided by footpaths with steps and rows of flowering trees. The lots are of varied sizes—from 50 to 100 ft. in width and 80 to 150 ft. in depth. No alleys are provided, but on the rear lot line of the blocks rows of trees will screen the backs of the houses.

The scheme is not intended to be a housing effort for any one class, but rather an endeavor to place well-designed houses in good surroundings within the financial reach of the average man. About 140 houses are to be erected. Evidence of the spirit of the undertaking is shown by the action of the Housing Corporation in purchasing houses and lots outside their area to open up appropriate and dignified approaches to the estate, the main lines of which will radiate from the city thoroughfares of Olean. The writer has been responsible for the development of the design. The architectural planning of the residences is in the hands of A. C. Bossom, architect, New York City.



PLAN OF SENECA HEIGHTS PROJECT, OLEAN HOUSING CORPORATION

Broader Education for Engineers Favored

In connection with the conference on employment and education held by the American Association of Engineers Nov. 12, a brief questionnaire was sent to educators and engineers asking for their opinion as to whether engineering, legal and other professional college courses should be preceded by one or two years of general collegiate training. Out of the 154 replies received, 99 were in favor of two years of general education, 43 were in favor of one year and only 12 were opposed to any general collegiate training in addition to the professional course. These figures expressed in percentages are: 64 per cent in favor of two years and 28 per cent in favor of one year, a total of 92 per cent who are in favor of at least one year of general education. Out of 154 engineers who replied, 54 were deans, professors or instructors in engineering colleges and the balance was made up of consulting engineers, chief engineers and other engineers. No statement is made as to the distribution of votes received from the educators.

The Use of Phosphoric Acid in Water Softening

Causticity Removed and Softened Water Carbonated With Minimum of Residual Hardness and After-Deposits

PHOSPHORIC acid is being tried on a large scale at the Columbus softening and purification works to produce a fully carbonated stable water and to eliminate any residual causticity caused by the lime-softening process. Tennessee rock phosphate is used to make the phosphoric acid. It is boiled with sulphuric acid in one of the alum boiling tanks. Phosphoric acid and calcium sulphate are produced. The latter is practically insoluble and separates from the solution, leaving a clear phosphoric acid which is fed into the water at the rate of about 0.7 grains per gallon.

The argument and line of experiments by which C. P. Hoover, chemist in charge, arrived at the use of the phosphoric acid treatment is as follows:

The normal carbonates present in a lime-softened water form incrustations on the sand grains in filters, thus increasing the size of the sand. At Columbus the sand has increased in effective size from 0.42 mm. to more than 1 mm. The incrustation also causes the sand grains to become cemented together, forming hard lumps. Details of experiences with after-deposits at Columbus, Grand Rapids and McKeesport were given in a series of three articles in *Engineering News-Record*, May 3, 10 and 17, 1917, pp. 250, 304 and 351.

At the Columbus plant the filters are being rebuilt at a cost of $20,000, as the holes in the strainer plates have become so stopped up with carbonate that it is almost impossible to force water through the filter. Columbus has not had much trouble with after-deposits in the pipes and meters, but what has occurred is increased when it becomes necessary to conserve the use of soda ash.

The first investgations toward working out a practical method of eliminating the difficulties were along the line of colloidal chemistry. Early experiments indicated that the solubility of calcium carbonate depended upon whether it was precipitated in a crystalline or colloidal condition. Calcium and magnesium carbonates in the former state are soluble to the extent of 37 p.p.m., whereas the colloid of these carbonates is soluble to more than 100 parts and colloid precipitates when the water is high in magnesium, or is muddy.

In order to produce a lime-softened water that would be stable the first method which suggested itself was to carbonate the water with CO_2. There are a number of ways that the carbon dioxide may be produced, but the ones which were given particular attention were as follows: (1) Burn the lime sludge from the settling basins, producing lime and CO_2. (2) Treat the lime sludge from the settling basins with sulphuric acid, producing calcium sulphate and CO_2. (3) Calcine sodium bicarbonate, producing sodium carbonate and CO_2. (4) Treat soda ash with sulphuric acid, producing sodium sulphate and CO_2, then roast the sodium sulphate in a furnace with slack coal and limestone, producing sodium carbonate which could be used in softening.

By carbonating the water, the normal carbonates are put in solution and there is no reduction in hardness. Under normal conditions this objection is not so serious, but during certain periods of the year, when the precipitates of calcium and magnesium are necessarily colloidal, causing the alkalinity or temporary hardness of the softened water to be high, it is desirable that these carbonates be removed by precipitation, thus reducing the hardness of the water, rather than be dissolved by carbonation, leaving the hardness unchanged.

Experiments were also conducted to determine the advisability of neutralizing the normal carbonate with sulphuric acid. This was effective, but was more objectionable than the carbonic acid because by this process temporary hardness is converted to permanent hardness.

Silicic acid was tried but the results were not very promising. However, excellent results were obtained by filtering lime-softened water through porous silica gel, as prepared by Dr. W. A. Patrick, Johns Hopkins University.

Boric acid, oxalic acid, tartaric acid and phosphoric acid were next tried and a great deal might be said of the results obtained by each of these acids but Mr. Hoover came to the conclusion that as a finishing treatment for lime-softened water the phosphoric acid is the best and most economical treatment tried. When enough phosphoric acid is added to lime-softened water to combine with any caustic alkalinity that might be present in the water, and with one half the normal carbonates of calcium and magnesium, a reaction results which produces tri-calcium phosphate, which is insoluble and readily settles from the water, and CO_2, which carbonates the remaining quantity of normal carbonates. By this process half of the carbonates are removed, thus reducing the hardness of the water; the balance of the carbonates are carbonated, thus producing a stable water.

In coagulating muddy water, such as the Scioto River water during flood times, better results are obtained with coagulants when the water is treated with enough lime to soften the water and an additional amount is added sufficient to give the water a caustic alkalinity. This caustic alkalinity must be neutralized before the water is filtered and phosphoric acid can be used for this purpose also.

Salary Committee Makes Final Report

In its final report, dated Dec. 6, 1920, Engineering Council's committee on classification and compensation of engineers, of which Arthur S. Tuttle was chairman, makes the following recommendations:

1. That Engineering Council urge the appropriate congressional committee to take favorable action in the matter of providing for an immediate increase in the compensation of the engineering staffs of the federal government and to base this action, in so far as practicable, upon the compensation suggested by your committee on classification and compensation of engineers.

2. That such committee as may hereafter be constituted, be instructed to confer with a similar committee of the American Railway Engineering Association for the purpose of bringing about the acceptance of a common standard for the classification of engineers.

3. That owing to its vital importance the work of this committee be continued by some suitable agency.

4. That the investigation to determine the relation between engineering charges to cost of work supervised be continued by such committee as may henceforth take over the work of this committee.

5. That the present committee on classification and compensation of engineers be discharged.

The continuance of the work of the committee has been referred to the American Engineering Council of the Federated American Engineering Societies.

Oversize Construction Plant Demonstrates Value

Automobile Body Factory at Cleveland, Ohio. Completed in Quick Time by Concentrating Equipment for Peak-Load Construction

PLANT concentration solved the problem of placing large volumes of material—with railway transportation disorganized—last summer in constructing the immense manufacturing plant of the Fisher Body Ohio Co. With interrupted railway service, there were combined a jurisdictional strike, a long period of rainy weather and several inundations of the site by a local stream. All delays due to these causes were met and a planned-time schedule maintained by assembling equipment in large amounts not only for placing materials in the structures but also for transporting materials from factory to the work and in some cases for moving raw materials to the factory for fabrication.

Governing Quantities and Dimensions.—The operation involved the construction of seven buildings occupying about 15 acres of a 45-acre site near the eastern limits of the city of Cleveland, Ohio. The main dimensions and the structural character of the several buildings are indicated on the accompanying plant location map. A maximum over-all dimension of 2,500 ft., had to be covered in placing materials. These materials comprised, as main items, 50,000 cu.yd. of concrete, 3,000 tons of reinforcing steel and 3,000 tons of structural steel. Brick, lumber and other material were counted by the trainload. There were for example 150 carloads of treated wood blocks for shop floors, sufficient to pave five miles of ordinary city streets. Indeed, the carload was the least unit by which the transportation volume of even minor materials could be estimated.

With materials in trainload volumes to be placed in structures extending 2,500 ft. and covering an area of 500.000 sq.ft., the construction problems were: (1) To bring the materials to the site, and (2) to assemble them into structure on the site. Construction was a transportation and handling problem and not a problem of fabricating a complex structure. With the nature of the construction problem recognized, a knowledge of railway conditions as they existed early in 1920 made it very clear that rail movement of materials to the site, if left to its natural course, would not be accomplished and so far as accomplished would be irregular in time, order and volume. Means to meet the conditions comprised close management of traffic movements, provision of equipment to aid the railways, and provision of a construction plant capable of a high-peak load. Such means were adopted. Conditions more difficult than were anticipated were met in this manner. The planned construction period was not exceeded.

Development of Site.—Water was the principal natural obstacle to the development of the site. A stream crossed the property. Its tortuous channel overflowed whenever there was rain and the area flooded by a moderate rise was about 30 acres. Ultimate diversion

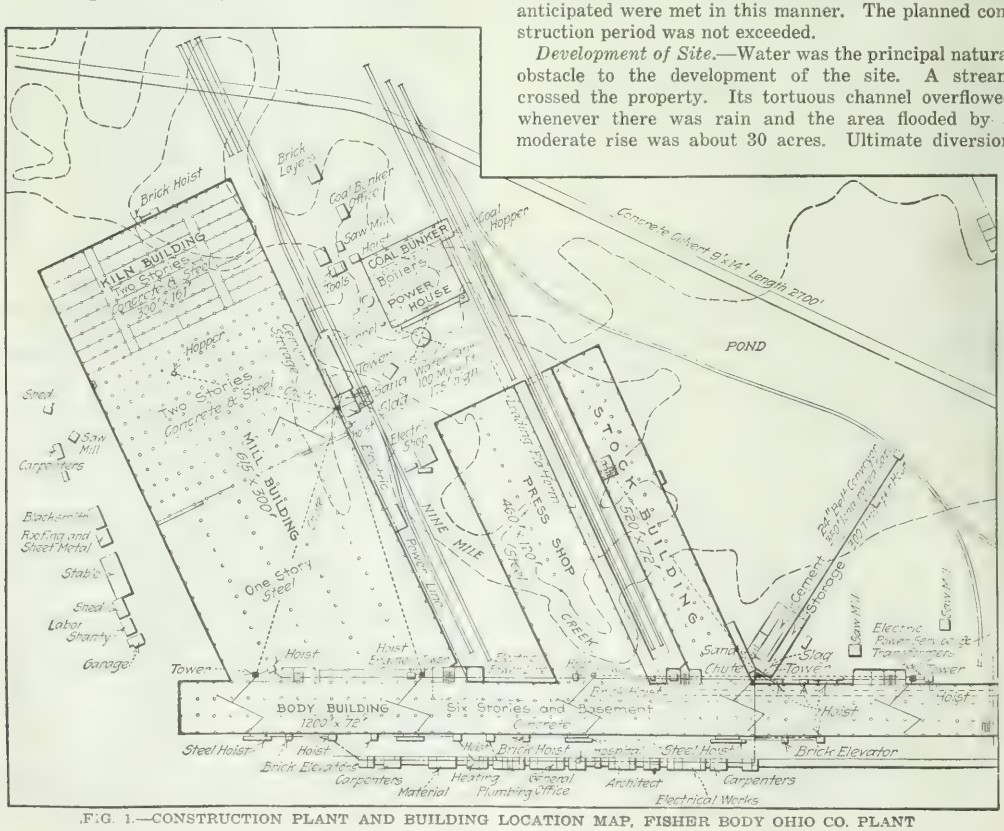


FIG. 1.—CONSTRUCTION PLANT AND BUILDING LOCATION MAP, FISHER BODY OHIO CO. PLANT

through the 9 x 14-ft. concrete culvert, indicated on the plant location map, was planned, but meanwhile, to allow work to progress, a temporary diversion channel parallel to the culvert had to be provided. As grading and stream diversion were begun at the same time there was a period when flooding could not be avoided. One of the floods, occuring June 16, 1920, is illustrated. They were a serious obstacle to progress during the first three months.

Grading was begun one week after signing the contract on March 16. About 100,000 cu.yd. of earth had to be cut from the high areas and filled into the low areas. The season was extremely wet. In April and May there was rain followed by overflows of the creek on over half of the days. To retard further the operations interrupted by wet weather, there was a jurisdictional strike between hoisting engineers and shovel runners. These delays were particularly troublesome because, as indicated, about one-half the area had to be excavated and the material spread over the other half, which allowed no room for unloading construction materials until the grading was completed. If, therefore, the grading time schedule was prolonged, the delay would be carried forward into the building construction operations.

Concentration of plant was adopted to meet the difficulty. For bulk movement a 3½-cu. yd., 70-ton steam shovel, a locomotive and train of 12-cu.yd. air dump cars handled excavation to fill; at the fill a second locomotive and a spreader maintained the dump. Less conveniently-reached yardages were handled by ¾- and ¼-cu.yd. revolving shovels, seven of which were in operation at the peak of the excavation. Trains of 2-cu.yd. cars and 3-ton gasoline locomotives moved the bulk of the small shovel excavation over the 2-mile system of narrow gage railway. At isolated points the steam shovels loaded to motor trucks and dump wagons. Elevator pits, machine foundations, tunnel emplacements, etc.., were excavated by a locomotive crane and clamshell wherever they could be reached from the main tracks. At other points a walking crane was employed. The outfit was extremely large for the volume of earth movement, but, despite delays, it completed the work within the time schedule, which was the object sought.

Development of Concreting Plant.—Concrete mixing and placing was the governing operation in building construction. There were placed some 3,000 tons of structural steel, but it was mostly one-story work. The concrete work, however, involved 50,000 cu.yd., including 3,000 tons of reinforcement. Structurally, the work was ordinary. The body, stock and mill buildings are of the flat-slab type, and the kiln building (first supported floor) is of tin-pan construction, with 2-in. concrete slabs cast in advance of placing the pans so that a flat ceiling effect was produced.

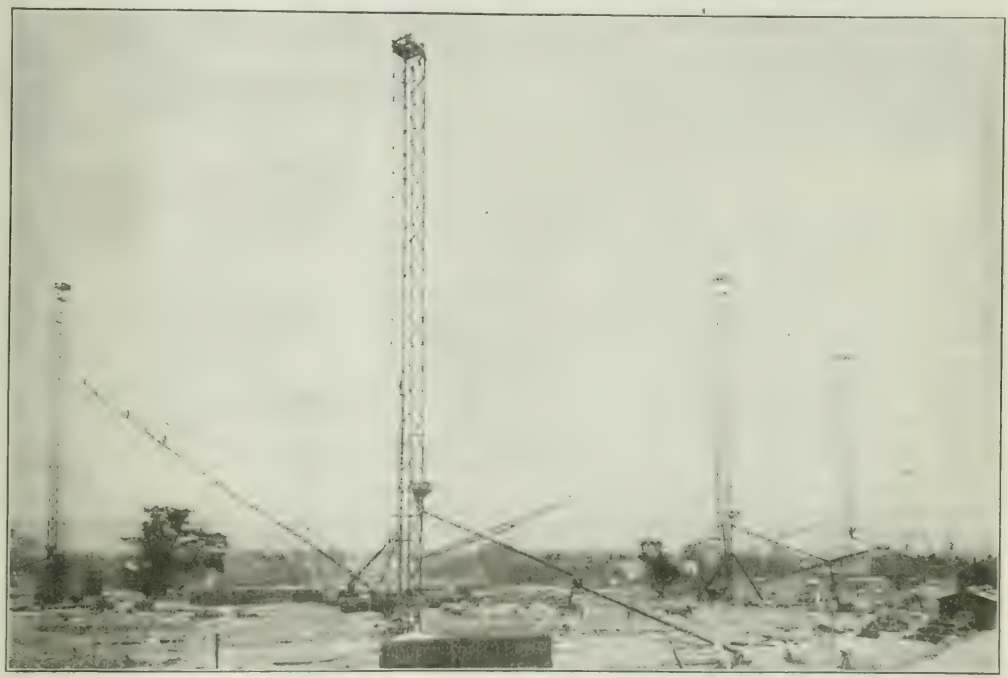


FIG. 2—SIX-TOWER, TWO-MIXER CONCRETE CHUTING PLANT SERVED ALL BUILDINGS

While the bulk of the concrete to be placed was in the body building, a yardage equal to an ordinary operation was required for the stock building, and almost double that amount required for the mill and kiln buildings, the concrete portions of these latter two buildings being 600 ft. from the body building. In order to accomplish the desired result of reaching all this work, it was decided that there should be two distinct and separate plants each with a one-yard mixer and over-head bins for bulk material. Along the rear of the body building were erected five steel towers, 160 ft. in height, at intervals of about 230 ft.

Plant No. 1 was located at the junction of the stock

FIG. 3—BODY BUILDING, 1,300 × 72 FT., UNDER CONSTRUCTION

and body buildings, and served the three easterly towers as well as a line chute to the rear of the stock building, from which a small portion of the yardage of this building was wheeled in buggies. Plant No. 2, with a 200-ft. steel tower, was located in proximity to the yardage of the mill and kiln buildings, and served, through two 400-ft. chutes, the two westerly towers of the body building, as well as a line chute to the kiln building, from which the yardage of this building was wheeled in buggies. The concrete delivered by the three easterly towers was hoisted in the center tower and shot to the easterly and westerly towers through a 230-ft. line chute, except when the work of concreting was being carried on within reach of this main tower, at which time it was discharged into the counter balance chuting equipment as was the case, after re-hoisting, in the auxiliary towers.

Plant No. 1 differed from Plant No. 2 in the respect that the railroad track was 350 ft. distant and all the material was handled on a 24-in. belt conveyor running with a rated capacity of 300 tons per hour. The stone and sand were fed onto the belt from hoppers underneath the track into which the contents of the gondola cars were dropped. The cement was also handled on this belt and an ingeniously arranged threeway device was located at the top of the belt by which the stone and sand were thrown to the right and the left and the cement went straight forward into a chute leading back through the roof of the cement house. Plant No. 2 was supplied with stone and sand (from individual hoppers underneath the track) by bucket conveyors each designed for handling its particular commodity, while the cement was trucked in from an elevated spur track at the end of the cement house.

Other Plant Features

While criticism was made of the size of this installation the satisfactory results obtained—from the standpoint of efficiency and speed—demonstrated the utility of size, as exemplified in such a record as 1,065 cu.yd. of concrete placed on the superstructure of the body building, with one plant running eight hours and the other nine hours, or a total of seventeen plant-hours, averaging in excess of 61 cu.yd. per hour per plant, thus requiring a carload of bulk material every fifteen minutes.

The construction plant was electrically operated throughout. All the concrete hoisting towers were operated by 100-hp. single-drum, electric engines, with a capacity of 6,000 lb. at a speed of 400 ft. a minute. The mixers were driven by 20-hp. electric motors, the belt conveyor by a 30-hp. motor, direct connected, while the bucket conveyors were driven by a 25-hp. motor through a line shaft with an independent friction clutch for each conveyor, thus elminating the necessity for operating both when only one was required, and also permitting the repair of one while the other was in operation. The cement bags, of which there were about 500,000, were shaken satisfactorily by two electrically driven, rotary bag shakers, and baled with two standard hand-operated baling machines. Double drum, 55-hp., electric engines were used for the brick and steel hoists, there being six of each, one drum being assigned to the steel hoists, and the other handling the brick hoist, being lagged up to develop the increased speed desired for the latter. Single cages of two-wheelbarrow capacity were used for the brick elevators, while the reinforcing steel was handled by self-unloading so-called aeroplane-type hoists.

Transportation Arrangements.—Hardly had the excavation reached a point where work could proceed on the foundations when the switchmen's strike demoralized shipments, so as to necessitate radical steps being taken to get equipment, etc. onto the job. Expressing and trucking long distances where freight had previously been arranged for was resorted to, and in many instances the manufacturer was provided with the raw materials. In addition, the finished product had to be transported to the job. This obstacle had not yet been removed when the coal movement to the Northwest (of which Cleveland was the heart) started. The Interstate Commerce Commission issued orders prohibiting the use of open-top cars for shipments other than coal, thus throwing a vast amount of commodities normally handled therein into box cars, causing a heavy shortage of these cars also. It was, therefore, evident that if the job was to proceed at all something other than railroad equipment must be depended upon.

It was at this time that full trains of gondola and box cars were purchased and a privately operated locomotive arranged for—the former to handle sand from the pits 12 miles distant, the box cars to bring cement, and the latter to take care of the switching within the plant.

The permanent sidings for service to the plan constitute approximately a mile of standard-gage track, while approximately three-quarters of a mile of additional track was built for temporary use during construction.

High Construction Speeds.—By the time the concrete of the rear buildings had been got out of the way, which effort was made in order that the steel superstructure and brickwork might progress while the body building was being concreted, and the large amount of extra foundation work not previously anticipated was finished, Oct. 1 was reached. It was during the early part of this month that the concreting of the first supported floor of the body building took place and between that date and the first week of December, at which time the roof was poured, the entire superstructure of this 1,200-ft. building was concreted. The speed averaged approximately ten calendar days per floor, comprising in excess of two acres. Two sets of slab, and one set of column and beam forms were used. Incidentally the brickwork on this operation (40,000,000, face and common) and the sash and glazing (over 500,000 sq.ft. of the former and 250,000 lights of the latter) so closely followed the concrete work that it was necessary to delay on the sixth story until such a time as the roof slab was sufficiently set to remove the forms.

The entire project was designed and supervised by Albert Kahn, as architect and engineer, while the actual construction was done under a general contract with Thompson-Starrett Co.

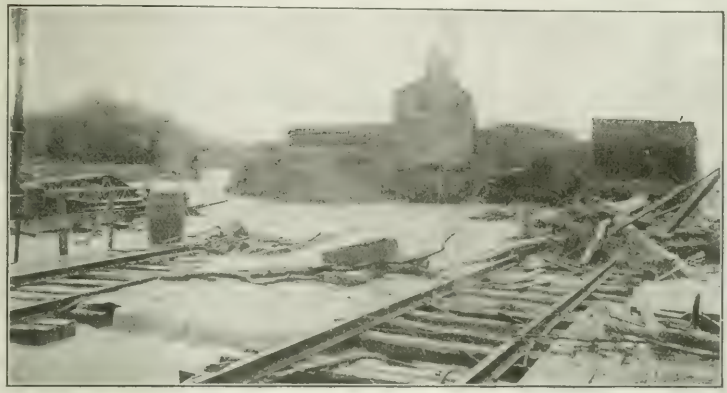


FIG. 4—MATERIALS STORE YARD DURING FLOOD OF CREEK TRAVERSING THE CONSTRUCTION SITE

United States Reclamation Service Projects

The net construction cost of the reclamation projects completed or under construction up to June 30, 1920, was $125,000,000 or $25,000,000 less than the value of crops grown in 1919, according to the nineteenth annual report of the U. S. Reclamation Service, as summarized by Arthur P. Davis, director.

Enormous Power Program in California

"The future of California is circumscribed by the extent to which it develops power," said Wigginton E. Creed, president of the Pacific Gas and Electric Co., speaking at a recent meeting of the San Francisco Section, Am. Soc. C. E. "The big problem to be solved in power development is finding the money for the enormous construction program that must be undertaken. A rate of increase of 100,000 hp. per annum will no more than meet present needs and take care of growth at the present rate." Taking the cost of development at $350 to $400 per horsepower, he estimates that there will be needed an annual investment of $40,000,000 for some years to come. If California takes advantage of its physical opportunities, Mr. Creed believes that there will be a demand for the investment of between $500,000,000 and $800,000,000 in the next ten years.

The relative extent to which the chief sources of energy are now used in supplying power in California were quoted as follows: Oil, 64 per cent; hydro-electric power, 21 per cent; coal and coke, 16 per cent. Too much independence has been placed on oil, Mr. Creed said, because the oil industry has reached out and assumed more of the industrial burden than it can permanently carry. If the excessive burden on the oil industry is to be relieved so that oil resources may be conserved for other uses, Mr. Creed pointed out that hydro-electric power must be developed at a still greater rate than an increase of 100,000 hp. per annum required to take care of present needs.

Concrete and Steel Harbor Towers

During the war there was a good deal of general comment in the English papers concerning some curious reinforced-concrete cellular towers which were under construction at Shoreham. These were huge structures made up of hollow concrete boxes and the popular suggestion was that they were caissons to raise sunken vessels. It has now been stated that they were built as the basis of permanent islands in the English Channel and were to carry high steel towers. It was the intention to float the concrete structure out into the Channel, fill the hollows full of concrete to sink to the bottom, at which time the steel tower would protrude above the water and form a site for coast defense work. The total weight of the concrete structure is about 10,000 tons and the tower about 180 ft. high. The buoyancy of the hollow blocks was such that they drew when afloat only about 4 ft. of water. One of these structures has recently been towed from Shoreham to Portsmouth, where it is to be sunk adjacent to one of the lighthouses. While the structure can be used for gun mounts as it was originally intended, at present it is merely to be used to serve as a navigation mark.

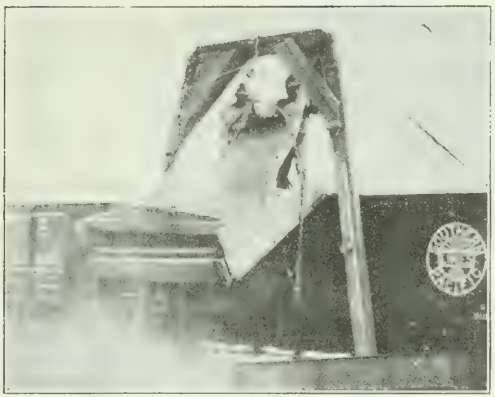
HINTS FOR THE CONTRACTOR

Slip Scraper With A-Frame Used for Unloading Rock and Sand

By W. B. Albertson
Construction Superintendent, California Highway Commission

A LIGHT, portable device for reducing the labor of unloading rock and sand from railroad cars has been developed by the writer and used on California highway construction work. It has been particularly satisfactory in the South during the summer, when it is almost impossible to keep men shoveling rock out of cars in the hot sun. The capacity of the outfit varies with the men, the record for speed being 55 tons of gravel unloaded in 70 min. This pace is too fast for the men to keep up, however, even if enough hauling equipment to handle the materials is available.

The device consists essentially of a timber A-frame,



UNLOADING GRAVEL WITH A SLIP-SCRAPER

attachable to the side of the railroad car, a bunker suspended from this by chains, and a gasoline engine operating a cable passing through a sheave in the A-frame to a slip scraper in the car. The A-frame is made up of 6 x 6-in. posts, 20 ft. long, with a 6 x 8-in. cap, 5 ft. long. Cap and posts must be securely bolted together and knee braces are required at the corners to carry the side strain. This side strain could be taken care of by guy wires, of course, but these were found to be hard to keep anchored and more or less in the way and so were entirely eliminated.

The frame is set up with its foot about 3 ft. from the rail, which leaves it in an almost vertical position when resting against the side of the car and yet permits of car clearance, by leaning the frame back, without changing the footing. The footing is anchored to the track by a chain hooked to the under side of the rail.

From each end of the A-frame cap, guy wires are run over the car and down to some convenient point on the bottom of the car body where they are attached. These guys are not carried straight across the car but are spread out to take some of the side strain that results when the scraper is worked in one end of the car. The part of each guy which remains permanently attached to the cap, has in its lower end a ring or loop from which a block and tackle is run to the anchorage. One man can pull the guys tight enough to bind the A-frame firmly against the other side of the car body.

The bunker, 6 x 7 ft. in plan and with sides and end high enough to hold 2½ tons when hung at an angle of about 33 deg., is slung from the cap by means of ½-in. chains. These are attached to the bunker at its outer end and by adjusting their length with grab hooks the slope of the hopper bottom can be suited to the material handled. This slope is set so the material will run out without being raked or shoveled. The other end of the bunker rests on the edge of the railroad car, being fastened there by hooks which prevent it from slipping either way. The door is made the full length of the bunker and hinged at the top. It is held shut by hooks so located that they can be released by the upward blow of a shovel. Ordinarily the truck driver tends the bunker gate.

Motive power is provided by a single-drum hoist operated by a 6-hp. gas engine which is set out at right angles to the track. It operates a ⅜-in. steel cable attached in the usual way to the scraper. Ordinarily two men handle the scraper and one man cleans up the corners. However, if the bottom is rough or hoppered, two men are used to clean up.

When the car is emptied the bunker is unhooked from the side of the car and allowed to hang suspended by its chains. The rope blocks are then loosened on the guy lines and the A-frame leaned back away from the track, in which position it is easily held by a 2 x 4-in. timber brace, while a new car is spotted. The entire operation of changing cars ordinarily requires only about fifteen minutes.

No Special Plant Needed to Handle Bulk Cement, Says This Contractor

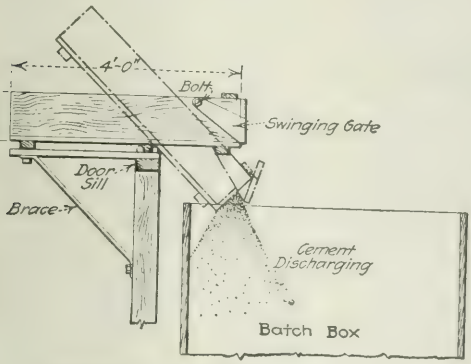
ACCORDING to Arthur Loeb, vice-president, Keystone State Construction Co., Philadelphia, Pa., no special plant or equipment is necessary in handling bulk cement. In a recent issue of the *Contractors' Atlas*, Mr. Loeb explained the method used by his firm in handling bulk cement for a concrete highway job at Townsend, Delaware.

The cement storage house is 150 ft. long and 20 ft. wide, with a capacity of 20 cars, or over 4,000 barrels. It is substantially built to withstand moisture or dampness. It has a concrete foundation and a concrete floor at the ground level. It is located between the railroad siding and industrial tracks.

The doors on the railroad side are fixed so that cement can be discharged through a chute from the car directly into the cement shed. The upper end of the wooden chute used is flared, with a cloth held over the top to prevent excessive dusting. This chute is located about breast high so that the cement can be easily shoveled into it. When unloading progresses to such a point where it is inconvenient to shovel into the chute cement is stored in the house with the aid of wheelbarrows. Horizontal struts and center posts of the cement shed at the door level support the wheeling

runway, which can be shifted at will. When the cement shed is filled to capacity the cement lies level with the door sills at each side of the house. For measuring into batch boxes, the following method is used:

The doors of the cement house are so located as to be at the proper spacing for the batch boxes on the industrial cars. The sills of the doors are located well above the track level and on each sill there are two



DETAIL OF TILTING MEASURING BOX

tilting boxes, each holding 4 cu.ft. of cement—the proper amount for the four-bag batch that was used on the job. These measuring boxes are filled by means of hand pails. When a box is filled a slight pull tilts the box and discharges its contents to the automatic gate located at the outer end of the box.

Railroad Type Shovel Swung End for End In Shale Quarry

THE method used in turning end for end a heavy shovel of the railroad type operating in a shale quarry is told in a recent issue of *The Excavating Engineer*, by E. J. Strock, superintendent of the Colorado-Portland Cement Co., Portland, Col.

In working the shale quarry each cut was carried lower than the preceding one, giving the floor a staircase appearance and making it impossible to have any great width of level floor on which to turn the shovel. The shovel was backed to within its length of the place where the new cut was to begin, chains were disconnected, and the rear end of the shovel jacked up.

The rails had been bent to a curve, the radius of which was the distance between truck centers. These rails were bridled together and set loose on ties laid at right angles to the length of the shovel, but curved in the arc of a circle. The rear truck was then swung at right angles to its usual position and lowered to the rails. The dipper hung free in front.

The rear end was then moved around the curved rails until the front truck jammed. Next the front end of the shovel was jacked up, the jack screws following closely in case a jack failed. When clear of the rails the front truck was swung around in the same direction as the rear was moving until the truck jammed, the short section of track fitted under the truck in its new position, the truck lowered and the rear end again pinched over. This was repeated until the shovel was facing in a direction directly opposite to its original one.

Steam Compressors Simply Converted to Electric Drive

By Donald G. Coombs
Office Engineer, Braden Copper Co., Rancaugua, Chile

SIMPLE alterations successfully converted into motor-driven machines for smelter purposes, a number of old 14 x 12 in. straight line steam driven air compressors previously employed in mine tunnel excavation. The change was accomplished by removing the steam piston and both the air and steam end piston rods and replacing them by one rod from the air end to the cross head. The stuffing boxes of the steam cylinder served as bearings for the new rod, and with the valve rod disconnected the machine was ready to be belted to a motor. The compressor fly wheel was 8 x 64 in. and it was belted to the 10-in. pulley of a 900 r.p.m. 50 hp. a.c. motor by a two-ply 8-in. leather belt. The pulleys are on about 15-ft. centers and no idlers are used.

Contrary to expectations no belt troubles have been experienced due to the narrow uncrowned faces of the fly wheels, although the blow-off is set at 110 lb. and the compressors are operating at an elevation of 5,100 ft. above sea level. Three of these machines have been running for nearly a year with no more trouble or expense than the regular motor driven type compressor. Since, previous to the change in drive, the direct labor and material charge was $40 per 10-hr. day per machine, using an 80 hp. vertical fire tube boiler with a fair grade of briquetted coal at $32 per ton, the saving effected has been considerable. The method of making the change was the idea of Wm. Dunne, shop foreman, Caletones. The writer was general foreman.

Gravity Conveyor Speeds Up Laying of Brick in Road Work

By F. W. Epps
Bridge Engineer, Kansas Highway Commission

THE device illustrated herewith, for delivering bricks in highway construction to the workman, runs on the tracks which constitute the forms for the base of the monolithic brick pavement. One end is elevated by a frame which is braced to the main part of the con-

BRICK CONVEYOR IN OPERATION ON KANSAS ROAD JOB

veyor bricks being delivered to the workman by means of mechanism operated by gravity.

The device can be changed to accommodate different widths of readway by shifting the frame at the upper end. Many miles of monolithic brick pavement in central Kansas have been laid in this method which has the double advantage of being economical and simple.

Letters to the Editor

The Proposed National Public Works Department

Sir—In your issue of Dec. 30, 1920, p. 1273, there appears a very clear "Analysis of the Proposal to Establish a National Department of Public Works," by Lieutenant-Colonel C. O. Sherrill. The writer is in hearty accord with the sentiments expressed so far as they relate to the Corps of Engineers, U. S. A. To curtail or hamper in any way the activities or authority of this splendid body of technically trained men on public works of the country would be a calamity. It is upon these great works that the young graduate of the Military Academy acquires the practical experience in the handling of men and materials that is so essential to his efficiency in the theater of modern warfare.

The magnificent record made by the Corps of Engineers in France was due to the fact that the men in responsible command were experienced in great construction works—on our rivers, harbors, Panama Canal, etc., and the writer believes that the sphere of their operations should be extended, that they should exercise supervision over highway construction when same is aided by federal grants, that they should have a certain period of training in the transportation departments of our large railway systems, and some experience in large industrial concerns.

St. Louis, Jan. 4. F. G. JONAH,
Chief Engineer, St. Louis-San Francisco Railway Co.

An Analysis of the Proposal for a Public Works Department

Sir—Because the writer was formerly an officer of the National Public Works Department Association numerous suggestions have been made by public works department supporters that he submit reply to an article which appeared in your issue of Dec. 30, p. 1273, entitled "An Analysis of the Proposal to Establish a National Department of Public Works," by Lieutenant-Colonel C. O. Sherrill, Corps of Engineers, U. S. A.

For some weeks prior to its appearance the writer had knowledge that the article in question was being prepared. He is advised that it has been carefully reviewed by the chief officers of the corps. It may therefore be accepted as an authorized pronouncement, if not a corps symposium. Coming with such authority and under the authorship of one of the ablest engineers in the corps, as well as one of the finest gentlemen in the army, the article is most opportune. It sets forth clearly, for the first time since the public works movement was revived, not only the attitude of the Corps of Engineers but also its concepts as to the fundamentals of organization. The advocates of the Jones-Reavis bill, or any equivalent instrument, may be quite content with the latter. It is rare that any party to a controversy reveals misconception of fundamentals so ingeniously.

It would be profitless now to make reply to the points raised in this article. Congress has recently created a joint committee, which in the course of its investigations into the executive departments would presumably cover the whole subject of public works and the relation of the Corps of Engineers thereto. All parties will have their day in court and the public will have the benefit of facts rather than of arguments. This opportunity to secure an unprejudiced hearing should be welcomed by all concerned, and while the writer has no expectation of taking part in the proceedings he is nevertheless prepared to abide genuinely by the findings of this joint committee of Congress.

In the meantime it will be conducive to a proper understanding of the matter if the civilian engineers will concede that it is natural for the Corps of Engineers to oppose a measure which it confidently, though mistakenly, believes will mean its destruction. In the conduct of broad propaganda in which existing conditions must be criticised it is difficult, if not impossible, to avoid the appearance of personal unfriendliness toward those whose doings are regarded unfavorably. The public works matter will now, so to speak, be carried into court, where actual evidence rather than special pleading will be the order of the day. Between parties there is an honest difference of opinion. Let us lay our evidence before the tribunal without derogation of motives.

M. O. LEIGHTON,
Consulting Engineer.
Washington, D. C., Jan. 4.

Useful Dodges in Surveying

Sir—In the interesting articles for the "Average Engineer" which you are now publishing, one by H. L. Thackwell in the issue of Dec. 16, p. 1164, seems to call for some comment.

Under paragraph 7, Mr. Thackwell describes a method for taking topography which is not a short cut but rather a description of a method adopted by engineers who sought better results than those obtained by straight transit and stadia work. The writer believes that for taking topography, nothing yet invented can take the place of the plane table, properly handled Mr. Thackwell has merely moved his office drafting force to the field, increasing the cost of the field party without obtaining any increase in output.

In Mr. Thackwell's method, computation of distance and elevation is made by the slide rule. This operation became unnecessary upon the invention of the Beaman stadia arc. The use of vertical angles is avoided by the use of this standard attachment, which also carries a scale giving the correction needed to reduce observed stadia distances to horizontal.

In the method described in the article in question, the angle observed by the transitman is called out to the recorder, who plots it. It is evident that this introduces another operation and at least a personal factor error in the plotting. Such an error is eliminated by the direct observation of the angle on the plane table sheet.

The speed claimed by Mr Thackwell is not equal to that of a plane table party. With two rodmen, the writer has averaged 1,000 acres of rolling prairie land daily, using 1-ft. contours on a scale of 2,000 ft. equal to 1 inch.

Under the method advocated by Mr. Thackwell, there is a division of responsibility between transitman and recorder. The recorder is not able to vizualize the country, has no choice in the matter of the location of the rod, and the resulting map is apt to be "wooden." On the other hand, in plane table work, since the responsibility is fixed upon the plane table operator alone, the credit for good work is fixed with equal exactness.

L. B. ROBERTS,
Division Engineer, N. Y. Water Power Investigation.
New York, Dec. 22.

Kenova and Niagara Measurements of Secondary Stresses

Sir—I have read with much interest the article "Secondary Stresses in Kenova Bridge Measured," by John I. Parcel and George A. Maney, in *Engineering News-Record* of Dec. 9, 1920, p. 1116. There is no doubt that much is to be learned, especially concerning secondary stresses, from stress measurements in existing structures, and the thanks of the profession are due to Profs. Parcel and Maney for this presentation of their results.

In view of the authors' statement "so far as known no test has been made on a structure of anything like the size of the Kenova bridge," the writer wishes to call attention to the paper in the *Proceedings* of the American Society of Civil Engineers for May, 1920, "Revision of the Niagara Railway Arch Bridge," by Charles Evan Fowler, in which an account is given of a very extensive series of tests made on that bridge.

During the summer of 1918 Prof. A. H. Fuller and the writer, under the direction of Mr. Fowler, made a very extensive investigation by means of the

strain gage, of the stresses in the 550-ft. double-deck arch bridge over the Niagara River at Niagara Falls. Stress measurements were taken on all the members of one-half of one arch, with the exception of one upper and four lower-chord members, and check readings were taken on a number of members in the other arch. In all cases readings were taken on the four corners of a member. At two upper-chord joints additional sets of readings for secondary stresses were made, as near the joint as possible, on all the members centering at these joints.

The instruments used were Berry strain gages. The gage length was 20 in. in all cases except for the readings near the joints; for these an 8-in. gage was used because the stresses are changing rapidly there and it was desired to find the maximum variation. The assumption made by the authors that the inflection point is § l from the joint is open to question.

The loads were specially-made-up trains of known weight and were placed in position for maximum stress in the member in each case. The loads remained stationary while the readings were being taken, thus eliminating all effects of impact and variation in time of taking the readings at a point. Secondaries were not computed theoretically but were estimated by comparison with the computed values for the Hell Gate arch, which is a similar structure. The estimated values thus determined and the measured values were plotted together and compared.

It is of interest to note that secondary bending stresses were found in the top chords in a horizontal direction as well as in the plane of the arch.

Permanent gage points were placed in a number of the members so that check readings can be taken at any future time desired.

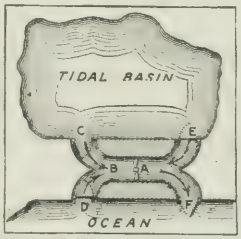
CLYDE T. MORRIS,
Professor of Structural Engineering, Ohio State University.
Columbus, Dec. 30, 1920.

Old New England Tidal Power Plants

Sir—I note on p. 1221 of your issue for Dec. 23, 1920, a description of a proposed tidal power project to be applied to the Severn River in England. From the specific periods of operation set forth it would appear that possibly the engineers are not making as full a use of the tidal flow as would be possible were a structure employed similar to that used many years ago in certain tide mills on the New England coast.

Referring to the accompanying sketch, the waterwheel at *A* is placed in a conduit *B* communicating at each end both with the sea and with the tidal reservoir. Suitable gates *C*, *D*, *E*, and *F* are provided and during the outflow the gates *C* and *F* open, supplying water to the turbine. At the same time the gates *D* and *E* automatically close. Similarly, during the flow of the tide, the gates *C* and *F* close and the gates *D* and *E* open, producing a flow through the turbine in the same direction as before.

Incidentally, electrical engineers will notice the marked similarity between



A TYPICAL TIDAL POWER PLANT

this structure and the ordinary rectifying circuit for use with electrolytic valves, suggested, I believe, by Nodon.

D. C. DAVIS.
Philadelphia, Pa., Dec. 29, 1920.

Soil as an Elastic Solid

Sir—In *Engineering News-Record*, Dec. 30, 1920, p. 1268, appears an interesting article, "Earth in Foundations Considered as an Elastic Solid," by Lazarus White. I have no criticism to make other than with that portion of the title (which I assume to have been written by the editor rather than the author) which refers to the theory of earth as an elastic solid as "new." I quote below from my discussion in 1907 before the American Society of Civil Engineers of a paper on "Earth Pressures and Bracing," by James C. Meem:

> Some time ago, after consulting all the available writings on the subject of earth pressure, and being unable to reconcile the results with his own observations, the writer became convinced that the common theory was erroneous and that no practical formula could be developed by considering earth (unless either so dry or so saturated as to flow) either as a granular or as a liquid mass, but that it must be considered as a solid body, the characteristics of which it possesses.
>
> This fact is important. It is utterly inconsistent with the theory for fluid pressure or that for a fine granular mass; but it is perfectly consistent if the earth is considered as an elastic solid body. This assumption may properly be made, as a mass of earth in its undisturbed state possesses the same properties of cohesion, weight, tensile, compressive and shearing strength, as does a mass of sandstone, but in much less amount.

These quotations, with the rest of the discussion, will be found in *Transactions*, Am. Soc. C. E., Vol. LX, June, 1908, p. 27, in that discussion earth was considered as an elastic solid and discussed from many viewpoints. The experience of over 13 years since then has but more firmly convinced me of the truth of the statements then made. In fact, were soil not an elastic body much of the immense structural work which has been successfully completed in and around New York City for a number of years would have been utterly impossible.

The principle involved is so important and has such far-reaching consequences that it is difficult to understand the lack of interest in the matter on the part of many engineers, especially when it is considered that much useful information could readily be obtained on many important pieces of public work.

There are certain phases of the case to which I called attention in a discussion of a paper by H. G. Moulton, presented before the American Institute of Mining and Metallurgical Engineers, Feb. 20, 1920, and similarly in my discussion of a paper by Mr. Meem before the Brooklyn Engineers Club, Feb. 12, 1920. There are other phases also, but the nature of my connection with the Transit Construction Commission in New York City, as well as being a member of the committee, to codify present practice on the bearing power of soils for foundations, appointed by the American Society of Civil Engineers, preclude my treating of them now—though I hope to later.

In addition to my calling attention to the matter Mr. Moulton has for several years been spreading the gospel up and down the land "as the voice of one crying in the wilderness," and only of late has he been heard. I am therefore forced to the conclusion that engineers read but little technical literature.

Mr. White, with whose work I am entirely familiar, is one of relatively few engineers who take immediate advantage of any useful suggestion in engineering, and the success of his work has shown close attention to the theory and technique of the profession. Granting that soil is an elastic solid the logical thing to do, as suggested by Mr. White, and adopted for several years past in his practice, is to retain the compression to which the soil is subjected in any test imposed, and not release it, and he deserves much credit for calling the matter to the attention of the profession. There is no more sense in releasing the pressure developed by a jack or other means beneath an underpinned foundation than there would be in letting go of a rope by which one were attempting to lift a heavy weight. The effect would be the same in both cases, that is, all the work must be done over again. The close attention to these small details, many of them fundamentally important, is what marks the difference in the measure of success between Mr. White's work and much similar work done by others.

E. G. HAINES.
New York, Dec. 31, 1920.

Russian Engineering Society

Sir—It may interest you to know that the Russian Engineering Society in the United States, with permanent address at 29 West 39th St., New York City, was founded in 1918.

Since the spring of 1920 it has been affiliated with the United Engineering Society through the American-Russian committee, a body subordinated to Engineering Council and consisting of three Russian and four American members.

The Russian Engineering Society in the United States is purely a profes-
fessional organization and counts amongst its 91 members many prominent Russian engineers in the United States. The society has organized its own employment bureau, the services of which are at the disposal of the prosional organization and counts among its 91 members many prominent Russian engineers in the United States. The society has organized its own employment bureau, the services of which are at the disposal of the profession.
fession. A. PAZDZERSKY,
Secretary, Russian Engineering in U. S. A.

New York, Jan. 3.

Other Weak Retaining Walls

Sir—The article by C. W. Cook, entitled "Retaining Wall Failure Predicted" in *Engineering News-Record* of Dec. 23, 1920, p. 1217, describes a wall that is similar to one that came under our observation about a year ago.

This wall was a curtain wall about 30 ft. high, 4 ft. 6 in. thick at base, resting on piling and anchored back by rods or wire rope to concrete blocks in the bank. These anchor blocks were placed back of the angle of repose, and in that respect and in the piling at the base the design was superior to the design shown in Mr. Cook's plan "B." The builders submitted to the owners a plan evidently in accordance with the owners' ideas, as they marked on the plan that the contractors "assumed no liability for the design of the wall." No engineer's name was attached to the plan, and we therefore felt at liberty to advise the owners, when the plan was submitted to us that the wall would not stand; we advised a radical modification of the plan, requiring a considerable increase in cost. The owners however decided to build the wall as designed, and it was so built.

We recently made an examination of the wall and found that the wall had bulged in places as much as a foot, and that it had then been reinforced by groups of piles in front of the wall, encased in concrete. These buttresses were about 6 x 8 ft., 30 ft. on centers, and extended to about 8 ft. from the top of the wall, making a very ugly harbor-line frontage. The wall with its buttresses must have cost more than a correctly designed wall, and it is still uncertain as to stability.

Other parties also advised that the wall would not stand, but as the owners had been eminently successful manufacturers during the boom they apparently knew more than any one, either engineers or contractors, and as it was their own money they felt at liberty to spend it as they pleased.

Retaining walls correctly designed and built will stand. Some walls have stood when the design was theoretically incorrect. This is due sometimes to the conditions that should have been expected not having been realized. I have in mind a division wall between two sections of a reservoir, the upper section being only half as deep as the lower section. With the upper basin full and the lower one empty, the resultant pressure line falls outside the face, and the wall should overturn. But it doesn't. It has stood for 25 years and is a fine job of ashlar masonry. Why doesn't it fail? My answer is that the masonry must have been built into the shale backing from the level of the lower basin to the bottom of the upper one so that the solid shale at the back of the lower half of the wall forms a part of the structure. The design does not, however, show this. If some "congeneer" should copy the design of the wall, and the backing condition were not similar, something might happen.

It is usual in the design of a gravity dam to design it so that the resultant pressure line falls within the middle third of the base. Some years ago there was built a dam in the mountains where the resultant line fell near to the outer edge. When the attention of the engineer was called to this he built an additional triangle of masonry at the toe of the dam anchored to the first work by shear rods. This was not done throughout the entire length of the dam, but dependence was on the earth in front of the dam. It still stands. Other dams more correctly designed have gone out. In this case, the workmanship and foundation were excellent and a cutoff wall at the upper side must prevent seepage of water under the face so that the uplift is negligible. Suppose someone builds a dam according to the original design. Would the eminent engineer who designed the first dam be responsible?

I once saw a retaining wall whose base was but about one-eighth of the height. It stood for 35 years and would have stood longer had it not been undermined. Examples such as the above are dangerous, not only by themselves but for the one who copies them without knowing the modifying conditions. Supposing the wall described by Mr. Cook is filled with granulated slag well compacted. The angle of repose might be 90° and the wall might stand, to confound engineering opinion.

N. F. HOPKINS,

Pittsburgh, Dec. 29, 1920.

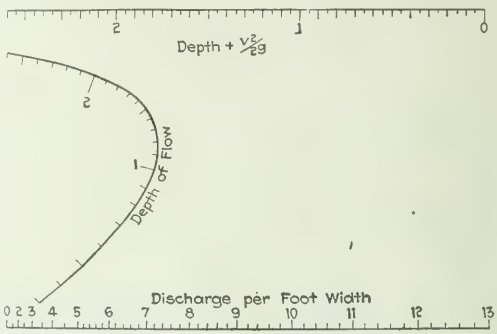
Another Nomogram for Cubic Equations

Sir—Mr. Okabe's nomogram for the solution of cubic equations (*Engineering News-Record,* June 24, 1920, p. 1249) is interesting, but complicated to use. A nomogram with one curved support can be made to give the solutions by direct reading. An example is given for the solution of a hydraulic problem. In the formula involved the coefficient of x is zero, but when that of x^2 instead is zero the nomogram is similar in form.

The full analytic method of constructing these nomograms is given in Chap. VIII of Prof. John B. Peddle's "The Construction of Graphs and Charts" and also on p. 187 of Prof. Ocagne's work on nomograms; p. 335 of the latter even gives a nomogram for solution of the full cubic equation containing all terms.

Graphic methods, as usual, afford some short cuts. So, in the present example, when there is no discharge $v = 0$, and each point of the scale for "depth of flow" will lie on the line connecting the zero point of the discharge scale to an equal reading on the full-depth scale.

It is worth while to draw such a nomogram only for problems that occur frequently. For general and casual use the writer has devised means of solving both quadratic and cubic equations on the slide rule.



NOMOGRAM FOR SOLVING CUBIC EQUATIONS

India, Oct. 25, 1920. CUSEC.

The Writing of Engineering Reports

Sir—Your correspondent in your issue of Dec. 23, p. 1248, seems to deplore the absence of instruction in the "King's English" in our technical schools. He seems to forget that the technical school is not a grammar school and that a thorough knowledge of English is a prerequisite for the successful study of an engineering course.

The lack of fluent expression in speaking and of logical arrangement in writing is painfully evident in the efforts of many engineers. The writing of reports and the making of oral presentation should be included in the technical course, but they should be incident to the subject pursued rather than a drill in English.

The use of clear and forceful English is the work of the preparatory school and to a great extent should be acquired before the technical course is undertaken. H. C. HODGKINS,

Syracuse, N. Y., Jan. 5.

NEWS OF THE WEEK

New York, January 13, 1921

Enlarged Appropriation for Reclamation Service

(Washington Correspondence)

Approval by the House of Representatives of the Sundry Civil bill carrying $20,277,000 for the Reclamation Service practically insures that amount for the work of the Service when the bill becomes a law. The bill still is to be considered by the Senate, but no reduction of the appropriation in that body is likely. By making available this large appropriation, a decided expansion of operation can be undertaken by the Reclamation Service. It will admit of nearly three times as much construction as is being carried on during the present fiscal year. The House made only minor changes in the bill as it was reported from the committee, among which was the elimination of the authority to continue the publication of the *Reclamation Record*.

The appropriation of $1,570,000 for the Boise project in Idaho makes it possible to construct a new unit on that project. An appropriation of $300,000 for the King Hill project in Idaho will make it possible to finish the work there. The item of $1,735,000 for the Minidoka project, Idaho, allows for the beginning of that work on an extensive scale. The appropriation of $1,017,000 for the Milk River project in Montana probably will allow for the commencement of work on a new reservoir. The same is true of the Sun River project in Montana, to which $687,000 is allotted. The item of $2,115,000 for the North Platte project in Nebraska and Wyoming will permit the inauguration of the important work of the Fort Laramie unit. The Newlands project, Nevada, is allotted $1,488,000 which will make possible the construction of a new reservoir. The appropriation of $1,213,000 for the Klamath project in Oregon and California will permit a very considerable extension of that project. A new reservoir at Tieton is the probable result of making available $2,100,000 for the Yakima project, Washington. The Riverton project, Wyoming, for which a small amount was allowed last year with which to start the work, now receives an appropriation of $850,000, which will permit of operations on a much larger scale. The Shoshone project in Wyoming is allotted $1,784,000, thus making possible the new Willwood unit. The only new project authorized in the Sundry Civil bill is the Deschutes project in Oregon, for which $400,000 is allowed to begin construction. The increased appropriations are derived from funds released by the General Storage Law.

Favors Another Panama Canal

According to newspaper reports, Secretary of War Baker favors the construction of a second Isthmian canal, either paralleling the Panama Canal or cutting through Nicaragua. He said he was opposed to the proposal to make the Panama Canal a sea-level canal.

It is stated that some of the authorities consider that traffic through the canal has reached such proportions as to make it only proper foresight to begin to think of an extension or duplication of its facilities.

Tentative Program for Road Builders' Convention

The tentative program for the eighteenth annual convention of the American Road Builders Association, to be held at the Coliseum, Chicago, Feb. 9-12, has been announced. Some of the discussions on the program, and the speakers, follow:

"Our National Road Problems," Thomas H. MacDonald, chief, Bureau of Public Roads; "Relation of the Highway and Motor-Transport Movement to Education," R. D. Chapin, president, Hudson Motor Co.; "The Highway's Part in the Development of Efficient Transportation," C. W. Reid, manager, transportation bureau, Federal Highway Council; "Subgrades," H. G. Shirley, secretary, Federal Highway Council; "Importance of Drainage in Road Construction," F. M. Eno, professor of engineering, Ohio State University; "Highway Research and What the Results Indicate," A. T. Goldbeck, engineer of tests, Bureau of Public Roads; "Highway Finance," H. C. Sylvester, vice-president, National City Co., New York; and, "Relation Between Engineers and General Contractors," D. A. Garber, Associated General Contractors of America.

One of the features of the sessions will be a mass meeting and smoker to be addressed by Governor Small of Illinois, and Mayor Thompson, of Chicago. A musical program has also been arranged.

Propose Bridge Over Ohio River at Evansville

Bills have been prepared for introduction in the Indiana and Kentucky legislatures authorizing the construction of a bridge across the Ohio River at or near Evansville, Ind. The projectors propose that each state shall contribute $1,500,000 and that the national government shall also share in the cost. E. H. Hyman, secretary of the Chamber of Commerce of Evansville, is one of the sponsors.

Public Works Association Makes Final Report

Under date of Dec. 30, 1920, C. T. Chenery, secretary of the National Public Works Department Association, made what is in effect a final report to the executive committee of the association. The practical termination of the work is indicated in the following paragraph: "The Federated American Engineering Societies by a vote of its council on Dec. 17, 1920, decided to carry on the work undertaken by its predecessor, Engineering Council, and to include therein the work of the National Public Works Department Association." The association ends its career in debt $14,902.18 to Engineering Council, which advanced $25,000 out of funds provided by J. Parke Channing. The amount on hand at present is $430.

The final report of Mr. Chenery recites in detail the history of the association and gives credit to the various individuals who aided it in its work. He also describes the progress of the campaign for a public works department, ending with the signing by the President of the Smoot-Reavis joint resolution providing that a committee made up of three Senators and three Representatives be charged with the duty of making a survey of the administrative branch of the government for the purpose of working out a general reorganization program. It notes the bill introduced by Senator McCormick, of Illinois, which provides for the reorganization of the executive branch of the government, and in particular for the creation of a department of public works substantially along the lines as laid down by the Jones-Reavis bill. This McCormick bill bears the number S. 4542.

Mr. Chenery's report has a final paragraph on the present situation regarding a public works department: "Either Senator McCormick's bill or the Jones-Reavis bill to create a department of public works is acceptable to this association. The former is perhaps the better of the two. It was drawn more than a year after the introduction of the latter and the framer had the benefit of the observations and of the criticisms which had been made. The most serious objection to the Jones-Reavis bill in the minds of many men is that it transfers various activities of education and public health to the Department of Labor. The McCormick reorganization bill handles this situation by setting up a separate department of public welfare and transferring these activities to that. The McCormick bill does not include in the department of public

works the Coast & Geodetic Survey or the Bureau of Standards. It does, however, include the Federal Power Commission, the War Minerals Relief Commission, and the Inland Waterway Service which were not included in the Jones-Reavis bill. Either bill will give a well rounded department and one satisfactory to the engineering profession. This is the legislative situation as it exists at the close of the year 1920."

Would Consolidate N. Y. State Engineering Offices

The message of Governor Miller of New York to the Legislature recommends the consolidation of a number of departments. Among them is one that is of interest to the engineering profession, the consolidation of the State Engineer, Superintendent of Public Works and the Commissioner of Highways.

This consolidation will require three years, as the Superintendent of Public Works is a constitutional office and cannot be consolidated before submitting a constitutional amendment to the people to be voted upon. The office of the Superintendent of Public Works was created in 1878, and provides compensation of $8,000 annually. The duties of the Superintendent are to execute all laws relating to the repair and navigation of the canals. The Department of Highways was reorganized in 1913 with a single head as Commissioner, for a term of five years at an annual salary of $10,000, to have general supervision of all highways and bridges of the state.

The Governor believes that the duties of these departments should be performed by the State Engineer, both from an economical and efficient view, inasmuch as the duties of the State Engineer are waning with the completion of the Barge Canal.

Growth of New York Rapid Transit Shown in Annual Report

An increase of 284,830,770 passengers carried during the year ending June 30, 1920, over the preceding year is indicated in the annual report of the Public Service Commission, First District, New York, submitted to the legislature Jan. 10, the principal feature of which is the rapid growth of traffic on the rapid transit lines of New York City.

On the Interborough Subway traffic increased from 461,147,058 in 1919 to 586,098,633 in 1920, or an increase of 27.1 per cent. Passengers carried by the Brooklyn Rapid Transit System increased from 308,879.791 in 1919 to 376,782,635 in 1920, an increase of 21.98 per cent. Traffic of the elevated lines increased 15.99 per cent and the Hudson and Manhattan Tubes 7.21 per cent. Traffic on surface lines in Manhaatan shows a decrease of 5.71 per cent and in Richmond 4.96 per cent. In Brooklyn and the Bronx travel on the surface lines increased.

Army Engineers Approve Potomac River Project

Acting under the order included in the Federal Water Power Bill passed last June, the Chief of Engineers, U. S. Army, has forwarded to Congress a preliminary report on the possibilities of developing the water power in the Great Falls of the Potomac, 18 miles above Washington, D. C. This investigation was in charge of Major M. C. Tyler, Corps of Engineers, U. S. A., but at the time Congress convened Major Tyler was ill and could not prepare his complete report. The Chief of Engineers, Major-Gen. Beach, therefore presented the report in preliminary form until Major Tyler's report was available.

The preliminary letter states that the estimates show that it is probable that the Potomac River will be more advantageous as a source of additonal water supply, which was also a part of the investigation, than the Patuxent. The conclusion has been reached that a power development of from 45,000 to 50,000 kw. is possible and that its cost will be such as to permit the delivery of intermittent power at a total cost, including all proper overhead and transmission charges, of about 5 mills per horsepower at substations in the city of Washington at a voltage of about 6,600. This estimate includes the cost of the high tension transmission line at three substations. The storage possibilities are found to be not very favorable unless an ultimate development of a total head of about 200 ft. is decided upon as desirable, thereby permitting the storage to be used twice, once in each stage of the development.

Work Started on Sacramento Water Filtration Project

Construction started Dec. 31 on the first or water-supply portion of the filtration project at Sacramento, Cal., the cost-plus contract for which is described on p. 77 of this issue. The work now under way includes the construction of (1) a pumping station 75 x 128 ft. in plan, housing both low-lift and high-lift motor-driven centrifugal pumps, having a combined capacity of 170,000 gal. per day. The pit in this station will be 75 ft. in diameter and 58 ft. deep, 38 ft. of the depth being below ground-water level; (2) a pair 30-in. steel pressure mains leading from the pumping station to the city's distributing system, 3,900 ft. distant; (3) a concrete structure in the Sacramento River serving as an intake tower which is to be 20 x 36 ft. in plan and 97 ft. high, with 64 ft. above the bottom of the river; (4) a pair of 5-ft. concrete intake conduits, 1,044 ft. long, leading from the intake tower to the pumping station's pit. These conduits are to be laid in open trench about 35 ft. below ground surface. Of this depth, 18 to 20 ft. is below the groundwater plane.

Because the equipment in the old pumping station, which is now serving the city, is reported to be of inadequate capacity and in a bad state of repair, this new work is being rushed to completion so that water may be delivered through it as soon as possible. Contract for the second or filtration portion of the new water-supply project is to be awarded next summer. The entire cost of the system will be approximately $2,500,000, of which the present work is to cost $1,035,000 and the remainder is to be used for the filtration contract not yet awarded.

The contractor for the work described is the Coast Construction Co., and the work is under the supervision of Bayly Hipkins, president. C. G. Gillespie is resident engineer on the work and C. G. Hyde is consulting engineer.

Detroit Postpones Action on Bids for Belle Isle Bridge

Action on the second set of bids for the construction of the Belle Isle bridge at Detroit was postponed indefinitely by the city council on Dec. 28. All of the first bids opened in November were rejected, as reported in these columns Nov. 18, 1920, p. 1015. Though Mayor Couzens urged that the contract for the substructure be let to the low bidder, a local contractor, the work was readvertised. Bids on this second letting were opened Dec. 17.

Councilmen who voted against letting contracts at the present time believe that a new bond issue should be voted on before any further contracts are awarded, inasmuch as the original bond issue authorized by the voters in 1919 provided for a bridge to cost $3,000,000, and the bids indicate that the bridge as planned probably could not be built for less than $4,500,000.

The council rejected all bids, but this action was vetoed by the mayor. The council thereupon voted to reconsider its action, and later postponed indefinitely any further consideration, which makes the situation similar to that existing before the mayor's veto. Mayor Couzens takes the attitude that it is the wish of the people that construction work on the bridge be started immediately instead of waiting until further bonds could be voted at the April election, which postponement would result in a year's delay in the completion of the bridge. He also has stated that the council's action in readvertising for bids when it was evident that the bridge could not be built within the $3,000,000 limit authorized, and then refusing to let the contracts, will discourage large contracting firms from bidding on this and other Detroit jobs and will deprive the city of the benefits derived from competitive bidding.

A communication has been addressed to the mayor by the Detroit Building Trades Council commending his action in the matter in advocating that immediate work be started. It is stated in the letter that all public projects should be carried on where possible to relieve

the conditions resulting from present unemployment.

Suggestions that the work be proceeded with by the city in event contracts are not awarded at this time do not meet with the approval of the head of the Department of Public Works, as that department is not provided with the necessary equipment to do the type of work involved.

Further consideration of the bids is expected, since the council's action temporarily prevents the return of checks submitted by the contractors with their bids. Of the eleven contractors who bid upon various sections of the work two contracting firms, the Gillespie Contracting Co., of New York, and the Keystone State Construction Co., of Philadelphia, bid upon the entire job. Esselstyn, Murphy & Hanford are the engineers in charge of the bridge for the city.

San Diego-Arizona Railroad Again in Service

Service on the San Diego and Arizona Railroad, which connects San Diego, Cal., with the Imperial Valley, was resumed on Thanksgiving Day. Construction on this road was completed about a year ago but after six months of operation a very extensive rock slide occurred in Carriso Gorge which tore out a tunnel and so effectively blocked the line that it has taken almost six months to clear the right-of-way again.

Highway Transport and Engineering Courses Offered

Short courses in highway transport and engineering are offered this month at Purdue University and the University of Michigan. At Michigan the courses extend from Jan. 10 to March 25 and comprise the subjects: Earth, sand, clay, gravel and broken stone roads; bituminous surfaces and bituminous pavements; the mechanism, operation and maintenance of motor trucks, tractors and trailers; brick, cement, concrete, stone block and wood block pavement; highway engineering, financing, administration and organization. The seventh annual Michigan conference on highway engineering and highway transport is held Feb. 21-25.

The Seventh Annual Road School at Purdue will be held Jan. 18-20, and comprises lectures and practical demonstrations.

A. R. A. Elects Officers

At the annual meeting of the Board of Directors of the American Railway Association in New York City, Jan. 6, Daniel Willard, president, Baltimore & Ohio R.R., was elected chairman of the board. Other officers are: President, R. H. Aishton; vice-president, W. G. Besler, president, Central R.R. of New Jersey, and Hale Holden, president, Chicago, Burlington & Quincy Ry., and general secretary and treasurer, J. E. Fairbanks.

Ontario Engineers Taking Steps for Registration

Steps were taken to further an engineers' registration law for the province of Ontario at the meeting held in Ottawa, Jan. 5, attended by members of the combined engineering organizations of Ontario and presided over by Charles Camsell, Deputy Minister of Mines. Engineers' registration acts have been passed in every province of the Dominion except Ontario, Saskatchewan and Prince Edward Island, and it is estimated that most of the practicing professional engineers of the Dominion are resident in Ontario, many being employed by the Dominion of Ontario governments and by the Ontario Hydro-Electric Power Commission. The meeting was addressed by Willis Chipman, consulting engineer, Toronto, and J. B. Challies, director, Dominion Water Power's Branch, who have been acting on the provincial committee of engineers formed to draft a registration law for Ontario.

Engineers Approve Licensing Statute

The Memphis, Nashville and Chattanooga chapters of the American Association of Engineers have approved a tentative bill that will be presented to the Tennessee legislature to convene in January providing for the licensing of civil engineers, architects and surveyors. The committee appointed to draft the bill follows: C. H. Olmstead, engineer, Nashville; J. G. Gaut, engineer, Chattanooga; C. E. Shearer, architect, of Memphis; W. M. Beer, engineer, Knoxville; and Henry Hibbs, architect, of Nashville.

Will Hold Hydro-Electric Symposium

On Friday, Jan. 21, a symposium on hydro-electric power and distribution is to be held under the auspices of the Engineers' Club of Philadelphia and the Philadelphia sections of the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. Two sessions are to be held, one at 2:45 p.m. and the other at 8 p.m., both at the Manufacturers' Club, and an informal dinner will be held at 6:30 p.m. at the Bellevue-Stratford Hotel. The program of the meeting includes the following papers:

"The Modern Hydraulic Turbine," by Frank H. Rogers, hydraulic engineer, I. P. Morris Dept., the William Cramp & Sons Ship and Engine Building Co.; "The Application of a New Method of Water Measurement in the Efficiency Tests of the 37,500-Hp. Turbines of the Niagara Falls Power Company," by Norman R. Gibson, hydraulic engineer, the Niagara Falls Power Co., Niagara Falls, N. Y.; "Surges in Conduits and Other Hydraulic Problems," by Raymond D. Johnson, consulting engineer, New York City; "The Present Trend of Hydraulic Turbine Development," by Lewis F. Moody, consulting engineer, I. P. Morris Dept., the William Cramp & Sons Ship and Engine Building Co.; "Niagara Falls Power Development and Its Products in Philadelphia" (illustrated), by John L. Harper, vice-president and chief engineer, the Niagara Falls Power Co., Niagara Falls, N. Y., and "Electrical Features of Hydro-electric Power," by David B. Rushmore, chief engineer, Power and Mining Department, General Electric Co., Schenectady, N. Y.

File on Huge Power Project on Colorado River

The Federal Power Commission has acknowledged receipt of an application filed by the Southern California Edison Co. of Los Angeles, Cal., for developing 2,500,000 hp. on the Colorado River. The plan is for a dam at Lees Ferry, about 800 miles from the mouth of the river, at a point where a 500-ft. dam would back up the water for 200 miles and provide a storage of 40,000,000 acre-ft. This site, which is above the Boulder Cañon site, and also above the Grand Cañon, will not affect the Grand Cañon or other sites within the National Park. A feature of the project is the control of flood waters and an increase of the area below that could be irrigated by Colorado River water from 750,000 acres to 3,000,000 acres.

Increase in New York Building Plans During 1920

According to the annual report of the Manhattan, New York City, Bureau of Buildings for the year 1920, compiled by Superintendent R. P. Miller, plans were filed for 783 new buildings costing a total of $96,199,860, as against 370 buildings costing a total of $72,283,061 during 1919. The most active month of the year was July, when plans were filed for 141 new buildings. Classification and cost of construction is as follows:

Number	Class	Cost
22	Dwellings	$1,503,500
22	Tenement houses	13,565,000
48	Stores and lofts	6,8[illegible]
81	Office buildings	14,658,100
23	Manufactories and workshops	500,000
1	Church	60,000
11	Municipal buildings	1,[illegible]
[illegible]	Hospitals	3,[illegible]
182	Garages	6,[illegible]
51	Other structures	403,892

Of these new buildings for which plans were filed the construction of 300 was commenced and 253 were completed.

Highway Labor in New Jersey to Suffer Wage Reduction

Beginning Jan. 16 wages of 500 to 600 men employed in the maintenance division of the New Jersey State Highway Department will be reduced ten cents per hour. This action was taken by the commission upon the recommendation of the chief engineer,

Thomas J. Wasser. The present wages of laborers range between 45 cents and 60 cents per hour. The reduction, it is estimated, will represent a saving of $200 per day.

Chicago Bricklayers Demand Pay Increases for 1921

Michael J. Faherty, president of the board of local improvements, Chicago, recently received notice from union bricklayers that an increase in wages was to be demanded for 1921, says recent press reports. Ordinary bricklayers ask $10 a day with time and a half for overtime and double time for Saturday afternoons and holidays. Other demands are:

Examining mason contractors, $275 a month; general construction foremen, $275; sewer foremen, $310; sewer repair foremen, $310; bricklayers in charge of gangs, $285; sewer inspectors, $275; mason inspectors, $235; junction setters, $235; brick and concrete foremen, $275; and foremen of brickwork in water-pipe extension work, $275.

Residential Construction Decline Marked in 1920

According to figures compiled by the F. W. Dodge Co., New York, the most conspicuous feature in the decline in building construction during 1920 was in residential building. In 1919 this class of construction represented 33 per cent of the total and in 1920 but 22 per cent. The amount of residential floor space contracted for fell off from 240,000,000 sq.ft. in 1919 to 140,000,000 in 1920.

Southern Pine Orders Lowest in Closing Week of 1920

For the week closing Dec. 31, 1920, 125 mills, members of the Southern Pine Association, reported orders aggregating approximately 33,000,000 ft. b.m., the lowest figure that was reported by the barometer of the association for the last quarter of 1920. The actual production of these mills was 74 per cent below normal, the shipments 57 per cent below normal production and the orders 62 per cent below normal production. The normal production of the mills is 86,000,000 ft. b.m.

Nominations for A. G. C. Offices Are Reported

The nominating committee of the Associated General Contractors of America has proposed the following candidates for office:

President, W. O. Winston, of Winston Bros. Co., Minneapolis; vice-presidents, to serve until 1924, F. L. Cranford, of F. L. Cranford, Inc., Brooklyn, N. Y.; Arthur Bent (to fill vacancy), of Bent Bros., Los Angeles, Cal.; treasurer, to serve until 1922, Lee Pascal, of Wise Granite Construction Co., Richmond, Va.; directors, to serve until 1924, Benjamin H. Hardaway, of Hardaway Construction Co., Columbus, Ga.; Noble Foster Hoggson, of Hoggson Bros., New York City; George C. Mason, of Hurley-Mason Co., Portland, Ore.; W. A. Starrett, of George A. Fuller Co., New York City; directors, to serve until 1923 (to fill vacancies), Richard McCarthy, New Orleans, La.; G. O. Muhlfeld, of Stone & Webster, Boston; John R. Wiggins, of John R. Wiggins Co., Philadelphia.

Pan American Labor Conference Opens in Mexico City

Samuel Gompers, president of the American Federation of Labor, with fourteen other representatives of American labor, are in Mexico City, where the third Pan-American Federation of Labor Conference is being held. Creation of harmonious relations between labor in the United States, Mexico and Central and South America is the object of the conference.

Trade Associations Advised to Correct Codes of Practice

In a circular letter issued Jan. 10 by the Building Trades Employers' Association of New York City trade associations, members of the employers' association, are requested to examine carefully their constitutions and by-laws and eliminate therefrom any provisions that, in the light of the recent investigation made by the Lockwood committee on housing, might render such trade associations subject to criticism. If these trade associations have adopted codes of practice they are requested to discontinue them unless it is felt the associations are acting absolutely within legal rights. If the latter is the case the employers' association asks that codes of practice be presented by representatives on the board of governors at the next regular meeting of the board.

The letter from the employers' association also maintains that it has the right to make agreements with labor unions, and "until such time as another method is found by which a more amicable relation with labor can be established the Building Trades Employers' Association will continue to deal with unions as it has in the past, always endeavoring to strengthen its power and influence for the promotion of the building industry and the protection of the interests of owners and investors, not only in the city of New York but throughout the entire country."

The employers' association points out that there is nothing in either the constitution or by-laws of the association, or orders of the board of governors, that is contrary to law or in any way conflicts with public policy or the best interest of society, citing its constitution, which provides: "Nor shall there be any action on the part of this association to control or in any way deal with prices or restrict competition."

The Building Trades Employers' Association believes that the building industry is confronted with more serious problems than it has faced since 1903.

Sand Dealers Plead Not Guilty to Trust Charge

Five of the sand dealers of the metropolitan district of New York who were recently indicted by the Federal Grand Jury in violation of the Sherman anti-trust law appeared Jan. 3 before Judge A. N. Hand, of the Federal District Court, and entered pleas of not guilty. Bail of $5,000 was fixed in each case, and nine days were allowed the defendants in which to file demurrers or take other action.

Broader Powers Proposed for Lockwood Committee

The Lockwood Legislative Committee on Housing, which has been investigating housing conditions in New York City, is to be invested with broader powers if the plans of the committee's counsel prevail. There has been drafted a resolution, now in the hands of the New York Legislature, empowering the committee to grant immunity from prosecution to certain witnesses, and to inquire into the management of insurance and banking institutions.

Special Federal Counsel Provided for Building Exposé Cases

The Attorney-General of the United States has appointed William Rand and Isador J. Kresel, New York City attorneys, as special assistants to the Attorney-General. They will take charge of all cases under the Federal statutes, civil or criminal, developing from building trade investigations.

Annual Meeting of U. S. Chamber To Be Held April 27-29

Announcement was made Jan. 11 that the ninth annual meeting of the U. S. Chamber of Commerce will be held at Atlantic City, N. J., April 27-29.

Housing Problems to Feature U. S. Chamber's Council Conference

Interchange of information and a general discussion of housing conditions will mark the conference in Washington of the national council of the United States Chamber of Commerce, Jan. 27-28. The tentative program announced by the chamber includes discussions on all phrases of national as well as sectional housing problems.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Junior Engineer and Deck Officer, U. S. Coast and Geodetic Survey, $2,000 a year increased to $2,240 after one month of satisfactory service. Examinations to be held Feb. 9-10 and April 13-14, 1921.

State of Idaho

For application blanks apply to Bureau of License, Boise, Idaho.

Surveyor. Examination to be held March 1, 1921.

Civil Engineer. Examination to be held March 8, 1921.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Jan. 19-20, 1921.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; New Orleans, Feb. 9-12.

The Michigan Engineering Society will hold its annual meeting Jan. 25-27 at the Wayne County Building, Detroit. The secretary is C. B. Huff, 6017 Grand River Ave., Detroit, Mich.

The Indiana Engineering Society will hold its forty-first annual meeting at the Claypool Hotel, Indianapolis, Jan. 27 and 28. Several of the sessions will be joint meetings with local sections of other organizations.

The Engineers' Club of Little Rock, Ark., at its noonday meeting Dec. 18 decided to recommend to the General Assembly a bill providing that no person, firm or corporation will be allowed to execute any job of land surveying, engineering or architectural work in the state except under a certificate from an engineering board showing qualification.

The Michigan Engineering Society will hold its annual meeting Jan. 25, 26, 27 at Detroit. The speakers for Jan. 25 are Hon. John Lodge, Hon. A. J. Groesbeck, Charles Wood and Dean George W. Bissell. For Jan. 26 the following topics and speakers are announced for the morning session: Major Theo. Leisen on "Detroit's Filtration Plant," H. H. Esselstyn on the "Bell Isle Bridge" and John Reid on "Grade Separation in Detroit." The program for the afternoon consists of inspection of the Belle Isle Bridge, the water-works pumping station and sewers. The evening meeting will be addressed by Prof. Arthur Blanchard. There will be a discussion on highways by Frank F. Rogers, State Highway Commissioner. The Jan. 27 morning session will be addressed by L. K. Sherman, R. C. Bailey, Dr. Vaughn, Health Commissioner, Detroit, and Alexander Dow. The business session will be held in the afternoon.

The San Francisco Section, Am. Soc. C. E., held its annual meeting on Dec. 21. The following officers were elected for the ensuing year: President, F. R. Muhs, vice-president San Francisco Bridge Company; vice-president, Thomas H. Means, irrigation engineer; secretary-treasurer, Nathan A. Bowers, Pacific Coast editor, *Engineering News-Record*. There were present about one hundred and thirty members and guests who listened to a symposium on hydro-electric development consisting of three illustrated, twenty-minute talks as follows: "Economic Aspects of the Present situation," Wigginton E. Creed, president, Pacific Gas & Electric Co.; "Modern Hydraulic Equipment," E. C. Hutchinson, chief engineer, Pelton Water Wheel Co.; "Successful Methods On Rush Construction," Rex C. Starr, construction engineer, San Joaquin Light & Power Co.

The Illinois Drainage and Rivers Improvement Association will hold its annual meeting Jan. 18-19 at Springfield, Ill.; secretary, G. W. Pickels, Urbana, Ill.

The Albany Society of Civil Engineers at its meeting Dec. 21 elected the following officers: President, Alexander R. McKim; vice-president, Walter H. Mansfield; second vice-president, C. H. Wood; third vice-president, Joseph A. Murray, Jr.; secretary-treasurer, John W. Henry; librarian, Carl O. Ullrich.

PERSONAL NOTES

ARNOLD B. MACSTAY has resigned as street cleaning commissioner, New York City, and has been appointed deputy commissioner of public welfare.

GEORGE E. TEBBETTS, formerly with the construction and engineering division, Stone & Webster, Boston, Mass., has resigned to become associated with the Roberts & Schaeffer Co., engineers and contractors, Chicago.

LEE RILEY, consulting engineer, Leavenworth & Fort Leavenworth Water Co., Leavenworth, Kan., will continue in charge of the operation of the works which are to be taken over by the city early in 1921 and operated under the supervision of the Commissioner of Water and Street Lighting.

E. M. ARNOLD, recently engineer, Boone County, Ky., has accepted a position as assistant division engineer, Second District, State Highway Department of Georgia.

LLEWELLYN N. EDWARDS has resigned as senior highway bridge engineer, Bureau of Public Roads, to become bridge engineer for the Maine Highway Commission, Augusta, Me.

ORES E. PARKS, formerly town engineer, has been appointed superintendent of highways, sewers and water-works of the Department of Public Works for Westfield, Mass., recently incorporated as a city.

JOHN H. HEINTZ, formerly assistant engineer of the Newport Levee District, Ark., has engaged in the stationary and office supply business in Oklahoma City, Okla.

B. B. SHAPIRO, for the past five years with the architectural firm of Holabird & Roche, Chicago, most recently as chief engineer, has engaged in private practice in consulting and designing structural engineering with offices at Chicago. During his connection with Holabird & Roche he was designing engineer for many office buildings and industrial enterprises in Chicago.

SAMUEL J. HUMES, for four years engineer of King County, Wash., will, upon expiration of his term, become a member of the engineering firm of Parker-Gould Co., Seattle, Wash.

D. O. LEWIS, formerly district engineer, Vancouver Island division, Canadian National Rys., has been appointed engineer maintenance of way, Canadian Northern Ry. east of the Great Lakes, with headquarters at Toronto.

J. H. REDDING, assistant superintendent, Pittsburgh division, Pennsylvania R.R., has been appointed superintendent, Wheeling Terminal division.

HARRY THOUROT, recently connected with the Hudson County Engineer's office, has been appointed town engineer, Union Hill, N. J.

L. P. O. EXLEY, office engineer, Mobile & Ohio R.R. at St. Louis, Mo., has been appointed office engineer, Gulf, Mobile & Northern R.R. at Mobile, Ala.

L. B. DUTROW has resigned as chief engineer, Atlantic Coast Realty Co., to enter private practice in engineering and land surveying with offices in the Roper Building, Petersburg, Va.

E. W. SYLVESTER has resigned as superintendent of public works and city engineer of Poughkeepsie, N. Y., to enter the Pennsylvania State Highway Department.

GEORGE F. WHITMORE, engineer in charge of jetty work at Eureka, Cal., has been ordered to San Francisco by Colonel Herbert Deakyne, district and divisional engineer, to act as his assistant on river and harbor works.

WILLIAM H. PENFIELD, engineer of track maintenance, Chicago, Milwaukee & St. Paul Ry. since 1913, has been appointed engineer maintenance of way, with headquarters at Chicago.

PHILIP L. PRATLEY, mentioned in these columns last week, is in charge of the bridge section of the Montreal office, Department of Railways and Canals, Grand Trunk Arbitration. R. A. C. Henry is the department engineer in charge of the project.

H. L. THACKWELL, formerly hydraulic engineer, Anaconda Copper Mining Co., on the Andes project in Chile, S. A., has accepted the position of hy-

draulic engineer for the Royal D. Salisbury Co. of New York and Denver.

DORSEY W. HYDE, JR. has left the transportation engineering division, Packard Motor Car Co., to become assistant manager of the recently created Civic Development Department, Chamber of Commerce of the United States, Mills Building, Washington, D. C., of which John Ihlder is manager.

J. O. BOAKER has resigned as engineer in the timber and land department, Southern Pine Lumber Co., to become city manager of Lufkin, Texas.

F. LAVIS will resume his independent practice as consulting engineer at 120 Broadway, New York, specializing in transportation developments, especially in those relating to foreign countries. He has been retained by the American International Corporation, with which he has been associated since its inception.

GEORGE W. CUTTING, JR., recently engineer, production department, Atlantic Corporation, constructors of steel cargo ships, Portsmouth, N. H., has resumed private practice at 10 Post Office Square, Boston, specializing in property development, landscape engineering, drainage, sewerage, road location, surveys, investigations and reports, superintendence of construction.

F. W. AUSTIN has been appointed city engineer of Chanute, Kan.

WILLIAM T. FIELD, consulting engineer, Watertown, N. Y., has opened an office at 296 Broadway, New York City, and will specialize in industrial, hydraulic and municipal engineering work.

G. H. PALMES, Cimarron, N. M., has been appointed superintendent of the Cimarron & Northwestern Ry.

MANUEL C. CUTLER, for four years bridge engineer, has been appointed superintendent, Bridges and Public Buildings Department of the Department of Public Works, Milwaukee, Wis.

JOHN KLORER has been appointed city engineer of New Orleans, La.

GEORGE W. BOSCHKE has been appointed assistant chief engineer for Lines West of Ogden, El Paso and Portland, with the Southern Pacific Co., Pacific System.

JOHN N. CARLISLE, former state highway commissioner, New York, has been elected president of the Northern New York Utilities, Inc.

COLONEL GLENN S. SMITH has secured his discharge from the army and has resumed his position with the U. S. Geological Survey as topographic engineer in charge of the West Indian surveys.

NORMAN J. HOWARD, bacteriologist in charge of the filtration plant of the city of Toronto, has resigned to become manager of the water-works department, General Supply Co. of Canada, Ltd., with headquarters in Ottawa.

W. E. SELBY has been appointed assistant engineer of Tarrant County, Texas.

COL. FREDERICK F. CLARKE has been apointed chief land surveyor for the Canadian National Railways and is organizing a land surveys department.

MAJOR PHILIP H. SHAFFER has been appointed engineer of Somerset County, Pa.

L. W. DUFFEE has resigned as chief engineer, Gulf, Mobile & Northern R.R., to enter general practice with office at Laurel, Miss.

CARL NYMAN, formerly resident engineer, State Road Commission, Utah, has resigned to enter private practice in general engineering in the coal fields of Carbon County, Utah, with headquarters at Castlegate.

OBITUARY

ROY BULLEN, civil and mining engineer, died Dec. 24 while on his yacht near Florida. He was born in Richmond, Utah, 1877. In 1903 he was inspector of steel concrete construction at Harvard Stadium. During 1904 he acted as assistant in the engineering department Massachusetts State Board of Health, Boston; 1905, tutor in hydraulics, Harvard University; June, 1905-1906, Engineering Aid, United States Reclamation Service, in charge of canal construction on Minidoka and Payette-Boise projects, Idaho. From 1906 to 1908 he conducted railroad location surveys and mine surveys at Salt Lake City, Utah, and later at Rosebud, Nev. He was later mine superintendent, White Alps Leasing Co., Rosebud, Nev. In 1909 he reentered private practice in civil and mining engineering, Salt Lake City. Later he was general agent, Grand Trunk Ry., Minneapolis, Minn.

J. E. KENNEDY, C. E., died at Owen Sound, Ont., Jan. 1. He was 68 years old and had been city engineer of Owen Sound and also of Vancouver, B. C.

ROBERT C. SATTLEY, valuation engineer, Chicago, Rock Island & Pacific Ry., died Dec. 31 at Oak Park, Ill. He was born in 1856 at Ferrisburg, Vt. and was graduated from the University of Vermont in 1879. From 1879 to 1884 he was with the Northern Pacific Ry., advancing from the position of rodman to that of assistant engineer. In 1884 he was assistant engineer, Oregon Pacific Ry. In 1885 he became assistant engineer on location and in charge of construction, Northern Pacific Ry. From 1885 to 1907 he was with the Chicago & Northwestern Ry. as assistant engineer, superintendent of bridges and buildings and division engineer. During the following year he served as assistant engineer for the State of Minnesota and later was locating engineer, Denver, Laramie & Northwestern Ry. in Colorado, and for the St. Louis & San Francisco R.R. in Texas. In July, 1909, he was appointed valuation engineer, Chicago, Rock Island & Pacific Ry. and continued in the employ of this company until his death.

BUSINESS NOTES

THE CHICAGO PNEUMATIC TOOL CO. announces the appointment of J. F. Huvane as Eastern manager of compressor and engine sales with headquarters in New York City. G. C. VandenBoom has been appointed Western manager, with headquarters in Chicago.

CHICAGO BRIDGE & IRON WORKS announce the opening of a new sales office in the Forsythe Building, Atlanta, Ga. Joseph L. Zeller, for several years with this company, will be in charge.

THE NATIONAL LIME ASSOCIATION, Washington, D. C., announces the appointment of Laurance E. Hart, C. E., as manager of the construction department and Dr. Major E. Holmes, manager of the chemical department. Mr. Hart's experience includes six years on the New York State Barge Canal. His most recent engagement was construction sales engineer with the Lakewood Engineering Co. Dr. Holmes was for nine years research engineer for the National Carbon Co., Cleveland, Ohio, during which time his experience extended to most of the departmental duties of a manufacturing plant.

THE TROJAN POWDER CO. has taken over and will conduct the entire business heretofore conducted by it and its associated companies, the Pennsylvania Trojan Powder Co., the California Trojan Powder Co., and the Trojan Chemical Co., Inc.

THE GOULDS MANUFACTURING CO., Seneca Falls, N. Y., manufacturer of pumps, announces the appointment of Edward S. Jenison as acting sales manager to succeed W. E. Dickey, who is retiring from business. For the past five years Mr. Jenison has been manager of the company's Philadelphia office.

THE CUTLER-HAMMER MFG. CO., Milwaukee, has opened a branch office in the Railway Exchange Building, St. Louis, Mo., which will be in charge of Harold Phillips, recently manager of the Chicago office.

A. J. WHIPPLE has been appointed general sales manager of the Republic Truck Sales Corporation of Alma, Mich.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

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Thrift Week

THIS is Thrift Week. Led by the Y. M. C. A. the nation's thoughts are being especially directed toward saving and, its corollary, intelligent spending. The lessons to be inculcated have a general applicability; therefore, we make no apology for referring to the subject here. In fact, engineers and contractors, as leaders and employers, have an opportunity to impress upon others the need of thrift. Possibly the idea that most needs to be hammered home is that every one *can* save. It requires planning and self-denial—and, as a rule, far more planning than self-denial. Carelessness, lack of system, are more to blame for our poverty than any other causes. Two of the Y. M. C. A.'s "Ten Financial Commandments"—make a budget and record expenditures—would, if generally applied, have so wide reaching an effect as to change, we believe, the whole economic attitude of the nation. Budget making and balancing are of the essence of good business. They more quickly give one an idea of the methods of conducting a successful business, a successful society, a successful home than any thing we know. True, they touch only the material side of life, but they are a necessary basis, without which the spiritual and sentimental sides are likely to suffer serious disturbance.

Reinforced Concrete in Sea Water

IT IS CUSTOMARY to assume that the defense against sea-water attack of reinforced concrete is a deep embedment of the steel and a good, dense concrete. The present condition of the southern California pleasure piers, noted on another page, gives at least a partial confirmation of this. That is, there is no doubt that the lightly covered steel is the source of primary failure in those structures, but whether the "good dense concrete" would save the situation is open to question. Certainly the concrete in these piers is not poor concrete; in fact, as ordinary surface inspection goes it is, as a rule, distinctly first class. Yet the corrosive salts penetrate to the steel to the ultimate failure of the structure and the behavior is so consistent that one doubts whether an inch or two more embedment would save the situation. The evidence in this case, and in that of the Boston Harbor test pieces also noted, is valuable mainly as an addition to the accumulating facts regarding sea-water concrete. There is no absolute quantitative rule yet to be laid down for such concrete, for the data are not altogether consistent, but it seems safe to say that concrete can be made that is proof against a destructive attack by sea water of the concrete itself but that it is extremely difficult to make it dense enough to protect against corrosion any steel which is near enough the surface to be of value as reinforcement. The better part of judgment would be not to use reinforced concrete of the articulated type which requires slender members in any ocean structure.

Embargoing Railroad Credit

A SERIOUS condition of railroad credit was brought out last week at hearings before the House interstate commerce committee on the bill directing the Treasury Department to make partial payments of amounts due the carriers covering the guarantee period from March to September, 1920. While it is acknowledged that at least $300,000,000 is now due the railroads the treasury has ruled that it can only make payments upon final certification by the Interstate Commerce Commission of the totals due. The commission itself favors partial payments on the basis of minimum acknowledgment of indebtedness, and several of the commissioners urge the passage of a bill authorizing and directing the treasury to make such payments. Many carriers have already found themselves unable even to meet operating exepenses, i.e.; bills of supply and material manufacturers. The government owes the Pennsylvania system more than $40,000,000, and the railroad as a result cannot pay a large number of its bills covering materials for current use. Another road has over $20,000,000 withheld. The falling off of traffic and the consequent reduction of net earnings—only 3.5 per cent of the valuation, as indicated by the November figures of Class 1 roads—have increased the strain on the carriers' credit, so that not only the railroads suffer, but also their creditors and the banks that have had to assist in carrying the burden. The construction industry has a direct interest in the situation for no large sums for construction work (capital account) can become available until the credit of the roads is improved by their ability to pay accounts already overdue. The effect of the Treasury Department's ruling against making partial payments on account, however necessary from the legal viewpoint has been to embargo railroad credit. It is hoped that there will be speedy relief through early passage of the pending bill.

A. G. C. Meeting

UNTIL the war showed the necessity for a nation-wide organization of contractors there was not the whole year through a meeting of the contracting branch of the construction industry that was comparable to the place which the annual meeting of the American Society of Civil Engineers holds in the engineering branch of the field. Merely to mention the matter is sufficient to indicate that that was a deplorable condition. The Associated General Contractors are but two years old. The organization has subordinate member bodies—consisting of associations of local contractors—in some fifteen cities, one of them in Canada. It has divisions devoted to the problems of contractors specializing in building, highway, railroad and public-works construction. It is functioning vigorously. Committees are working on the standardization of practices; others are concerned with the major problems of con

struction organizations. Obviously, the scope of such an association is broad. There are difficult problems in connection with labor, with materials, with transportation, with finance, while legislation requires close watching. All of these things are included in the vision of the organization. It should in a few years produce results in the contracting branch of the construction industry that will compare favorably with the organized work in the engineering branch. Furthermore, it affords an agency through which important co-operative work can be done. The New Orleans Convention next week should mark a further important step in its work of getting settled to its important tasks.

Emergency Service

RESISTANCE to the impact of a train wreck such as displayed by the Georges Creek bridge, whose repair is described in this issue, is not often called upon, yet its value is obvious. In fact, such resistance is expected of a bridge. Failure of a bridge under a wreck will cause engineer as well as layman to think that the structure was not quite all that it should have been. Consciously or unconsciously, we do demand of bridges that they be sturdy enough to resist abnormal attack of this kind; a fair-weather bridge is not enough for the needs of railroad service. While bridge design does not have emergency service in view, yet specifications that do not produce structures with adequate resistance to such service will fail of proper effect. It may well appear surprising that existing bridges do possess this extra strength and sturdiness, since designers do not take account of possible emergencies nor do current specifications and standards of design make allowance for them. Where does the extra resistance reside? Partly, no doubt, in the safety margin! but if this were the sole or even the most important source of robustness or "toughness" of a bridge, then equal resistance should be expected from different types of structure, which is against all practical experience. The designer's instinctive foresight and seasoned judgment are decisive factors in making a structure sturdy. In the end, however, these factors must be translated into more concrete terms and suitable principles incorporated in our standards of practice. Present specifications and standards are immature, in so far as they do not specifically assure resistance to emergency attack. Indeed, if the short paneling and the stubby proportioning of the members of the bridge in question contributed to its surviving the violent battering it received, then recent specifications tend away from a desirable type, since they give preference to designs with low secondary stress ratios and therefore discourage the use of a design such as represented by this structure. Both the requirements of emergency service and those of normal service demand consideration in fixing standards of practice, and in some instances the former may claim controlling weight.

A Reconnoissance Only

TOO LARGE a subject for a single evening made the discussion before the New York Section of the American Society of Civil Engineers on Jan. 13 no more than a reconnoissance of "Water Supply and Sanitation in the Metropolitan District, Including Sewage and the Disposal of Solid Wastes Such as Garbage, Ashes and Snow." (See p. 104.) Perhaps only a reconnoissance was intended, but if so should not the usual more detailed survey follow, especially in the fields of waste disposal?

Dr. Soper—perhaps as an exaggeration to challenge discussion—virtually accused engineers of having failed to do their duty in sewage disposal and of having left the disposal of garbage and other solid wastes a virgin field. The subsequent discussion, especially that of Messrs. Hazen, Whipple and Fetherston, went far toward clearing engineers of the charge of neglect in these fields. Certainly engineers have responded when they have been given a chance to solve any or all of the various sewage and waste disposal problems, classing each—as has also the public to a large extent—according to its vital importance and its relative claim upon limited available municipal funds. Lack of time and the minor position of garbage disposal on the program were perhaps responsible for the fact that the previously uninformed person who attended the meeting must have left the hall with no conception of the vast amount of solid engineering work that has been done in the fields of garbage incineration, reduction and hog feeding, both in the Metropolitan district and elsewhere; nor of the fact that today the garbage of nearly all the large cities and many small ones is being utilized by reduction or feeding; nor of the blundering way in which New York City has been handling garbage disposal for the past three years—because it has cut loose from common sense and good engineering and has been led nowhere by will o' the wisp inventors and promoters.

To devote an evening to sanitary problems in the Metropolitan district and not bring out such facts at a time when New York City seems ready to plunge into almost any untried method of garbage and refuse disposal shows how much too large for a single evening was the topic discussed on Jan. 13. For the present the larger questions of water supply in the Metropolitan district are either solved or else in competent hands; sewage disposal for the most part can wait, if need be; but garbage and refuse disposal, more especially in New York City, needs to be put back in the hands of engineers competent to handle it—not because of any great menace to health but as a matter of efficiency.

The Uniform Vehicle Law Conference

THE National Conference on Highway Traffic Regulations labored for three days at Washington last week and brought forth a set of "general principles." In their avoidance of specific statement they closely resemble the usual political platform planks which "commend" and "deplore" in a flood of generalities without binding canditates to any real definite performance. Too much stress, therefore, should not be placed upon the approval of the general principles of a uniform vehicle law. That action means merely that agreement could not be reached on the definite form of bill which had been prepared.

It was a good deal to expect that such diversified bodies as state highway departments, automobile organizations, police departments, electric railways, agricultural equipment associations, trailer manufacturers, insurance companies and others could, in a three-day session, unite in their approval of a specific form of law. The discussion showed that the demands of three powerful groups—the highway, the automobile and the agricultural bodies—would have to be reconciled before general indorsement could be secured.

As a matter of fact, the work proposed for the conference had, in large part, been done before. Last year a joint committee, representing state-highway and motor-vehicle organizations, drafted a uniform vehicle law, of which between 30,000 and 40,000 copies have already been distributed to state legislatures, chambers of commerce and other civic and public bodies. This joint committee practically agreed on all of the provisions except the gross weight of vehicles, including loads, and the point at which the width of tire should be measured. The uniform law which that committee prepared was designed to cover the field in a workable and practical manner and has been of considerable value as a guide for legislation.

What then was the reason for the Washington conference? While somewhat more voluminous the model law submitted at Washington is substantially a repetition of the joint committee's law. On the vital questions of weight, size, speed and license fees the conference draft added nothing new.

In the corridors one heard frequent inquiries regarding the motives of the conference and references to the danger of taking action which might be construed as an attempt to make compulsory by legislative act the use of certain patented automobile accessories. In the joint committee's proposed law arm signals only are prescribed for operators intending to turn or stop their machines. The Washington draft provided that such signals "shall be given either by the use of the hand and arm or by use of a mechanical or electrical device." This section was not reached in the discussion of the Washington measure, but an amendment was proposed providing specifically for the use of illuminated number plates on motor vehicles.

There was a well-defined feeling that the meeting was a "rump convention," an attempt by Western interests to "jump" a claim already staked out by the joint committee previously referred to. It is true that thirty national and regional organizations were represented at last week's conference, but one could not escape the impression that some of them were present chiefly to watch what the other fellow was doing, rather than to unite in an effort to produce a new uniform vehicle law. Certainly it is significant that the committee on future activities brought in a report objecting to the creation of any new organization to continue the work of the conference and recommending that the conference should adjourn without provision for future meetings. This action probably disposes of the "National Conference on Highway Traffic Regulations" once and for all—which is just what we believe should have been done with it.

The Antioch Plan

THE Antioch Plan, set forth in this issue by its originator, Arthur E. Morgan, chief engineer of the Miami Conservancy District and president also of Antioch College, is certain to attract much attention in educational circles. Not only does it undertake to train for administration and proprietorship in the small college, but it challenges the theory upon which the small college is, as a rule, conducted. To the usual liberal-arts curriculum he opposes studies with the aim of preparing for a definite place in life; to the multiudinous courses of most small colleges he opposes a few courses, all contributing to a specialized product. The plan includes engineering courses, and therefore will interest engineers. Moreover, it was proposed by an engineer after making what may be termed an engineering analysis.

Much interest has been displayed in recent years in courses in business, in administration, and in administrative engineering. The Antioch scheme differs from these in that it proposes not merely to tell its students about proper methods of management and administration, but by the content and spirit of the courses, supported by co-operative work in industries, give them the confidence and poise necessary for administration and proprietorship. The theories of the two kinds of courses are radically different.

But it is not merely in attempting to prepare for administration and proprietorship that Mr. Morgan's plan opposes the educational ideas of the day. It challenges the theory that the small college should be an epitome of the large institutions. Save for the small colleges under strong religious control, notably those under Catholic auspices, they try to pattern after the universities. Their courses run the whole gamut of liberal-arts education. In opposition to this practice Antioch proposes to specialize.

To our mind the theory underlying the specialization plea is sound, while the analogy drawn between the factory and the college stimulates the sort of analysis that throws into relief the reasons for difficulties of the small college. Further analyses of this sort would probably introduce much differentiation in the courses of the smaller institutions.

To the engineer the challenge that the Antioch plan gives to present methods of engineering education is no less interesting than the broader challenge put to the educator. Mr. Morgan's engineering courses involve a new conception of the training of the engineer. They assume that there is a demand for men who need not have the capacity to design the most intricate structures nor to conduct research work, but who have a reasonable acquaintance with the methods and theories of engineering, combined with the point of view of the administrator. To some extent this concept is found in the courses in administrative engineering at the larger technical schools, but Antioch carries its thinking to a practical conclusion—by combining theoretical and practical work in engineering and business.

Contrast to present methods of teaching engineering is further emphasized by Mr. Morgan's description of the students of the larger universities as a mass product. Certainly mass-production methods are used. The courses are designed to produce a certain finished ideal, to be turned out at the end of a four-year course, neglecting entirely what may be the proper equipment for those who will leave at the end of the first, of the second, or of the third year. Under the mass-production plan the needs only of those who are certain to be graduated can be considered.

To the term "mass product" there will, of course, be objection. That Mr. Morgan expects. In fact, the whole purpose of his article is to put the new idea before engineers and engineering teachers, to the end that the reactions may be helpful in producing at Antioch a solid contribution to American educational methods. Challenges to present theories and practices, particularly when backed by remedial proposals, always have, if discussed with open minds, a beneficial effect.

Repairing a Railway Bridge Damaged by Train Wreck

Span Shifted Longitudinally by Impact of Derailed Train and Many Members Damaged so as to Require Replacement or Straightening—Work Done Under Traffic—Distorted End Post Straightened with Jacks

By Clyde B. Pyle
Engineer, McClintic-Marshall Co., Pittsburgh

DERAILMENT of the locomotive of a loaded coal train last August resulted in serious damage to the floor system and trusses of two 150-ft. double-track through riveted spans at Georges Creek Junction, near Cumberland, Md. The train, loaded with coal, was coming east and by some unknown cause had acquired a high speed on the down grade approaching the bridge. The locomotive was derailed at a frog just beyond the bridge and the cars piled up behind it. About 35 cars lodged on the bridge, as shown by the view Fig. 1. They did most damage to the south truss and floor of the near span, leaving the north trusses so little damaged that it was considered and proved to be safe for trains to run on the westbound track after the wreckage had been removed. Subsequently the damaged parts had to be replaced or repaired, under traffic; the methods of doing this work are briefly described in the present article.

FIG. 1. LOADED STEEL COAL CARS PILED UP ON TWO 150-FOOT BRIDGE SPANS

The effect of the wreck on the floor and stringers may be judged from the view Fig. 2. The two main end hangers and one post at center were cut entirely off and the other post at center was held by only one leg of one angle. The diagonals and sub-members were badly damaged. All web members of the one truss except the upper part of the two middle diagonals were in such condition as to require replacing.

The stringers and the upper half of the floor beams were badly twisted and bent. Most of the stringers had to be renewed; a few merely had the top flange angles renewed. In all floor beams the top flanges were renewed, and in most cases also the top half of the floor-beam web, from stringer of the westbound track to the south truss, was replaced by a new web section and the necessary splice plates.

The force of the train against the floor beams was so great as to move the span longitudinally about 6 in., against the adjacent span. The brackets carrying the track outside of the end floor beams came into contact with such force as to buckle them. The bottom chord of the south truss moved about 2 in. more than the north truss of the same span, but the top lateral system, retarding the movement of the top chord, distorted the outlines of the truss. The bending of the web members further distorted the chords, thereby changing the camber of the lower chord. Near one end it was about 1 in. low and near the other end about 1 in. high. One hip was lowered and the other raised.

The distortion of the truss made replacement of members a rather complex problem. When the two new posts and new end hangers were put in place, they were connected at both top and bottom, but the diagonals were connected to the upper chord only, until the truss should be brought back to shape. The camber was made *nearly* correct by wedging the lower chord on a few bents of falsework (Fig. 3), but it was found impossible by several wedge jacks to bring it back to what it had been originally. The truss was then jacked back longitudinally about 2 in., which brought it into correct position relative to the other truss; this made the camber practically correct. The holes in each of the diagonal connections now mismatched those in the gusset plates by ¼ in., but driving about eight driftpins in each point simultaneously brought the holes to match and the truss proved to be back to its original shape.

Before this work on the diagonals, it was found in placing one of the middle posts that the chords were too close together to make the holes. Two 12 x 12-in. timbers with 60-ton hydraulic jacks were placed between the chords, and the falsework under the floor beam (this

FIG. 3. REPAIR ALMOST COMPLETED: FALSEWORK IN PLACE

end of the floor beam being connected to the lower chord only) was lowered to clear the chord. With a considerable load, probably 80 tons, on both jacks, the rivet holes did not match well enough to allow pinning them. Then a locomotive was brought on the floor beam, and the holes came to match. It is rather remarkable that the floor beam with one end connected only to the chord, and with a heavy load at this end, would carry a locomotive.

It may be interesting to note that the original truss, built by the company with which the writer was connected, which also carried out the repairs, was assembled and reamed before shipment. Therefore there was some doubt as to how the new web members should be fabricated to assure enough leeway in adjusting the rivet holes in the field and yet not delay erection, as it was desired to replace each member between trains. The longest interval available, two hours, would give far too little time to place the members with small holes and to ream, pin and bolt without delaying traffic. It was therefore decided to punch the holes $\frac{13}{16}$ in. (for $\frac{7}{8}$-in. rivets) and simply run a $\frac{15}{16}$-in. reamer into them to clear away the bad metal. This plan of reaming to full size in the shop proved successful in that about 80 per cent of the holes matched the old holes almost perfectly, and none mismatched by over $\frac{1}{16}$-inch. Straightening the end batter post (Fig. 4) under traffic and without falsework was done by means of a jacking rig, shown in Fig. 5. Old 24-in. plate girders with 6 x 6 x $\frac{3}{4}$-in. flange angles, to which were fitted cover plates made from old stringer webs, were held by four 2-in. bolts and field-made channel yokes. Small screw jacks and a 60-ton hydraulic jack were used to do the straightening. Long bends came out rather easily with about a half dozen screw jacks, each of about two tons capacity. Burning out the outstanding legs of the post angle, bolting on temporary straps as in Fig. 5, and using the 60-ton jack, made it possible to take out the shorter bends readily. A heavy diaphragm was put in the center of the member, running from the lower batten plate to the upper end of the sub-hanger. After this diaphragm was well bolted and pinned, the corner angles were replaced one at a time by the new ones.

FIG. 4. BENT END POST

In cutting apart the old steel, the surfaces riveted in contact in the shop were found to be clean close to the rivet holes, but farther away about two-thirds rusted and one-third covered with shop paint or the dust resulting from burning the paint by the rivets. The rust was very slight, although the bridge has been in place about ten years. The field connections were free from rust around the rivet holes where there was perfect contact, but the balance of the surface was almost entirely covered with very slight rust; here and there was an indication of paint. This rust was very slight, and was not more than that of the mill scale. There was no evidence anywhere of continuous rusting, pitting or damage or danger of increase of rust beyond a mere film. As a matter of interest it might be stated that bridges of 30 to 35 years' service on the Southern Ry. taken out under the writer's direction showed about the same rust conditions as on this bridge. It is evidently caused by rain before the field paint is applied, and becomes no worse because the moisture is eliminated by filling the cracks and crevices with field paint. This seems to confirm the belief of some engineers that painting of field splices is unnecessary.

FIG. 2. DAMAGED FLOOR AND TRUSSES

Straightening of steel in place proved to be work of decidedly different character under different conditions. Where the bend was so slight that the steel was not actually stretched it was readily jacked straight or bent

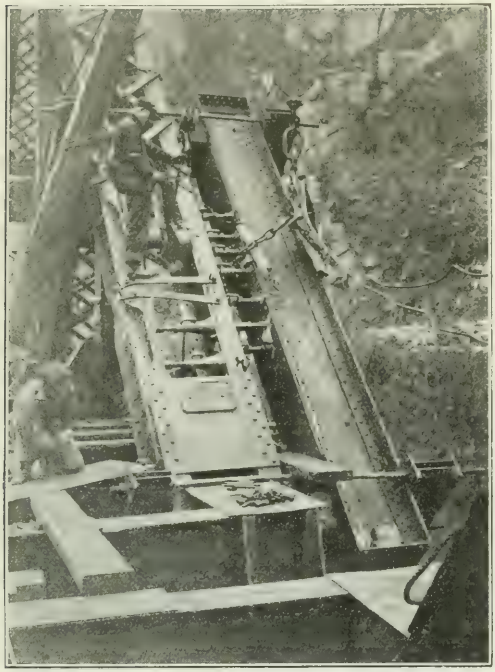


FIG. 5. STRAIGHTENING THE DAMAGED BATTER POST

by heavy mauls or a rail ram. If the steel was heavy, ¾ in. thick or over, and was bent so as to be stretched, it could not be straightened even after heating moderately with an oil torch. When the attempt was made to straighten an angle by heavy forcing, it was apt to bend as a whole in the perpendicular direction, so that it was necessary to replace everything that was bent far enough to cause perceptible stretch.

Combating Increase of Fire Hazards

Fire protection men were aroused recently by the publication of a series of articles in a popular woman's magazine on home dry cleaning, in which the use of gasoline was recommended and discussed in a way that threatened to result in greatly increased fire hazard throughout the country. To counteract the possible harmful effect of these articles, W. E. Mallalieu, president of the National Fire Protection Association, has prepared an article on the hazard of dry cleaning in the home, which is to be published shortly in the same magazine and is expected to draw general public attention to the dangers attendant on the free use and storage of gasoline in dwellings. A somewhat similar increase of the home fire hazard was threatened by the action of another periodical in offering as a premium to boys for obtaining new subscribers a home moving picture machine, which would bring nitrocellulose motion-picture films into the home without the safeguards prescribed for film theaters. Protest was made to the journal by the National Fire Protection Association, and as a result the journal has withdrawn the moving-picture machine from its premium list.

Trend of Highway Development —A Survey

Pennsylvania's Practice

THIS IS THE ELEVENTH *of a series of articles on highway practice. It discusses chiefly the policies of proceeding with paved road construction despite market prices, of creating permanent organization for highway service and of maintenance to serve year-round traffic.*

The twelfth and last article of the series will appear in next week's issue.—EDITOR.

PAVED highway construction was pushed to the limit of possible production in Pennsylvania in 1920. Prices were not permitted to curtail the mileage placed under contract if a traffic need for paved road was evident. With 681 miles of construction brought forward from 1919, contracts were let for 346 additional miles of pavement, making a total of 1,027 miles under contract. Of the mileage under contract 420 miles were completed. Both the contract mileage and the completed mileage are the greatest recorded for any state.

DEVELOPMENT POLICY

A study of highway practice in Pennsylvania indicates the following process of thinking prevailed: Need is superior to cost; if a highway is needed, go into the market and buy that highway. Need is measured in commodity units and cost must be measured by the same units. So long as paved roads cost no more in commodity units, bushels of wheat or tons of iron, in post-war than in pre-war times, their construction is warranted. With funds provided by bond issues, construction of none but highly improved roads, promising a life as great as the life of the bonds, is justified. With these fundamentals esablished, the logical policy is to plan a system, keep to that system and build as rapidly as possible. For construction, the first requirement is complete elimination of political interference with business administration. The next step is organization; build up an organization as does a great manufacturing industry or a great railway company.

Warrant for the policy followed last year, of paving the greatest mileage practicable, is found in the need for paved roads. Briefly, this need, at least for the main traffic routes of the state, was valued at more than the market price. This was a valuation which most other road-building states refused to accept. Therefore, Pennsylvania was virtually alone in 1920 in freely undertaking contracts for highways of the first class. Attack or defense of this policy is not in order at this time, but the policy has to be noted as one of the facts which stand out in the trend of highway development.

CONSTRUCTION AIDS

A policy of service to the contractor accounted in large measure for the volume of work done. This service was rendered first through the testing laboratory, which prospected local sources of materials and advised the contractor on their utilization. A service of more immediate value, however, was in securing transportation. Both aids were developed to a higher degree of perfection than is customary.

Materials investigations, although only one of the duties of the testing laboratory, are conducted with the

most careful attention to their practical usefulness. Locations and extent of deposits and their suitability for road construction are determined closely, but the survey goes farther and determines all the local conditions which affect pit or quarry development and transportation of the product. Neither the quantity nor the continuance of quality is guaranteed and the contractor is expected to determine himself all facts affecting development, equipment and transportation, but the records of the laboratory investigations are open to him as are the opinion and advice of the laboratory engineers.

Transportation of construction materials for highways was last year about 75 per cent efficient; about three-quarters of the required service was provided. Two circumstances aided in this accomplishment. One is that practically all of the road materials can be provided by intrastate hauls. The other is that about 50 per cent of the service required can be provided by a single railway company, which has adopted the broad policy of actively assisting highway improvement. All traffic, nearly, being intrastate, car orders for road materials were secured through the Public Service Commission as described in *Engineering News-Record*, Sept. 23, 1920, p. 612.

Organization Highly Developed

Co-ordination of transportation service with the requirements of many scattered construction operations was effected by the traffic officials of the highway department. This was quite as important a factor in the success of the service rendered as were car orders and the disposition of the railways to help. It was made possible by that thoroughness of organization which characterizes the Pennsylvania highway department.

Particulars of the organization of the department cannot be given here. It has been built up on the assumption that highway service is a continuing business of great size which will increase in magnitude. With this conception, complete organization machinery is essential; administrations may change and policies may alter, but a working organization is basic. Policy, finance, research, design, construction and maintenance in all their phases are provided for in the organization now operating.

This organization operates on the theory that all information is open to reasonable inquiry. Its records are kept in unusual detail and also in a form which permits essential facts to be visualized and appraised quickly. For the latter purpose graphs have been developed to present all the main facts. They have proved of signal service in the internal activities and in presenting facts to the public.

Maintenance is considered even superior to construction in importance. Its purpose is to keep the highway structure as nearly as possible in its original perfection, and in usable condition the year around. The fact that snow removal has been carried farther than elsewhere is an illustration of the latter purpose. A year's records of maintenance operations show 315 miles resurfaced, 1,400 miles treated with bituminous surfacing, 4,000 miles of surfaces kept in repair and 6,175 miles of earth roads maintained. This program involved an expenditure of $7,000,000 and an average organization of 4,000 men.

Preparedness, system and the development of machine methods are considered the essentials of successful maintenance. Materials for the succeeding season's work are delivered on the highways in fall and winter. When materials are shipped in quantities to justify it, unloading plants are installed at the sidings. Motor trucks have replaced teams for hauling. Large crews for spreading covering materials in bituminous-treatment operations have been eliminated by the adoption of mechanical spreaders hauled by small tractors and trucks, which can also be used for hauling. In earth-road maintenance fleets of tractors operate the road graders. A material reduction in the number of men required for maintenance has resulted from these methods.

Snow removal is considered an established maintenance duty. Both removal proper and means for preventing drift formation are employed. The task is one of careful organization and detailed methods and will be described in a future issue of *Engineering News-Record*.

Research and Design

Only permanent construction is considered justified on main traffic routes. Permanency of subgrade is fundamental. In the paved road work of 1920, over 45 per cent of the money was expended in producing permanent grade. In subgrade design attention is given particularly to drainage, soil capillarity, compactability of soil and soil treatment to reduce moisture effects. Designs are changed from point to point on each road, as conditions require. As an example, the standards of the department indicate half a score of drainage ditch plans for regular use as the conditions may indicate.

To assist in perfecting design the testing laboratory is making a study of cores taken from all kinds of pavement in service. Where these cores were removed the pavement is kept open for a study of subgrade moisture conditions. Service studies are given preference in all research work.

In a word Pennsylvania's practice in 1920 is based on the following assumptions or principles: (1) The need of improved roads is superior to questions of cost; (2) organization is a supreme necessity in highway improvement; (3) maintenance is secondary to no other highway activity.

Methods of Eradicating Moss from Canals

Seven ways of combatting moss and plant growth in canal systems are given in the November *Reclamation Record* (Washington, D. C.) by George E. Stratton, project manager, Milk River Project, U. S. Reclamation Service. He queried several project managers on the subject and gives his own experience. Muddy water seems to be of doubtful value. Hand methods work on a southern project. Drying out the canal and letting the sun kill the growth works when there is time. Submarine saws are successful in some places but not in others where the moss is not stiff enough to be cut. Dragging with a spring-tooth harrow is effective but disturbs a soft canal bottom. Dragging a chain is the most practical method used by Mr. Stratton. About 33 miles of canal were dragged with a chain made of 1¼-in. reinforcing bars with 18-in. links. The cost was $9 per mile. A special harrow with knives set at an angle used on one project was abandoned for submarine saws. Copper sulphate has proved successful on concrete-lined canals. It does not work so well in earth canals.

Water Supply and Sanitation in the Metropolitan District of New York and New Jersey

Discussion Before the New York Section of the American Society of Civil Engineers Deals with Water Supply, Sewerage, Refuse Disposal and Snow Removal

CONTINUING its monthly discussions of engineering problems that confront New York City and its nearby neighbors, the local section of the American Society of Civil Engineers had for its topic "Water Supply and Sanitation in the Metropolitan District, Including Sewage and the Disposal of Solid Wastes, Such as Garbage, Ashes and Snow." President W. J. Wilgus outlined the program and introduced the speakers. The opening address by George A. Soper and those portions of the other addresses that dealt with sewage, refuse and the snow problem are abstracted below. The discussion on water-supply will be summarized in a later issue. —EDITOR.

Opening Address

By George A. Soper
Consulting Engineer, New York City

TO INSURE a sanitary environment is the paramount problem which faces New York and its vicinity today. We have now a population of about 10,000,000 people in a confused mass of cities, towns, villages, boroughs, counties and states. There should be some system of co-ordinated government over the great metropolitan population. There should be definite systems of water supply and sanitation devised and administered without the embarrassments which now result from the hundred separate political parts into which this territory is divided. From some standpoints it would be an advantage if the district were to be separated from the states of New York and New Jersey in which they are now located and consolidated into a separate state—perhaps a free port.

Although water supplies may properly be considered under the head of sanitation, I submit that the problem of how we shall get rid of our wastes is a much more pressing problem at the present time than how we have procured our water. The waste problem is completely unprovided for, while the water supply as it exists today represents a high stage of technical perfection. We have scores of engineers in New York whose professional careers have been almost exclusively devoted to our water supplies and they could talk about what has been done through many long and interesting evenings. But there is hardly one in this great metropolis who has ever been called upon to devise a system for the collection and disposal of refuse and it is toward the satisfactory disposal of our wastes that I think our attention should be chiefly directed. What I have to say, therefore, is largely on the sanitary side of the title, confidently expecting that others will sufficiently speak about the water.

A strange apathy seems to possess the public with respect to the conditions under which our sewage and solid wastes are disposed of. We have become indifferent to our dirt.

Sanitation: Making A Place Healthful

The usual definition of the word "sanitation" is the science and art of making a place healthful. In its broad sense it includes the elimination of unwholesome swamps and other natural conditions which favor disease. In order to confine this evening's discussion to a practical basis, I am using the word sanitation as though it applied only to the removal and disposal of the waste products of our municipal inhabitants.

There is no question but that New York must look forward to the expenditure of large sums of money upon its sewers as well as upon the disposal of its sewage. Common prudence as well as economy demand that provision be made without further delay for this work. What is needed cannot all be done at once. The city should adopt a program of work based upon carefully prepared plans. All reconstruction should conform to these plans.

It was officially estimated that in the year 1910 the population of the Metropolitan District emptied into the Harlem each year the equivalent of 12,000,000 tons of sewage sludge, having a bulk of 14,000,000 cu. yd. It goes without saying that the amount of this polluting material is increasing rapidly. The volume of sewage being discharged into the lower East River was 246,000,000 gal. a day in 1910 and it was estimated that by 1940 it would be 454,000,000 gal. The Harlem River was receiving 99,000,000 gal. a day in 1910, and for 1940 would receive 253,000,000 gal. These two arms of the harbor, called rivers, but neither of them rivers but tidal straits, with about as much water flowing in one direction as the other, have been found to be the most seriously polluted of all the water highways in the Metropolis, and—a point of considerable significance—they are at the centre of our population. It is impossible to sanitate them on the easy principle of mere removal, for if the sewage were to be dumped somewhere else this would only shift the nuisance from one point to another. Already there has been too much of this shifting.

Realizing that the question of sewage disposal in the Metropolitan District needed careful study, the State and City of New York provided for a commission of engineers to thoroughly overhaul this subject. That was nearly fifteen years ago. It was hoped that New Jersey would appoint a similar body and that the two would work out the common problem of properly protecting the harbor in a spirit of neighborly good-will. New Jersey did not appoint a commission; New York went ahead alone.

The Metropolitan Sewerage Commission was composed of four engineers, all Members of the American Society of Civil Engineers, and one physician. It existed in efficient form for six years. Three large reports were published: the first set forth the insanitary conditions which the commission discovered to exist; the second proposed a standard of reasonable cleanness for the Harbor waters; the third provided general plans for the work which it would be necessary to construct in order to attain the standard.

What New York Should Do With Its Sewage

Briefly, the City ought to construct main drainage works consisting essentially of intercepting sewers, to gather the sewage from the present outfalls and carry it to suitable points for disposal. For the most part, the disposal work would consist of mechanically operated screens and settling basins. From these the clarified effluent would be discharged into the Harbor through long outfalls placed at the bottom of the deepest and most swiftly flowing channel.

Having acomplished what it was created to do, the Commission went out of existence. All interest in the subject seems to have expired with it. The City did not adopt the recommendation to start the work at once. New York is not improving its sewerage or sewage conditions to any considerable extent, but it at least knows what it ought to do.

Turning to the third and last division of our subject, we must take up the second class of wastes to which I referred some time ago and sketch the way in which this question is handled. It is not an agreeable task, for there is little that is commendatory about it. It is the crudest and least developed of all our great sanitary undertakings. It has never been erected to the dignity of an engineering enterprise, but has been likened to a contracting business. Certainly contracts play an important part in the disposal of the material.

Ocean dumping [the means of disposal for the bulk of the

garbage of New York since the present city administration caused the shut down of the new Staten Island reduction works—EDITOR] cannot properly be called final disposition. When the garbage of New York is dumped even as far as fifteen miles outside of the farthest limits of the harbor, it produces a nuisance along more than seventy-five miles of the New York and New Jersey shore-lines. The City has some incineration plants which burn small quantities of the wastes which are produced locally.

From the report of the Department of Street Cleaning, for the last year for which a report has been printed, it appears that the aggregate quantity of materials collected in 1918 were: ashes, 5,314,315 cu.yd.; garbage, 664,432 cu. yd.; rubbish, 3,089,395 cu. yd.; or 9,068,142 cu. yd. in all. About one-sixth of this is collected by private carts hired at the expense of those who produced the waste. The largest item was ashes, the removal of which from buildings other than private residences is not compulsory upon the city.

GARBAGE, ASHES AND REFUSE OF OVER 6,000,000 PEOPLE

The collection and disposal of solid wastes in New York is the function of the Street Cleaning Department so far as the Boroughs of Manhattan, Brooklyn and the Bronx are concerned. In Queens and Richmond this work is done under the borough president. In 1918 the department exercised jurisdiction over the solid wastes of a resident population of 5,377,456 persons and of about one million transient inhabitants.

The expenditures of the department are largely for labor. In the year 1918, $6,460,168, or about two-thirds of the total cost of the department, was for services. In 1919 the department spent, roundly, $13,000,000. This was about 5 per cent of the total cost of the city government, and nearly two dollars apiece for all the inhabitants of the city. Only two departments cost more—Education, and Police. If we add to the costs just given the cost of private scavenging, the expense incurred in removing steam ashes, and trade wastes, and consider the cost of removal and disposal so far as these are accomplished in the rest of the Metropolitan District, the total will amount to a surprisingly large figure. It is probably no exaggeration to say that the inhabitants of the Metropolitan District spend nearly $20,000,000 a year to get rid of their wastes, without getting any return or having their wastes properly disposed of.

The removal of snow from the streets is done under the supervision of the Street Cleaning Department. It is unsatisfactory from every standpoint, not least from the standpoint of the department itself. The crux of the difficulty lies in the uncertainty and infrequency of the snowfall. It appears to be impracticable to make suitable provision for the work beforehand. A great force of laborers must be assembled at short notice and the handling of these men with the supervisory staff which is available involves problems of administration which would be exceedingly difficult to cope with under any imaginable circumstances.

The snow is removed from the most important thoroughfares. It is shoveled into piles and then into carts and wagons, and hauled to the waterfront or to some convenient sewer for disposal. Often it becomes necessary to break up the compact and frozen masses of ice and snow with pickaxes. Plows have been used successfully to open ways for traffic when the snow is soft. Snow-melting machines have been repeatedly experimented with without success. Flushing the snowy streets with water has been found useful under some circumstances.

A FIELD AWAITING DEVELOPMENT

There is a general feeling that the removal of solid waste costs too much. The apparatus is obviously crude and the work inefficient, speaking generally and without particular reference to New York or any other municipality. The undertaking is generally lacking in spirit and in the interest which attaches to successful enterprises where large numbers of men are involved. In the opinion of some, there is lack of system, of method, of purpose. It has been claimed that too much dependence has been placed upon hand labor, and that there is not enough plant and equipment of a high grade of efficiency.

The subject of solid wastes is full of possibilities for development. So far as the technical side is concerned, the inventor has a virgin field, if the metaphor may be pardoned, in this connection. The practical statistician could hardly wish a better opportuunity for the exercise of his ingenuity, in showing how economies can be introduced. The expert administrator has an opportunity to show how the work can be systematized in greater loyalty, and skill stimulated.

But there is a less promising side. A natural repugnance unquestionably attaches to the whole subject of waste disposal. Looking into the future, it is impossible to see how any great improvement can be made in the work of removing the solid and liquid wastes of our houses and streets, and disposing of them properly, so long as the public views the subject with the aversion with which it is commonly regarded.

The whole subject of collecting and disposing of our solid refuse needs to be taken carefully into consideration. A commission of qualified engineers should be appointed, with a view to ascertaining the details of the problem to be solved and laying down the fundamentals of the correct solution. It would be easy to make a list of topics to which this commission could give attention. If possible, the commission should include the whole of the Metropolitan District in its scope. The results would be of value to the whole country.

The object should be not to find what is wrong, but what is right, to make what is good, better, and to prepare a plan and program of development which will put this city and this district upon a basis of enterprise and efficiency with respect to sanitation, such as already exists in regard to its water supply. When this is done, and not until then, can we call ourselves sanitary.

Other Discussions

GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University

IT MAY be that the New York metropolitan district will some day have the twenty or thirty million people which Dr. Soper suggests, but I cannot help feeling that the years are not far distant when its rate of growth will materially decline and when declining growth will make the financial problem one which will overtop all others—that of sanitation included. With this future in mind as more than a possibility I believe that whatever is done toward improving present sanitary conditions and preventing future ills must keep the cost of such projects well to the front. But parsimony is not economy and preparedness is as necessary in sanitation as in war.

A stream being gradually polluted loses its dissolved oxygen little by little until it is almost gone. Suddenly the oxygen disappears and almost overnight the stream changes to a black liquid reeking with foul gases. This has happened in the past in Gowanus Canal, Newtown Creek, and the Passaic River. It will happen in the Harlem River if the pollution continues to increase and no relief is given. Will it happen in the East River and the North River? Probably not, or at least not for a great many years, except perhaps locally in spots.

The supply of oxygen brought into the harbor from the ocean is enormous. The oxygen absorbed by the water from the air is very great, and the law of absorption is that the greater the depletion the more rapid the absorption. Analyses and studies which I have personally made have convinced me that the absorption of air by the water is much greater than has been often estimated. Nevertheless, it is possible for pollution to so press upon available oxygen as to cause the critical limit to be passed. It is therefore a matter of fundamental importance that the city keep account of the natural oxygen resources of its harbor water by systematic analyses made at many places, at different depths and at all seasons, so that future conditions can be predicted with enough certainty to anticipate needed engineering works. The Metropolitan Sewerage Commission made a beginning of such a study and some work has been

done ever since. It is important that this be established on a sound and permanent basis.

In spite of all that may be said as to local nuisances around the rivers and harbors, and they already exist; in spite of the occasional oily films on the harbor water which are derived from industrial works more than from the sewers; in spite of windrows of debris from shore and shipping; in spite of a certain dullness of the water due in part to sewage but even more to the silt with the Hudson River contributes, the fact remains that New York and her neighbors on the water front are very favorably situated with reference to sewage disposal. There is not at present a serious pollution problem in the harbor. What the inland cities and towns suffer may be seen from Newark. It would be a fine thing to take all of the New York district's sewage far to sea, but it would be unwarrantably expensive. Some day, and perhaps at no distant future, some of the sewage ought to be taken out to sea; but how much, and how far, and where, and at what cost are questions to which answers have been attempted but to which no satisfactory and convincing answer has been given.

In solving the coming problems of sewage and industrial waste disposal in and around New York there will be some regions where treatment of some sort prior to removal may be necessary. It would be wise, therefore, for the city to maintain a permanent experiment station for the study of these problems. But so far as the treatment of the bulk of New York's sewage is concerned, I cannot refrain from quoting what the late Frederick P. Stearns once said to me, "If you are going to dump sewage at sea, the less you do to it the better!"

I believe that New York should continue to take advantage of the natural receptive conditions which the ocean and the harbors provide in the interest of much needed economy, but that she should closely watch these conditions and make sure that relief sewers and such other works as may be necessary are actually ready for use by the time they are needed.

I agree with Dr. Soper that the disposal of solid refuse is more difficult than that of sewage. My investigation of the Staten Island garbage project convinced me also that engineers have not given the subject the careful attention which they have paid to sewage disposal.

The treatment of garbage and the recovery of byproducts have unfortunately been chiefly in the hands of private interests who, if published statements are to be believed, have pocketed their profits, bragged of their losses, and kept their accumulated knowledge of the subject to themselves. The result is that scientific knowledge as to what garbage can be made to yield in the way of byproducts is not as great as it will have to be before the problem of ultimate disposal is solved. It is essentially a problem for the combined thought of the chemist and the mechanical engineer. I agree with Dr. Soper that a really serious experimental study of the problem of refuse disposal should be made. In these days when plague has been brought by rats and fleas to our American cities the garbage problem looms larger as a health measure than it did a few years ago. Until an adequate study has been made our city governments will flounder as they have in the past and continue to hand over the problem to companies which, very naturally, will put profit making above public service.

It has been my fortune recently to travel in the Orient, and one cannot observe the dense populations there, the reduced natural resources of the land, the lack of animals, and the universal use of human excrement as a fertilizer without reflecting on the awful waste of nitrogen which is taking place in the cities of our Western civilization, and without wondering what may be the food conditions in America a number of centuries from now. It is not a pressing problem, that of utilization of nitrogen and fats in sewage and garbage, but it is one which should be kept in mind. We throw sewage with its nitrogen and fats into the sea because at the present time it would cost more to recover these substances than they are worth in the market. That may be economically sound, but, nevertheless, it is a waste which some day must be corrected. In designing disposal works for New York, this ultimate salvage problem should be kept in mind. To throw garbage into the sea, when we do know how to recover valuable byproducts, is a sanitary crime. Some better solution should be found.

In the consideration of the sanitary needs of the communities in the New York Metropolitan District there are three mutually dependent variables which always have to be considered—size, comfort, and cost. In small communities comfort, which implies health and agreeable conditions of life, can usually be procured at a reasonable cost. In large cities comfort can also be procured, but only at increasing cost. The question for the New York Metropolitan District to solve is this: Can comfort be secured at a cost which the people can afford to pay? If the limit is approached, will it mean abandonment of comfort in order to maintain solvency, will it mean repudiation of debts, or will it mean limitation of growth? If the modern city cannot stand the economic strain, it will fall. Ex-Mayor McClellan [New York City] once pointed out that when the tax-rate reaches the normal interest rate, the taxes become confiscatory.

In the consideration of all these problems the financial element must of necessity control. Relative values must be studied and then, with fixed appropriations determined by economic considerations, a dollar must be made to buy just as much health and comfort and beauty as possible.

ALLEN HAZEN
Consulting Engineer, New York City

THE sewage problem of the New York Metropolitan District has not been overlooked by engineers. For instance, both the problem and its solution was admirably outlined by Dr. Soper's commission. It should be remembered that from the viewpoint of sewage disposal New York City is one of the most advantageously located cities in the world, being surrounded by large bodies of moving water which in themselves and by their power of surface absorption from the air have immense oxidizing powers—powers which increase with the growth of pollution. There are points of excessive pollution, notably along the East and the Harlem rivers; but the population in the lower East River section is decreasing. The pollution studies being carried on by Kenneth Allen should be continued so as to learn what to provide for in the future. Summing up, the fact is that neither the good people in general or the good engineers of New York are convinced that the time has arrived for radical action on New York's sewage disposal problem.

J. T. FETHERSTON
Formerly Commissioner of Street Cleaning, New York City

FROM a population of 10,000,000 in the Metropolitan District about 17,000,000 cu.yd. of refuse (ashes, garbage, rubbish, street sweepings) is produced annually. On a peak day in winter 80,000 cu.yd. of refuse will be removed and disposed of by various methods. That this work is being accomplished daily without undue public turmoil means that a systematic procedure is in force, even if the methods employed do not conform to the highest standards of sanitation and economy. There is no doubt that a great opportunity exists for improvements in handling the solid wastes within the Metropolitan area. To minimize dust, litter, odor and nuisances attending the handling of the refuse is as important as to reclaim the $10,000,000 market value of the waste materials. Here, certainly, is a great problem which will test the serviceability of engineers, chemists, organizers, managers, business men and politicians.

Engineering commissions have studied and recommended methods for treating the solid wastes from the three big boroughs of the city. Colonel Waring, over twenty-five years ago, inaugurated the methods in use today. Messrs. Parsons, Hering and Whinery [with Dr. Soper providing a survey and report] in 1908 advocated the same general methods. In 1912 a committee of the Board of Estimate and Apportionment (Messrs. Mitchell, McAneny, Cromwell) after investigation approved the same general plans. And

today another committee, appointed by the present mayor, is studying the same old problem and cannot logically fail to approve the general program of Waring without disastrous consequences.

The real need today is for funds, and for administrative action, followed by competent engineering design, execution, and expert municipal operation of a complete utilization-disposal system.

Of the factors affecting the removal of snow in New York the time, depth, density and rate of fall are unknown in advance. The area to be cleared is the only known factor—30,000,000 sq.yd. of pavement, equivalent to 950 miles of roadway 60 ft. wide extending from New York to Chicago.

United States Weather Bureau Records show that for the average winter four snow storms, averaging 6 in. in depth, require removal. The Department of Street Cleaning has been organized to the last detail of the force and equipment available for handling a snowfall of 10 in. with snow of average density (12 lb. per cubic foot). A detailed study of the organization, methods, procedure and appliances used by the Department on snow work will convince any unprejudiced observer that relatively few practical improvements can be made in the set up.

The average snowfall of the winters 1914-1917 was 43 in., compared with 32 in. for the 46-yr. period 1868-1914. Between 1914 and 1917 improved methods of starting work with the storm, using motor-driven plows and up to 30,000 laborers pushing snow into sewers or piling it kept the roadways open and resulted in quadrupling the rate of snow removal while decreasing the unit cost 65 per cent compared with the three previous winters.

Recently, due to the shock received by the city officials from the storm of last winter, about $4,000,000 has been appropriated for the purchase of additional apparatus for the removal and disposal of snow.

Experts are not popular in official circles today in this municipality. Colonel Waring said: "I did the work for its own sake alone, and any competent executive can succeed if he follows this same principle."

How a Port Terminal Looks from the Air

The accompanying view was taken by an army aviator flying 4,000 ft. above the completed Army Base on the Delaware at Philadelphia, Pa. It gives a remarkably good map-like impression of a modern port terminal.

Pier B, with its two 1,500-ft. warehouses is the longest pier. Its central track court has capacity for two 40-car trains and is seen to be nearly full. The two vessels at the outer end of this pier are 8,000-ton German freighters now flying the British flag; the large vessel at the inshore end of Pier B is a Dutch freighter. The 35-ft. deep slips between piers are 250 ft. wide. Fifteen ocean-going vessels can be counted docked at the base.

The half pier at left of Pier B is Pier A, has three lines of railroad track, seen mostly full of freight cars, and is a specially designed ordnance pier intended for the loading of heavy ordnance pieces directly from cars into the holds of vessels alongside. The large open-deck pier at the right of Pier B is Pier C. It is 1,320 ft. long and has foundations designed for warehouse superstructures similar to those on Pier B, but omitted after the armistice. Its four railroad tracks with freight trains are visible.

The extremely long narrow steamship at the inshore end of Pier C is the U. S. transport "Meade" now in the Shipping Board recruiting service. The piers under construction at the far right are new Philadelphia municipal piers.

The Philadelphia Army Base was described in *Engineering News-Record*, Mar. 18, 1920, p. 554. It was built by the Construction Division of the Army, under the direction of Day & Zimmerman, Inc., as supervising engineers, by the Snare & Triest Co. as contractors.

THE PHILADELPHIA ARMY BASE FROM 4,000 FT. UP

Concrete Barges on New York Canals

In his annual report on the Inland Waterways Service General F. T. Hines devotes a paragraph to the concrete barges which were built for the New York State Canals. He says that experience with them has shown that they require but a fraction of the steel needed for steel barges, and that under favorable circumstances they can be put into water within four or five weeks. Further than this, however, they are of but limited value from an operating point of view. While the maintenance costs of the concrete barges on the New York Canal are lower than the maintenance costs of steel barges, this advantage is more than offset by their greater susceptibility to damage from collision. These barges have an excessive yawing depth, even when light, 2 ft. more than steel barges. They are unwieldly to handle, navigate badly and have a tendency for yawing toward shore with the tides and endanger the tow formation. On the whole the experience of the government with concrete barges has indicated that under normal conditions they are not superior to steel.

The Antioch Plan

Training for Administration and Proprietorship at a Small College

Liberal-Arts and Technical Courses Both to Be Given Under Co-operative Plan—Campus Industries a Feature

By Arthur E. Morgan

President, Antioch College; Chief Engineer Miami Conservancy District

WHILE a discussion of the reorganization of a small college may seem unusual in an engineering periodical, the plan now being worked out at Antioch College (at Yellow Springs, Ohio) should be of interest to engineers. The plan is that of an engineer who has interested other engineers in the work. Moreover, the scheme differs so radically from current practice as to justify its being considered by all who are interested in our educational system.

This article will be justified if enough interest is aroused to bring out criticism of the scheme as a whole or in part. In fact, the author hopes that he will secure the criticism and help of engineers and this, the first published presentation of the idea, is offered in the hope that there may be directed toward it the earnest thinking of the members of the engineering profession.

The Antioch Idea

The Antioch idea, essentially, is this—

(1) To train men and women to be the persons in final responsibility, to be directors and administrators of business, professional, educational and other enterprises. Antioch will train primarily for proprietorship and management, not for subordinate employment.

(2) The essential idea can be worked out effectively only by combining theory and practice in the instruction. Therefore, the co-operative method—part time in college, part time at work—will be employed. This will also permit those to get an education to whom it might otherwise be denied.

(3) To furnish remunerative work to students and also a laboratory, on operating scale, for administrative training, campus industries are to be developed.

These are the main features which differentiate the Antioch plan from those of other small liberal-arts colleges—for Antioch will continue essentially to be a liberal-arts college, though a limited number of technical courses will be offered. Other aims and ideas there are, of course, such as proper emphasis on moral and physical training, but these do not require especial emphasis here. The object rather is to direct attention at the novel features of the plan, and secure helpful criticism thereof.

The Place of the Small College

The small college has had a very important part in the educational history of America, furnishing to many men of unusual ability opportunities that otherwise could not have been obtained. The intimate contact between student and instructor, and also between the students themselves, has resulted in better reactions than can usually be obtained at universities. For these reasons the well organized small college undoubtedly has a place in our educational system.

Antioch was organized in 1853. As far as known it was the first non-sectarian, privately endowed college in the country. It was also the first completely co-educational college, this principle being carried to the point of admitting women to positions on the first faculty. The alumnus has every reason to be proud of its record, for its influence has been much greater than its size would imply. Horace Mann, whose contribution to American education need not be discussed here, was its first president and organized the college. President Hill of Harvard, President Orton of Ohio State University, and President G. Stanley Hall of Clark came from Antioch. Recently, Dr. S. D. Fess was elected to Congress while president of the college.

For some time the governing board has been considering the difficulties of the American college, and it has been increasingly evident that unless the problem could be faced in a new way the college could not live up to the great hope of its founders—that it should be a pathfinder in higher education. Those interested called in friends outside the immediate college circle, among them the writer, who was elected to the board of trustees and, after working out the plan outlined below, was elected president of the college in order to carry the plan through. He will continue his active engineering practice, his engineering force being closely associated with the college.

Resemblance of College to Factory

An educational institution has certain points of resemblance to a factory. The academic type of educator may object to this comparison, but it is submitted that a study of the points of similarity might profitably be made by many colleges. Both the factory and the college should have a certain product in mind; those in charge should have a definite idea whether this product has intrinsic value and also, since all life has an economic basis, whether there is a demand for it. Both must select their raw materials, and their success in doing so will have a marked effect upon the product. Both must have a well-organized system for converting the raw materials into the product in mind.

The small college, like the small factory, must select an output that the larger institutions either have neglected or cannot deal with efficiently, and should fortify its position by selection of its materials in a manner which the wholesale methods of its large competitors have made impracticable.

Each type of school should recognize its limitations. Violins can be made most cheaply in large factories, but only the small shop could produce the Stradivarius. The remarkable production of leadership in small colleges is an analogy. In the case of the small college there is a possibility (1) of a product the demand for which cannot be met by the standardized mass production of the great university, and (2) of selecting on a small scale from a source of raw material not yet adequately developed. The problems involved are (a) to define the product desired, (b) to develop the necessary

processes and standards of production, and (c) to obtain the equipment.

The particular product aimed at in the vocational and technical courses at Antioch College is men and women with the capacity to stand on their feet, to be the persons in final responsibility, who direct their own courses, rather than having them directed by superiors. A fine product of this type can be secured only if the raw material—the incoming student body—is selected with unusual care, and in accordance with a definite and carefully considered policy.

It should be clearly understood that the difference between the man who is a proprietor or administrator, and the man who works under direction at a specialized job, is not wholly of size, but also of type. An extreme case may illustrate. The village blacksmith may have but one helper, but nevertheless he is a proprietor. On his own judgment rests the final decision as to the wisdom of any policy or course of action. He is final authority on metal working, purchasing, selling, accounting, shop management, in short, on every policy of his little establishment; and, with a given natural ability, his success will be greater or less depending on whether he is a master of the technic of proprietorship. On the other hand, a certain research engineer in the employment of a great corporation is said to receive a salary of more than $50,000 a year. He is of much higher grade than the village blacksmith, but his preparation need not cover nearly so wide a field.

On first impression we think of the proprietor and the administrator as belonging to a small class of exceptional men who are born and not made. However, when we consider the heads of manufacturing industries, large and small, the proprietors of commercial establishments, professional men and women in private practice, our millions of farmers, most of whom are responsible proprietors, and administrators of their small industries, and, lastly, our many women who are in fact and in daily practice proprietors and administrative heads of homes, while the specialized husband is away earning a living, we see that proprietorship is one of our chief occupations.

But, with very few exceptions, our schools and colleges do not prepare for this calling. They train men and women to obey orders, to follow instructions, to work under supervision, and to rely on the judgment of superiors for ultimate responsibility and for the determination of policy.

The central core of all vocational and technical training at Antioch is to be the *preparation for carrying the ultimate responsibility — training for proprietorship.* There exists in the United States a highly developed and enormously valuable technic of administration. This technic includes the ability and habit of analysis of a job into the factors that count for its success, such as cost analysis, plant operation, financial management, personnel organization, buying, salesmanship, development of morale, production methods, and analysis of supply and demand; while underlying all is the habit and ability of exercising responsibility and of being the final authority on matters of policy. This technic in its modern, highly developed form is the possession of very few men and women. It is the business of vocational courses at Antioch to be the medium for transmitting this technic to a selected group of students.

Where schools have endeavored to do this job there have been two chief sources of disappointment; first, failure to realize that careful selection must be made of the raw material in the form of the student body and, second, in ignoring a main part of the educational process. There are two main elements in education—first, the acquiring of knowledge through study and instruction; and, second, the development of the powers of mind and personality by practice at the occupations of life. This second element, generally omitted from the educational process, is to take an important place at Antioch. The student body will spend half time at the usual college work, and half time in industry.

The chief difference between part-time work at Antioch and that in other co-operative schools is that so far as possible the work at Antioch will center around training for proprietorship and administration. To this end it is planned to build a factory building on the campus, and to locate there a number of small industries. An inventory is now under way of small industries throughout the country in an endeavor to secure a number that will combine earning capacity, educational value and relative freedom from fluctuation due to economic conditions. By work in these campus industries and by co-operation with industries in the surrounding cities it is aimed to combine a considerable degree of self-support with training in the various phases of industrial operation.

Courses

In the main the college will, as previously stated, continue as a liberal-arts institution. The courses are to be determined, however, by the best judgment of present values rather than by tradition. Antioch will give more than the traditional weight to subjects that inevitably affect us and a knowledge of which assist us to direct our lives and our times, and proportionately less weight to other topics. After careful consideration of the purposes of a cultural course—to put one in possession of the great contributions made by the outstanding figures of human history, and to give one the ability to analyze and to classify facts—it has been determined that the object can be achieved by about 80 courses, a course consisting of the equivalent of three recitations per week for a semester of eighteen weeks. This is in striking contrast with the 200 or 300 courses commonly offered by small colleges.

If objection be made to the combination of a liberal-arts course with practical training in administration, on the ground that the latter type of training is not necessary when merely a cultural development is desired, it should be emphasized that the training in self-reliance, in administrative methods, in economics and sociology, which form the common elements of the vocational courses to be given at Antioch, will not be without value in any walk of life.

While the courses are planned for co-operative work, the full-time student can fit into the regime with perfect ease by taking half of his subjects with each shift. Instead of alternating between work and study, he will alternate between two groups of study. The courses can be completed by the full-time student in four years; the co-operative student will normally require six.

Technical and Vocational Courses

A number of technical courses, aimed to offer a limited number of students training for specific callings, are to be given. Several considerations, in which

engineers will be interested, have entered into the selection of these courses:

The technical and vocational courses contemplated include business and industrial administration, machine-shop operation and management, accounting, contracting, civil engineering, farming, education as applied to consolidated rural schools, and household management.

Technical and Vocational Courses

Several considerations, in which engineers will be interested, have entered into the selection of these courses:

1. They should to the fullest possible extent represent an essential contribution to public education in America—a contribution not being duplicated elsewhere.

2. They should be courses which gain rather than lose by being offered at a small college, where highly specialized equipment and faculty are not available.

3. They should belong to a single general class, so as to contain the greatest practicable proportion of common factors, thus simplifying the curriculum and reducing expense, while to the fullest possible extent retaining value for persons of widely varying aims.

4. They should be courses which will profit to the fullest extent by the peculiar location or policies of the college, the pertinent factor in this case being the policy of alternation of work and study, and the type of faculty and organization which that policy involves.

5. It is an aim of the Antioch program to develop a spirit of responsible citizenship. The courses are aimed to prepare students for environments where certain types of social service are peculiarly needed.

6. They should be courses the training for which will have the widest possible usefulness and application.

The principle set forth in item 6 needs elaboration. Some persons of college age have such unmistakable and well-matured vocational bent that they may without danger of mistake commit themselves to specific vocational training. Other persons never do develop highly specialized ability, but would succeed approximately as well in any one of several callings. With such persons also, definite commitment to a calling during college years is sound policy.

There are still other persons who finally give evidence of highly specialized ability, but with whom the possession of such ability, or the opportunity to use it, does not become clearly evident until during or after college years. It is the aim for Antioch to have vocational courses which to an unusual degree will discover to students their comparative abilities in various callings, and the contents of which will have the greatest possible residuum of value to the person who later may be diverted to some other calling than the one for which he was trained.

It is planned that the technical and vocational courses shall have the common aim of training for general competence rather than specialized technic, for administrative ability, for proprietorship or directorship; in general, training for ability to be self-directing, and for ability to administer industrial, professional or commercial enterprises. This type of training will have such wide and general applicability that even should the student fail to continue work in the line of his specific vocational training, as so frequently is the case now with technical students, that training nevertheless will have high value in almost any calling.

In the professions, for instance, technical skill has run so far ahead of administrative organization that today increase in administrative efficiency is of the greater moment. The average doctor, lawyer, engineer or educational administrator could increase his total productiveness two or more times if his administrative practice were on a par with his technical skill. In commerce, manufacture, contracting, mining, and most other callings dealing with material production and distribution, efficient administration is needed at least as much as any other service.

There are two ways of arriving at the position of administrative head of an important institution. One is by "starting at the bottom" of that or a similar institution and burrowing through it to the top. The other method of arriving is by going over the top; by beginning as a small self-directing unit, going from the top of one organization to the top of another. Both of these are necessary and standard methods of procedure.

The Antioch program aims to prepare for the latter method of progression by preparing a selected group of students, through part-time study, combined with part-time work in which initiative and self-reliance are necessary, for becoming the responsible heads of small institutions. After becoming the head of a small institution the Antioch trained person would be equipped to go as far as his innate quality would make possible. There are definite advantages in this method of approaching administrative responsibility. Progress from the start depends upon the use and growth of individuality, whereas "starting at the bottom" in a big organization frequently puts a premium on conformity.

Moreover, the administrator sees all phases of industry. If he has not yet discovered himself he has a prospect for doing so in his contacts with various elements of his work. Many a man by "starting out for himself" has discovered his real genius in selling or in research or in some other specific field opened to him by his experience.

An example of the possible usefulness of the Antioch training is afforded by the proposed course in machine-shop operation and management.

All American industry and notably agriculture is becoming increasingly mechanical. While the factories of our country are turning out an enormous mass of mechanical appliances our maintenance system, outside of large cities and the maintenance of transporting equipment, is limited to the infrequent machine shop and to the service departments of a few industries. There is room for a large number of independent machine shops for maintaining this equipment and otherwise for serving the mechanical needs of the communities. Such machine shops would not be "blind-alley" industries, for it takes but a slight change to turn a well-organized shop into a factory and its manager into a manufacturer.

The course in machine-shop operation and management would have as an underlying requirement the essentials of a liberal-arts course. The student should become a cultural and social asset to the community as well as an industrial asset. By half-time work through a six-year course, covering the different phases of his prospective industry, he may gain some of the experience necessary to make him an effective technician, a superintendent and an executive. His technical studies would include the fields of physics and

mechanics, business administration and accounting, psychology and sociology. After graduation he would at once undertake the management of a small machine shop, or would serve an apprenticeship in such a shop, depending upon his maturity and ability.

Selection of Students

The success of the new plan will depend as much upon the quality of the students and their success after graduation as upon any other single element involved. Therefore, the selection of the student body will be given relatively much more attention than in the ordinary school.

It is the plan to advertise as widely as possible just what is to be attempted in the way of a course, with the idea that the number of applicants shall be as large as possible. From this large number a very careful examination will select those persons who seem likely to make the most of the opportunities offered. Much more time and money per capita will be spent in selecting the freshman class than is spent in the larger institutions, since the need of selecting with care is so apparent. The examinations will be directed toward determining the quality of mind, industry and initiative of the applicant and less emphasis than usual, in proportion, will be given to the completion of a high-school course. It is recognized that a certain minimum of knowledge of facts is required, but it is more important that the student give promise of becoming a man of high intelligence, sound character, and balanced personality.

Faculty

Obviously the recruiting of a faculty for an institution based on such ideas is not an easy one. The faculty must necessarily be in harmony with the spirit of the institution.

For the vocational work tentative arrangements have been made, dependent in some cases on financing, with four or five men, who also are pioneers and who have records of orderly, successful accomplishments. With one exception they have not been professional educators. They are men who could not be attracted by purely academic work, but can be interested because they will be responsible for the economic and professional stability of the practical undertakings. Though they have not been professional educators each one of them is a great teacher, each one having tested capacity for imparting knowledge and outlook.

In the search for academic members of the faculty there has been much discouragement. A thorough canvass is being made in an effort to find about a dozen men who, along with scholarship, have the necessary originality and virility. Individual ability alone would not be sufficient. The curriculum must be a synthetic whole and a genius who cannot do teamwork will not fit into the Antioch faculty.

Trustees

For the direction of the college there has been secured a board of trustees on which a wide variety of ability is represented. The following are the members of the board:

Dr. F. C. Caldwell, professor of electrical engineering, Ohio State University; William Chryst, chief engineer, Dayton Engineering Laboratories Co.; Homer Corry, attorney, Springfield, Ohio; Joseph P. Cotton, of the law firm of McAdoo, Cotton and Franklin, New York; Henry S. Dennison, president, Dennison Manufacturing Co., Boston; George Drake, retired merchant, Yellow Springs, Ohio; Edward F. Gay, formerly dean, Harvard School of Business Administration, now president, New York *Evening Post;* Jerome D. Greene, of Lee, Higginson & Co., bankers, Boston; John C. Haswell, president, Dayton Malleable Iron Co.; Milton F. Hosea, attorney, Cincinnati; Ralph Howell, farmer, Yellow Springs; John H. Hunt, research engineer, Dayton, Ohio; General J. Warren Kiefer, banker and lawyer, Springfield, Ohio; C. F. Kettering, chief engineer, General Motors Co.; George Little, manufacturer and banker, Xenia, Ohio; William Mayo, chief engineer, Ford Motor Car Co., Detroit; Arthur E. Morgan, civil engineer, Dayton; Gordon S. Rentschler, active head, Hooven, Owens, Rentschler Co., Hamilton, Ohio; Ellery Sedgwick, editor, *Atlantic Monthly;* Frank D. Slutz, head master, Moraine Park School, Dayton; George M. Verity, president, American Rolling Mill Co., Middletown, Ohio, and Frank A. Vanderlip, banker, New York.

Plans have now progressed so far that the new plan will be put in operation in September, 1921. Obviously, it cannot be put in operation in its entire fullness then, but it is hoped that the main lines of work can be started. It is expected that accommodations will be available for about 600 students.

How Engineers Can Help

Engineers who may find interest in this plan can assist materially in the development of the idea and of the school. Engineers might, for example:

1. Suggest suitable students. The college is already building up a list of prospective students who will enter as freshmen during the next few years. An acquaintance for some time in advance will help in making an intelligent selection. Students are desired from every part of the country. In other words, it is believed that the institution should have a national influence.

2. Suggest types of industries which it might be possible to have located near the college, and which would combine earning capacity and educational value.

3. Suggest particularly suitable members for the faculty.

4. Discuss the program so as to help the members of the faculty and the trustees to fortify themselves against weak points and to further develop the best features of the plan.

Engineers are accustomed to casting aside prejudice and considering plans on their merits. If the members of the profession will do that in the present case they can be of material assistance in developing a plan that may eventually have an important bearing on American educational methods.

Housing Conditions in Prague

In order to provide immediate means of dealing with the housing crisis in Prague, Czechoslovakia, the police authorities have decided that not more than one room per person shall be lawful in apartments and dwelling houses. Every householder is required to report the size of his dwelling, together with the number of persons occupying it, according to a recent issue of *Commerce Reports*. Those who have spare room are required to share it with others. In the meantime, however, it is deemed essential to stimulate building.

Digest of Joint Committee's Uniform Vehicle Law

AT THE National Conference on Highway Traffic Regulations held in Washington, D. C., Jan. 10-12 (see news section) frequent reference was made, in the discussion of a proposed bill presented at that meeting, to a "Proposed Uniform Vehicle Law" which had been prepared last year by a joint committee, of which H. G. Shirley was chairman, representing the American Association of State Highway Officials, the National Automobile Chamber of Commerce, the American Automobile Association and the Highway Industries Association. A digest of this joint committee's proposed law is given below, inasmuch as the new bill offered at the Washington meeting was, in its essential features, a practical duplication of the joint committee's measure, of which from 30,000 to 40,000 copies in printed form have been distributed.

Chief Provisions of Joint Committee's Law

A commissioner of motor vehicles is provided for; he may be the secretary of state, state highway commissioner or any other duly elected or appointed official. He may appoint assistants and deputies to enforce the provisions of the act, the power of dismissal, in the latter case, resting with the vehicle commissioner.

Registration is required of all vehicles operating upon state highways.

The bill contains a three months' reciprocity clause.

Fees for the registration and licensing of vehicles are in accordance with the following schedule:

MOTOR VEHICLES

Equipped with	Per Hp., Cents	Per 100 Lb. Gross Weight of Vehicle, Load, Cents
Pneumatic tires	25	25
Solid tires	25	35
Iron, steel or other hard tires	25	50

Motor vehicles used for the purpose of transporting persons for hire shall pay double the above rates.

TRACTORS

Equipped with:	Per Hp., Cents	Per 100 Lb., Weight, Cents
Pneumatic tires	25	25
Solid tires	25	35
Iron, steel or other hard tires	25	50

Tractors used for agricultural purposes shall pay one-tenth of the above rates.

TRAILERS AND SEMI-TRAILERS

Equipped with:	Per 100 Lb. Gross Weight of Vehicle and Load, Cents
Pneumatic tires	15
Solid tires	25
Iron, steel or other hard tires	35

Motorcycles ..... $5.00 each
Motorcycle sidecars ..... 5.00 each
Horse-drawn vehicles ..... 3.00 each
(Except those used for agricultural purposes and for transportation of passengers not for hire.)
Weighing not more than 1,000 lb., unloaded..... $3.00
Weighing more than 1,000 lb., unloaded..... 3.00 for first 1,1000 lb. and 50c. for each additional 100 lb. weight of vehicle.

Horse-drawn vehicles used solely for agriculture shall pay one-half of the above rates.

MOTOR VEHICLE and Tractor Manufacturers and Dealers.
Registration and first five sets or pairs of plates.... $25.00
Each additional plate 2.00

TRAILER, Semi-Trailer and Motorcycle Manufacturers and Dealers.
Registration and first five plates..... $20.00
Each additional plate 2.00
Pupil's permits ..... $1.00 each
Operators' and chauffeurs' license..... 2.00 each
Duplicate licenses ..... .50 each
Duplicate plates ..... 1.00 each

Horsepower is computed as follows: Square the bore of the cylinder in inches, multiply by number of cylinders and divide by 2.5.

Load plates showing the actual weight of the vehicle with equipment and the weight of the seating or loading capacity of such vehicle as specified by the manufacturer are required.

Size—The size restrictions specified are: Width, 96 in. (except traction engines which are limited to 108 in.); height, 12 ft. 6 in.; length, 30 ft. No combination of vehicles is to exceed 85 ft. in length, except in special cases, where permits are required.

Weight—Weight restrictions are as follows: Four-wheeled vehicles, 28,000 lb.; limit of axle load, 22,400 lb.; limiting weight per inch width of tire, 800 lb.

Speed—Speed restrictions are specified as follows:

VEHICLES DESIGNED FOR CARRYING NOT MORE THAN SEVEN PASSENGERS

Max. Wt., Including Gross Wt. of Vehicle and Load	Open Country Highway	Suburban Street	Urban Street
6,000 lb.	30 miles	20 miles	15 miles
Other vehicles, equipped with pneumatic tires			
6,000 lb.	25 miles	20 miles	15 miles
8,000 lb.	25 miles	20 miles	15 miles
12,000 lb.	25 miles	20 miles	15 miles
16,000 lb.	25 miles	20 miles	15 miles
20,000 lb.	25 miles	20 miles	15 miles
24,000 lb.	25 miles	20 miles	15 miles
28,000 lb.	25 miles	20 miles	15 miles
Vehicles equipped with solid tires			
4,000 lb.	25 miles	20 miles	15 miles
8,000 lb.	20 miles	18 miles	12 miles
12,000 lb.	18 miles	15 miles	12 miles
16,000 lb.	16 miles	15 miles	12 miles
20,000 lb.	15 miles	15 miles	12 miles
24,000 lb.	15 miles	15 miles	12 miles
28,000 lb.	15 miles	15 miles	12 miles

All moneys received by the vehicle commissioner for licenses, penalties, etc., are to be used for the maintenance, repair and construction of highways and for other purposes prescribed by law.

Suggests Higher Working Stresses for Steel in Building Frames

Speaking on "Reducing the Cost of Steel Frame Buildings" before the Western Society of Engineers on Jan. 10, R. Fleming proposed an increase of the usual working stresses for steel in building work to a higher value, suggesting 18,000 lb. per square inch for tension and the equivalent in compression. He based this suggestion on the claim that processes of steel manufacture and workmanship in fabrication have improved greatly during the past few years, and that in spite of this we are still using the same working stresses as twenty years ago.

Other elements of cost reduction discussed in the paper are reduction of excessive building code requirements, chiefly in floor loads and wind pressure; good judgment in designing, to avoid using an unnecessary number of sections, to produce the largest possible amount of duplication and to avoid forge work, etc.; suitable detailing so as to avoid bevel cuts and other costly items of shop work; reduction of number of rivets in compression members; subdivision of the structure in such a way that the parts can be shipped in the most economical manner, taking into account reduction of freight charges and increase of erection cost when trusses and the like are knocked down; simplifying the work of the erector; and using care to avoid delays or missteps in the entire process from designing office through drafting room and shop to the finished structure, on the ground that the time element is closely related to the cost of a structure. Mr. Fleming also raised the question whether alloy steels might not be found economical in either industrial buildings or office buildings, but presented no facts or recommendations on this point.

Engineering Problems in Bubonic Plague Control

By Edmund B. Besselievre
Consulting Engineer, New York City

BUBONIC plague control is largely an engineering problem. Fortunately the U. S. Public Health Service, which in all cases handles the work of eradication, in connection with state and city health agencies, has recognized this fact and one of the two executives in each district where plague measures are carried on is an engineer.

Since the rat flea is responsible for the spread of this dire disease to human beings the first measure of plague control is the elimination of the rat. This work is done by intensive and systematic trapping by volunteer or paid trappers, with bonus for each rat caught; by poisoning; by fumigation of premises known or suspected to harbor rats; by intelligent wrecking of useless shacks and structures offering excellent harborages; by starvation of the rat through deprivation of his food supply; by rendering food inaccessible and by proper disposal of waste matters; and lastly and more surely by proper rat-proofing all buildings and structures—"building out" the rat. The first essential for successful operation of the "building out" method is to educate the citizens and arouse their civic pride so that they will keep their premises, and thus their city, free from rats.

HOUSE IN BEAUMONT, TEX., REQUIRING NO CHANGES FOR RAT ELIMINATION

Floor more than 18 in. above ground [illegible] regulations

The paid trapping, poisoning and fumigation measures when plague is present or feared are usually done by the U. S. Public Health Service, the State Board of Health, the Health Department of the city concerned, or all three jointly. In none of these is special engineering knowledge required. When it comes to rat-proofing of houses, office structures, warehouses, railroad freight depots, wharves and docks the studies that should be made preliminary to the preparation of plans and regulations for carrying out such work with the least inconvenience and cost to property owners are essentially the work of the engineer.

To determine how to rat-proof any one of these structures without needlessly destroying its usefulness for a considerable period of time by extensive rebuilding, with the expenditure of large sums of money, is a problem. To decide whether a dwelling house which perhaps only slightly violates the regulations, can be made to conform by some slight alteration at little cost or whether it must be elevated or a concrete wall built around it requiries that degree of common sense which is the basis of all good engineering.

As it is usual, in municipalities afflicted with plague, to draw up and have passed an ordinance whereby the necessary regulations may be enforced it is important that engineering advice be secured both to ensure proper regulations and to gain the confidence of the citizens as to its efficacy and as to its fairness to all concerned.

As the main foci of plague in this country have been in towns and cities along the Gulf of Mexico and Pacific Coasts, in other words in warm climates, the structures affected by the rat-proofing measures have been mainly those without cellars or basements, thus simplifying the problem as compared with what it would be in our Northern seaport cities with their deep foundations, cellars and basements.

In the main the method of rat-proofing adopted in New Orleans, La., and in Beaumont, Tex., where plague made its appearance in 1920, has been the division of the work into two classes: (1) Stores and other business structures; (2) dwelling houses. The first has been carried out by destroying wooden floors laid on or slightly above the ground, affording rat harborage beneath, and laying concrete floors with side walls 12 or 18 in. high of the same material. This is not only a protective measure against rats but an insurance against dampness and other possible nuisances. The dwelling-house rules usually require that such structures be elevated not less than 18 in. above the normal ground level, left free and clear underneath, all rubbish removed, etc., and the space between the outer and inner house walls boarded up at the bottom. Or if the owner desires he may construct a concrete "chain wall" entirely around the house, extending 2 ft. below the surface of the ground and making a tight seal with the sills and baseboard of the house above the ground. This latter method is both the most effective and the most expensive, but as the elevation of a large or pretentious house sometimes spoils its appearance the "chain wall" alternative is adopted in many cases where expense saving is not a primary consideration with the owner.

These "chain walls" are 6 in. thick and provided with ventilation openings covered with metallic screening. Six inches is selected as the thickness in order to prevent the use of brick for these walls, as the Norway rat (the main plague bearer) will gnaw through an ordinary brick and mortar wall and has been known to burrow under walls 18 in. below the ground surface.

Yards, outhouses, garages, and other small structures are treated simply but effectively and at little cost. Rubbish heaps are removed, garbage is placed in closed cans, wood piles or fuel bins are placed on elevated platforms not less than 18 in. above the ground. Outhouses having wooden floors are either destroyed or if useful their floors are removed and the earth used as a floor or else concrete or boards are laid directly on the earth. (Garages must be floored either with boards or with concrete laid on the earth.) If loose boards are used they must be loose, so as to be easily removable for inspecting for possible rat holes beneath. The [illegible] object being to remove all dark harboring places of the rat, to whom [illegible] is an abomination, and at

CHAIN WALL FOR SMALL STORE AT GALVESTON, TEX.

the same time continue the usefulness of business and home structures, it can readily be seen that practically enforceable regulations will go further in procuring the desired co-operation of the property owner than an arbitrary requirement framed without proper technical thought or influence. It is hoped, therefore, that the good work done so far along these lines, and the hearty co-operation of the medical and engineering professions, as exemplified in the organization of the U. S. Public Health Service in its work in New Orleans, Beaumont and Galveston, will be continued wherever and whenever evidences of plague make themselves felt in this or other countries.

Method of Computing Waste-Weir Capacity and Reservoir Rise

By W. S. Pardoe

Professor of Hydraulic Engineering, University of Pennsylvania, Philadelphia, Pa.

The following method was used by the writer in computing the rise in head on a waste weir 250 ft. long for a reservoir of about ten square miles water surface in a catchment of 50 square miles located in the North Atlantic States.

As no time flow record of flood discharge of the river was available the rainfall curve shown in the diagram was constructed from the best obtainable data; the total rainfall in 48 hr. being 10 in. and the maximum rate being 2.5 in. per hour for the last hour of the storm. The rates of rainfall were assumed constant for 4-hr. periods for the first 44 hr. and then rates were assumed constant for 1-hr. periods.

Referring to the sketch: If Q_1 (i.e. inches per hour $\times$ 645 $\times$ 50) flows into the reservoir for the time dt and Q_2 (i.e., $3.6 \times 250 \times Z^{\frac{3}{2}}$) flows out during a like interval and A is the area of the water surface at elevation Z the relation may be expressed as follows:

$$Q_1 dt = A dZ + Q_2 dt$$

or

$$dt = \frac{A\,dZ}{Q_1 - Q_2} = \frac{m(a+Z)^n dZ}{Q_1 - 900\,Z^{\frac{3}{2}}}$$

This expression looks mathematically integrable but it is very long and difficult and can be accomplished with sufficient accuracy by the following graphical methods:

$$\text{integrating } t = \int_{Z_1}^{Z_2} \frac{A\,dZ}{Q_1 - 900\,Z^{\frac{3}{2}}}$$

if the function $\frac{A}{Q_1 - 900\,Z^{\frac{3}{2}}}$ be plotted as ordinate and z as abscissa the areas under such a curve will be time in seconds.

The curve ab is for the fifth 4-hr. period. The area $a\,b\,c\,d$ is 80,500 $\times$ 0.179 or 14,400 sec. or 4 hr. during which period the reservoir rose from El. 0.615 to 0.795. The last four periods being of 1 hr. duration have an area of 3,600 seconds.

If the total rainfall is 10 in. and the final hourly rate 2.5 in. the final head on the weir will be 3.94 ft. and the discharge about 7,000 sec.-ft. This is very small com-

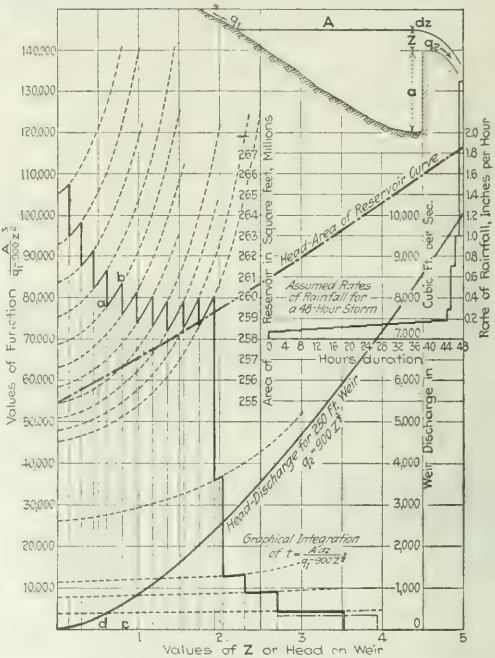


DIAGRAM FOR STUDY OF WASTE WEIR FOR RESERVOIR

pared with Q_1, which is equal to 2.5 $\times$ 645 $\times$ 50 = 80,600 sec.-ft. This is of course very excessive but the reservoir under consideration has an area of 20 per cent of the catchment area which has relatively steep and rugged hillsides and hence the assumption of 100 per cent flowing off land surfaces.

Some Notable Americans Who Were Surveyors

The following paragraph on notable Americans who "at some period of their lives" were surveyors has been extracted from Guy Emerson's "The New Frontier" and sent to this journal by John Nolen, city planner, Cambridge, Mass.:

It is an interesting fact that some of our most characteristic Americans have been surveyors at some period of their lives. This list includes Washington, Daniel Boone, Andrew Jackson, Thoreau, Lincoln. One of the fundamental things about a surveyor is that he blazes a trail; that he defines boundaries which hitherto have been vague and in dispute. A surveyor in the first place must be accurate, and in the second place he must be self-confident. He must be undismayed by any temporary obstacles and barriers which stand between him and his objective. There is something particularly appealing in this type of man in this age of problems so varied and difficult of definition, with so many human and material variants.

Germany's Dominant Industrial Issues—the Silesian Plebiscite and Coal-Mine Control

Loss of Silesian Coal and Zinc Faced—Shortage Forces Use of Coal Substitutes—Impending Socialization of Mines May Furnish Key to All Industrial Control — Low-Head Water-Power Development Active

(By Engineering News-Record's Berlin Correspondent)

GERMANY is facing two great problems, the outcome of which will have a very strong bearing upon the shaping of the country's future, and which, therefore, occupy the public mind to the exclusion of almost everything else. These issues are the fate of Upper Silesia and the socialization of the coal mines.

Upper Silesia is one of Germany's largest industrial and agricultural provinces, surpassed only by Westphalia and Rhineland, in fertility of the soil and possession of mineral wealth. It contains one of the most extensive coal deposits not only of Germany, but of the continent of Europe, contributing about one-fourth of Germany's total yield. The annual output of coal in 1913 was 43,000,000 tons, valued at 516,000,000 marks, and is at present 35,000,000 tons valued at 5,950,000,000 marks. Though slightly inferior to the Westphalian coal, it is of good quality and forms the basis of great manufacturing activity. Numerous industrial manufacturing works have settled down upon or near the coal mines. The district from Beuthen to Gleiwitz is densely covered with iron works, zinc foundries, machine shops, etc. The country contains sixty-five coal mines, seven iron mines, eight blast-furnace works, twenty-five foundries, fourteen rolling mills, and fifty-nine machine shops. The province also has iron deposits near Oppeln, which produced in 1919 460,000 tons of pig iron, and zinc mines near Beuthen, which are probably the richest of the world. Other mineral products of the country are lead, silver, copper, cobalt, arsenic, cadmium, alum, lignite, marble, etc. It produces the best portland cement and is one of the largest timber lands of Germany. It is therefore invaluable to the building industry.

It will shortly be decided by plebiscite whether the province shall in the future remain with Germany or fall to Poland. The loss on the one side, and the gain on the other is so great that both claimants are straining every nerve to retain or obtain possession of it. Political strife is at present running very high and the result is very much in doubt. The Polish population, though but a small minority, taking the country as a whole, is concentrated in the industrial district, where it probably forms the majority. Germany, therefore, stands in danger to lose this, the most valuable part of the province. Such a loss would greatly impair her economic strength, although it is an exaggeration to pretend that it would seriously cripple her, as the political propagandists maintain. The loss of all or part of the province, although severe in its immediate effects, would no doubt be an additional stimulus to the development of unexploited surface and underground resources, which is Germany's task in the future, and which has lately been taken in hand with surprising energy.

The other problem, that of the socialization of the coal mines, is just as momentous, although it lies in a different direction. Its import goes far beyond the immediate result it might have. The present strife will decide which course the country will take with regard to socialistic doctrines and the working classes in general. If defeated in this, socialization will be, if not a thing of the past, a matter of a rather remote future. Conditions for radical measures against the coal owners are exceptionally favorable. The control of the mines has passed into the hands of a comparatively few men, who have accumulated enormous wealth and influence, of which not always wise use is made. While the impoverished population is made to suffer under the increased cost of fuel, the annual reports of the mines openly show gains of a magnitude before unheard of, with still larger profits hidden behind the screens of intricate accounting. Even the bourgeois class, therefore, supports the demand of the workers to convey the coal-mining properties into commonwealth possession.

Proposals of Operators and the Government

The mine owners, on the other hand, put forward strong arguments against socialization. Experiences with socialization, they maintain, have as yet been very discouraging, from a financial as well as production standpoint. The strides the country can make toward economic recuperation strongly depend on the increase of the coal production, in view of the loss of the Sarre district, the possible loss of the Upper Silesian mines and the heavy coal tribute to the Allied countries. The mine owners claim that private enterprise is indispensable to this task, especially when considering the run-down condition of the mine equipment, the necessity of modernizing it, sinking new shafts, requiring a capital investment, and an amount of high-strung energy which red-tape state administration never could command. The result of socialization would, so they argue, be a decline of coal production which ultimately would mean disaster.

The present non-socialistic government is acting very half-heartedly in the matter. The socialists, while in power, treated the socialization problem very gingerly, and moved away from it as far as it seemed safe, but since they are out of government they have made it a party platform, urging the government to make good the promise which they themselves had made. The government, attacked by two factions—the socialization advocates and their opponents—is in a rather helpless position and takes recourse to lengthy committee deliberations and expert opinions. Two bodies, the *Reichswirtschaftsrat* or National Economic Council, and the *Reichskohlenrat*, or National Coal Council, have been deputed to collaborate in the preparation of the matter for parliamentary decision. The official proposal of coal socialization is the work of Professor Lederer, the reputed economist of the Heidelberg university. It demands expropriation of the mine owners against payment by government bonds, and complete control by state administration, totally eliminating the present owners. Another proposal submitted by Rathenau, gen-

eral manager of the A. E. G. Electric Co., attempts to strike a compromise. It will give the state control of the coal distribution, leaving the mines in the hands of the present owners for a period of thirty years, after which they shall become state property absolutely and without compensation. The danger of the mines being run down during that time is to be avoided by paying premiums on increased production and by leaving part of the latter at the free disposal of the mine owners. There are one or two other proposals, inspired like Rathenau's, to continue private enterprise but keep it under control.

Combines of Electrical Coal Users

In strong contrast to these proposals is that of the mine owners, submitted by Stinnes, an industrial leader of great wealth, power and astuteness. He proposes, if any change of the existing conditions be decided upon, to put the consumers in control of the coal mines and not the state as a whole. He would form co-operative combines of all large consumers like electricity works, power plants, etc., which would acquire the controlling interest in a number of coal mines, sufficient for their supply. The individual members of such combines would vary in proportion to their needs for coal. In the case of small consumers there would necessarily be more members than in that of larger consumers, who, it is recommended, should amalgamate with individual mines. Private enterprise would, so Stinnes says, in this way be maintained and the interest of the consumers safeguarded. Furthermore, the consumers would constantly be on the alert to increase the production and would, by combined strength, be able to find the necessary capital for extensions and new equipment. To reconcile the miners with this very non-socialistic proposal, he recommends the creation of small-capital shares of 100 marks denomination, which are to be reserved for the miners to be paid for from their earnings. The miners would in this way become part owners of the mines, and be able to exercise some control. Stinnes' proposal is of course strongly supported by all capital interests and by manufacturers. A large program of propaganda is being made to win the miners over to this plan with promises of betterment. It is, however, very doubtful whether the working classes, saturated with fifty years of socialistic propaganda, will acquiesce. Agitation is running very high, but the public interest is already diminishing and it may be quite possible that the whole matter will either be shelved for some time or end in a compromise, which, while saving appearances, will leave things pretty nearly unchanged in substance.

"Vertical Trusts"

In the meantime Stinnes' proposal is in a fair way to become a matter of fact, if not of law. The process of amalgamation which he recommended has, during the last few months, progressed with surprising speed. Its trend is to link together producers and manufacturers of all lines of goods, from the coal mine up to the finished product. The expression "vertical trust" has been coined here for such combines, intended to indicate that the combines follow the manufacturing process from the lowest stage to the highest, in contradistinction to existing trusts, which combine manufacturers of the same stage. Vertical trusts not containing business rivals will not concern themselves with the control of prices. Their chief interest will be economic production whereby the various members will stimulate one another, and each member will be in a position to profit by the experiences of the others. A number of such trusts have lately been formed amongst very large works. Noteworthy is the huge combine entered into between the works unde Stinnes' control and the Siemens group, in itself a combine of large dimensions. The Stinnes combine now comprises the following works: *Deutsch-Luxemburgische Bergwerks und Hütten-Akteingesellschaft, Gelsenkirchener Bergwerks-Aktiengesellschaft, Bochumer Verein für Bergbau und Gusstahlfabrikation,* and *Gebrüder Böhler Aktiengesellschaft.* These firms own coal mines, steel works and machine shops. Their present capital is quoted at 1,400,000,000 marks. The Siemens group consists of the following firms: Siemens & Halske, Schuckert & Co., Siemens-Schuckert G.m.b.H., Bergmann Electricity Works, and five subsidiary companies. Their capital value is almost equal to that of the Stinnes combine.

Trusts of this kind are an entirely new departure and indicate that the trusts and syndicates of former times formed to control prices and to distribute production have been abandoned. This will ultimately end in the fusing together of German manufacturers into groups and in the disappearance of the individual manufacturers. These groups will amongst themselves represent an imposing phalanx against government and outside interference.

Production of Coal Substitutes

The coal problem in its various aspects is the motive power of another development which is taking more and more concrete shape and which will, if nothing untoward happens to the country, take huge dimensions in the future. Coal is now Germany's chief national wealth. Coal exports will, for a long time to come—far beyond the last export of reparation coal called for under terms of the peace treaty—be the chief factor of Germany's own reconstruction. Germany's chief aim in the future will, therefore, have to be directed toward using as little coal for home consumption as possible, and to find the necessary substitutes through the exploitation of the other power-producing agents, i.e., water power, brown coal and peat. Considerable progress has been made in this direction during the last five years under the exigencies of the war. Germany possesses very extensive deposits of brown coal, which can be produced by surface mining. These deposits occupy a belt stretching from the Cologne district through the middle parts of Germany almost to her eastern borders in Silesia.

This brown coal has been considered of too poor a quality to bear the expenses of long-distance transport, but pressed into briquettes it forms a valuable part of the household fuel in districts removed from the coal mines. Its most economic use, however, is the generation on the spot of electric power and its transmission to power consumers within certain radii. Large power plants of this kind were erected during the war, a notable example being the power plant of Golpa, supplying practically all Berlin, 80 miles distant, with electricity. Power units developing up to 75,000 hp. have been put up on brown-coal fields, and manufacturing works needing large quantities of power like electrochemical plants have settled down near the brown-coal mines. The further development of brown-

coal mines intended to replace coal-power plants within a wide circle is the aim of the government and strong efforts have been made in this direction. The Spa Treaty has been an additional stimulus. The emancipation of electric power plants and manufacturing works from coal supply, and their shifting on or near brown coal deposits will no doubt be a dominant feature in the near future.

A similar development may be observed, although in much lesser degree, with regard to the peat districts in the northern provinces of Germany. Considerable experience has been gained in the use of peat as a fuel, and the power plants using peat have been quite successful. The richest peat districts are in parts of the country devoid of any other resources. They cannot be reached by long-distance transmission from the brown-coal fields, have no water power, and rail transport makes coal very expensive, quite apart from its shortage. Germany's dried peat resources are estimated at 10,000,000,000 tons, enough to feed all public electricity works existing in 1917 for 150 years, and to run all German railroads by electric power for 220 years. A number of large peat central power stations are under contemplation. The designs are finished and approved, and the projects are awaiting financing.

Peat and Water Power

Similar efforts are made in the south of Germany toward the utilization of water power. Germany possesses ample water power, which can be utilized at no great cost, and of which only 10 to 15 per cent has been utilized. This water power was formerly estimated at 1,500,000 hp., but close investigations carried on during the past year show, according to a statement made by Building Councillor Schmicke, that 6,000,000 hp. can be produced. This water power is equivalent to 37,000,000 tons of coal, equal to one-third of Germany's present coal production, and valued at the present coal price at no less than 13,000,000,000 marks. Two million horsepower are to be found in Prussia, 3,000,000 in Bavaria, and the rest in the smaller countries in South Germany and Saxony. This high estimate of Germany's water-power resources, differing so far from pre-war figures, is due to the discovery, lately made, that under the present circumstances it will pay to develop not only high-, but low-head prospects, the latter encountered in connection with the construction of shipping canals. Germany has a number of canal projects, which have formed part of the governmental inventory of one or two generations. These projects, intended to connect the various river systems, like the Rhine with the Danube, the Elbe with the Weser, and so on, have so far as memory goes been talked about, but never been taken in hand seriously. It seems that what years of abundance could not produce will now be achieved under the stress of sheer necessity. A bill authorizing the construction of the so-called Midland Canal (*Mittelland-Kanal*) has just passed the Prussian Diet. This canal will be an extension of the Rhein-Weser canal to the Elbe, which latter it will join near Magdeburg. Branch canals will connect it with the important towns Braunschweig and Leipzig. By the same bill the completion and enlargement of the Ihler and Lauer canal, and of the canal connecting the rivers Oder and Spree, has been decided upon. The cost of this work is estimated at 306,000,000 marks. The Midland Canal will be built for ships up to 1,000 tons. A considerable amount of electric power can be obtained between the canal levels and by the regulation of the tributaries in connection with the canal construction.

Miscellaneous Projects

The Rhine-Danube canal project has also reached decisive stages. This canal is of continental importance as it will open up an inland waterway from the North Sea to the Black Sea. It is estimated that 170,000 hp. of hydro-electric power can be obtained from this canal, which would pay a large part of the interest on the capital investment. Other plans of a similar kind are: (1) The regulation of the Upper Rhine between Lake Constance and Bâle for navigation purposes, through which 800,000 hp. are obtainable; (2) and further regulation of the Weser and Oder, each estimated to net 24,000 hp. of hydro-electric power. Hand in hand with these large plans for developing inland navigation goes the plan of the city of Cologne to build an extensive harbor.

Since the armistice Cologne has become of great commercial and industrial importance. Its present harbor facilities are by no means adequate. The new harbor will have quays four miles long, a water area of 3,000,000 sq.ft., and a warehousing area of nearly double that amount.

These huge projects are of course very much a matter of the future, and it is difficult to see where the money to pay will come from. The population is, however, now so convinced that all these projects are necessary for Germany's future prosperity that, no doubt, public loans will find ready support. From the energy devoted to the completion of the large Bavarian hydro-electric plants and their astonishing rate of progress, it can be assumed that the engineers and the contractors will soon be kept busy for a long time ahead.

The Bavarian hydro-electric plants now under construction comprise the following:

Plant	Horsepower	
Waldensee	144,000	(maximum)
Isar	87,000	"
Inn	75,000	"
Lech	117,000	"
Alz	29,000	"

All these projects will bring relief, too, in the matter of the unemployed, the number of which, although declining lately, is still very large, and who are a considerable burden upon the country. The time when the metal industry, overgrown during the war, will be reduced to normal size, has come, and numberless workers formerly employed in the building industry are looking for employment at their old trade. It is hopeless to expect a revival of private building activity yet, as long as rents are only slightly above pre-war level while the building costs have soared up to from twenty to thirty times of the pre-war level. Public utility works only, can therefore relieve an otherwise very difficult labor situation.

The Building Industry

At present the employment of the building industry leaves very much to be desired. Only a part of the contractors—mainly concerned with public work—can be said to be busy. Some very large contracting firms, amongst them Philip Holzmann of Frankfurt, have informed your correspondent that they are having a

very slack time. This is confirmed by recently issued figures of the employment of the German structural steel builders in their business year from July, 1919, to 1920. Only 143,000 tons of steel structures were erected during that time compared with 412,000 tons in 1913-1914. The number of employees and workmen employed with this association has, however, almost reached that of the latter business years. The production of building material, except bricks, has advanced even beyond inland consumption. It is noteworthy in this respect that the embargo on the export of cement has been withdrawn. The cement industry is suffering under the coal shortage, and the production has gone down considerably. Still there is more produced than the country consumes. With regard to private building, strong efforts are being made to reduce the cost of building by labor- and coal-saving devices and materials.

PRESENT PRICES

Wood	1,000 marks per cubic meter
Structural steel	2,500 marks per long ton
Ferro-concrete	1,800 marks per cubic meter
Concrete	200 marks per cubic meter
Ferro-concrete wire	2,850 to 3,150 marks per ton

Many such materials have been put on the market, backed by extensive claims, but so far none have been quite successful. The government has carried on experiments with adobe buildings, and is largely advocating their use for buildings outside of towns, especially for workmen's houses, although use of the material has found severe critics in engineering circles. Of all the various new materials the old slag brick made of cinder, cement and lime has so far proved the only one of lasting value.

Record of Production of Explosives in 1919

EXPLOSIVES manufactured in the United States during the year 1919 aggregated 417,634,470 lb., a decrease of 16 per cent from 1918, according to a report by Wm. W. Adams, issued by the U. S. Bureau of Mines.

These explosives are in three classes: 180,511,050 lb. of black blasting powder, 198,268,588 lb. of high explosives and 38,854,832 lb. of permissible explosives. Dynamite and all other high explosives of various trade names and compositions are classed as "high" explosives. In the "permissable class of explosives similar to samples tested by the Bureau of Mines and used in accordance with prescribed conditions; they include ammoniun nitrate explosives, hydrated explosives, organic nitrate explosives and certain nitroglycerin explosives containing an excess of free water or carbon.

PRODUCTION OF EXPLOSIVES, 1919

	Black Blast Powder, Kegs	High Explosives, Lb.	Permissible Explosives, Lb.
Coal mining	6,139,605	24,616,383	32,840,196
Other mining	252,134	89,754,788	2,498,132
Railways and other construction	201,197	12,759,623	183,353
Total	7,226,442	198,268,588	38,854,832

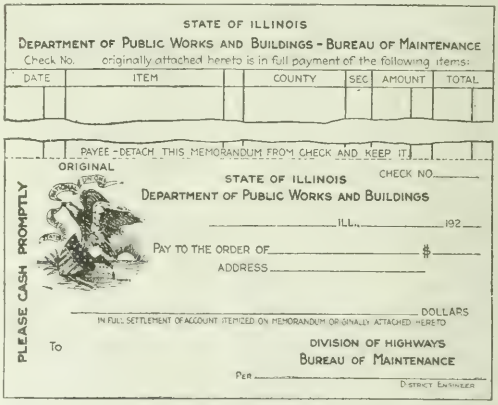
The most general uses of these explosives are shown in the accompanying table.

Highway Cost Analysis Simplified by Illinois Reports

Foreman Fills in Weekly Special Form, Showing Distribution of Costs—Local Bank Checks for Small Bills

By I. E. Scott
Assistant Maintenance Engineer, Division of Highways

QUICK results in recording and analyzing highway maintenance costs in Illinois have been secured by using a maintenance foreman's report blank which is a time sheet and a disposition sheet of costs of labor, materials, supplies and repairs. In connection with this form of report simplicity and speed have been secured in paying small maintenance bills by means of a special voucher-check drawn against local banks in the maintenance districts. The illustrations show, Fig. 1, the form of check and, Fig. 2, the face and reverse sides of the report blank. Both forms are given in full, because they have proved to be time and labor saving devices of importance.


STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS - BUREAU OF MAINTENANCE
Check No. originally attached hereto is in full payment of the following items:

DATE	ITEM	COUNTY	SEC	AMOUNT	TOTAL

PAYEE - DETACH THIS MEMORANDUM FROM CHECK AND KEEP IT
ORIGINAL
PLEASE CASH PROMPTLY
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
CHECK NO.
ILL., 192
PAY TO THE ORDER OF $
ADDRESS
DOLLARS
IN FULL SETTLEMENT OF ACCOUNT ITEMIZED ON MEMORANDUM ORIGINALLY ATTACHED HERETO
To
DIVISION OF HIGHWAYS
BUREAU OF MAINTENANCE
PER
DISTRICT ENGINEER

FIG. 1 LOCAL BANK VOUCHER-CHECK FOR SMALL BILLS

Small bills contracted by maintenance foremen for local labor, materials, and supplies are paid by check against local banks. This practice insures prompt payment, which assists the foreman in commanding quick service from dealers and in obtaining temporary laborers. An arrangement is had with one bank in each of the nine maintenance districts to handle the checks. The voucher-check for each district has printed on it the name of the bank for that district.

The maintenance foreman, with the report for his section, schedules all bills to be paid. He forwards the report, the schedule and all bills in duplicate to the district engineer, who checks them over carefully and then draws the voucher-check in payment. The checks are made up in pads in quadruplicate. The checks for each district are numbered consecutively, beginning at one, preceded by the district number. The original is printed on safety paper and the three copies are on yellow paper. All are made out at the same time and are identical. The original only is signed by the district engineer and is sent to the payee. When it is presented in a bank for payment the payee detaches the voucher portion which lists the items being paid by the check.

FORM No. 2

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS
BUREAU OF MAINTENANCE

District No. ____
County ____
Section ____
Type of Pavement ____

LABOR		Month of ____						DISTRIBUTION OF COST			
NAME	ADDRESS	Day of Week Here							Metal Shoulders	Earth Shoulders, Ditches and Drains	Bridges and Culverts	General District Charges
Maint. Foreman	Salary											
Maint. Foreman	Expense											

MATERIALS AND SUPPLIES													
Date	NAME	ADDRESS		ITEM	Quantity		Amount Due						

I hereby certify that the above expenditures were necessary for maintenance of the road named

If this is your Final Report for this section make an "X" here ☐

PASSED

SIGNED

Maintenance Foreman

District Engineer

over

Condition of Pavement ____

Condition of Metal Shoulders ____

Materials Used from Storage

Kind ____ Quantity ____

Amount Remaining ____

Where Stored ____

Kind ____ Quantity ____

Amount Remaining ____

Where Stored ____

Bituminous Material Used on this Section ____ bbls.

Used from Storage ____ bbls. Amount Remaining ____ bbls.

Where Stored ____ Brand ____

Car and Truck Report
(To be made out weekly)

	Date					
Number						
Condition						
Total Mileage to Date						
Total Mileage Last Report						
Total Mileage for Week						

Remarks

NOTE—This report must be sent in to the District Engineer at the end of each week. Report each section or combination separately. Do not combine except as instructed. When hauling materials or supplies be sure to get bills in duplicate, whether paid for or not. When paid by you have them properly receipted. Send them with report where requesting the item. Items must be OKed by you and approved by the District Engineer before same can pass for payment. Make proper distribution of all items. Do not put any item in general heading "General District Charges" except those items which cannot be considered a section charge. Items of supplies and repairs of a permanent nature or continued use and items of expense which are incurred by bad weather or in long travel from section to section may be posted in this column. Care in making out these reports properly will greatly assist in making prompt payment of labor and bills incurred.

FIG. 2 FACE AND REVERSE OF TIME AND COST DISTRIBUTION REPORT

PERSONAL EXPENSE ACCOUNT

Date	LOCATION	ITEMIZED DAILY EXPENSE				TOTAL
		Lodging	Breakfast	Dinner	Supper	

At the time that the original check is mailed to the payee the district engineer mails two copies of the check with report, schedules, and all bills in duplicate, O.K'd. by him, to the head office. Upon receipt voucher is made up for warrant as a reimbursement to the bank upon which the checks are drawn for the amount called for by the checks. When the cancelled checks come to the bank and it has received warrant as reimbursement for them the cancelled checks are forwarded to the main office and are then attached to the original bills and voucher in the auditor's office. This completes the circle and eliminates a chance of discrepancy.

This method is working very nicely and permits prompt payment for all bills under $100. At times it results in the bank being out of the use of the money for a few days on some of the checks, but as frequently the bank receives its warrant of reimbursement before checks have been returned to it for payment. The fact that the state is not able to make a deposit with the banks as a checking account necessitates asking the banks for this accommodation.

As the checks are numbered serially and consecutively for each district it is necessary that every check be accounted for. If for any reason a check is mutilated or made void when being made out it must be sent in to the head office and accounted for. A check register is kept in the head office in which the check number, date of issue, the payee, amount of check, warrant number given as reimbursement to the bank, date of cancellation and date sent to the auditor's office are recorded. In this way positive check is kept on all checks issued.

Foremen Report Costs in Triplicate

A separate cost report is made each week for each maintenance section, or each group of maintenance sections when for a logical reason several sections may be combined into a maintenance group.

In making the distribution of cost the roadway is divided into four divisions: (1) The wearing surface or traveled way; (2) the metal shoulders, as some sections of pavement have metal shoulders and it is desired to know the cost of maintenance on them; (3) earth shoulders, ditches and drains; and (4) bridges and culverts, these being common to all sections. There is also a column for general district charges. It is intended that no cost be placed in this general district charge column except that which cannot be considered as a

section charge. At the end of the year the general district charges are pro-rated to the various sections of road in this district in order that these charges of general nature may not unduly weigh against some particular section.

On the reverse side of the sheet there is space for stating the condition of the pavement and of the metal shoulders. There is also a space for a record of material taken from storage and materials used on particular sections. Also a space was provided for a truck report to be made out weekly covering every car and truck used by this particular maintenance foreman. Finally there is a space for a personal expense account, as to date, location, lodging and meals. As regularly employed maintenance men are paid their necessary expenses in the field in addition to their salary provision is necessary for such items as are chargeable to the particular section and road.

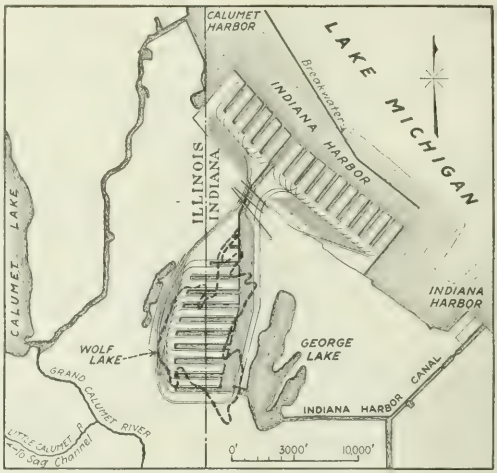
These reports are bound in triplicate in bank-book binding, the blanks being in three different colors. The first, or white, sheet, being the original, is sent to the district engineer by the maintenance foreman, who signs it, and then is sent to the head office for information and record of costs. The second, or yellow, sheet is retained in the district engineer's office for his files. The first and second sheets are perforated and the third, or pink, sheet is not perforated and remains in the book for the maintenance foreman's record and for reference at any time.

New Location Proposed for Chicago Harbor by Army Engineers

A NEW harbor site for the port of Chicago, utilizing an unoccupied part of the lake front at the Illinois-Indiana boundary line, south of the Calumet River and including the development of Wolf Lake, is proposed by Col. W. V. Judson, Corps of Engineers, U. S. A., who is the U. S. district engineer stationed at Chicago. He suggests the name "Illiana" for this new harbor, which is shown in the accompany plan. In view of the probable opening up of an 8-ft. barge channel to the Mississippi River and a 22 to 25-ft. ship channel through the Great Lakes and the St. Lawrence to the Atlantic Ocean, together with the fact that Chicago is a great railway center, Col. Judson believes that great port facilities will be needed to provide for vast transfer and warehousing operations in the Chicago district.

In this district the lake front is already occupied largely by residential, park and industrial developments, and the two harbor sites reserved north and south of the mouth of the Chicago River are considered much too small for the accommodation needed. The Chicago River has become unfit for navigation by large vessels, in Col. Judson's opinion; its commerce is now only 20 per cent of what it used to be and places indirect costs upon the community by bridge operations and interruptions to land traffic. Lake Calumet has been proposed for a harbor site, but has the disadvantage of being accessible only by the winding channel of the Calumet River, which is crossed by numerous bridges.

A little further east, however, are Wolf Lake and George Lake, lying close to the shore of Lake Michigan, which has here an unoccupied front of about 3½ miles. In and around the two lakes is an undeveloped area of six square miles of submerged and marsh lands. The



PROPOSED HARBOR FOR CHICAGO

tentative layout for the new harbor, as shown, provides nearly four miles of berthing for vessels and track storage for about 30,000 cars. These general plans have been approved by the War Department. Numerous railways near the site provide ample traffic connection and a short canal would connect the harbor with the Little Calumet River, which with the Calumet-Sag drainage channel forms a branch of the barge waterway from Chicago to the Mississippi River. The piers are planned to be 750 ft. wide, with provision for warehouses, tracks and driveways; those on the lake front are about 3,000 ft. long and those on Wolf Lake about 4,100 ft. long.

Col. Judson points out that the Esch-Cummins bill places upon the War Department the duty of studying local harbor conditions and giving advice as to developments suitable to commercial needs. After several years of study of the Chicago district he considers that the proposed site and development offer the best opportunity for providing adequate facilities for the future.

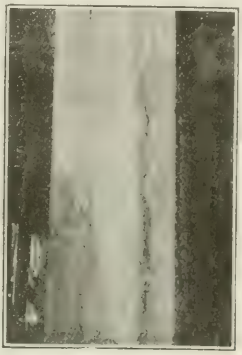
Elimination of Delays in Railway Traffic

Measures for relief from the present congestion of railway traffic by eliminating delays to trains have been recommended by the American Train Dispatchers' Association as follows: (1) Construction of double track from all large terminals to the first passing track, thus facilitating the movement of trains in and out of terminals; (2) universal adoption of the "19" train order system permitting trains to receive orders without stopping, which system is in use on several trunk lines and the safety and economy of which have been demonstrated; (3) reduction in train tonnage where necessary to permit trains to maintain a reasonable average speed and thus avoid loss of power by tying up engines and crews short of terminal points in order not to violate laws as to time of service; (4) closer inspection of trains at terminals to avoid the occurrence of delays due to hot boxes and other defects on the road; (4) more general installation of automatic block signals to facilitate more rapid line movement.

More Observations of Effect of Sea Water on Concrete

Ocean Piers in Southern California Are All Fast Disintegrating—Piles in Boston Harbor Eleven Years Old

THE behavior of concrete in seawater is being made the subject of study in many quarters and in consequence there is being built up bit by bit a practice of design for marine structures in which concrete is used. As a contribution to this study there is given here the results of some recent observations on a number of concrete piers extending into the Pacific in southern California and a report on the condition in 1920 of the test piles placed by the Aberthaw Construction Co. in Boston Harbor eleven years ago.



TYPICAL CRACKS IN CONCRETE PILE SUPPORTS OF CALIFORNIA OCEAN PIERS

The shore of the Pacific, north, west, and south of Los Angeles, Cal., is lined with a succession of towns and small cities, in nearly every one of which there is at least one pleasure pier extending well into the ocean. Most of these piers are of concrete and the design, though by different engineers, has become more or less standardized. The typical pier is of precast reinforced-concrete piles, square, round or hexagonal, driven in transverse rows 10 to 12 ft. apart and carrying, as a rule, the wooden floor on wooden floor-beams resting on the piles, though in some cases the entire structure is reinforced concrete, with the floor integral with the piles. A distinguishing feature is that the piles or posts are all slender, ranging from 10 to 24 in. diameter, and that their unbraced height is exceptionally great. In some cases at the outer end the floor will be 30 ft. above water level and the water depth 20 ft. more, so that the unbraced length of the concrete pile will be 50 ft. In few of the dozen or more piers is there any transverse bracing.

Early in December, 1920, all of these piers from Santa Monica on the north, to Huntington on the south, were examined. The inspection covered piers at the places named and at Venice, Manhattan Beach, Hermosa Beach, Ocean Park, Redondo Beach, Long Beach and Seal Point. At the same time a casual inspection of the Los Angeles municipal pier at San Pedro was made but the harbor there is so filled with oil that all structures are covered with a thick scum which prevents any close examination of the concrete, except to note that there is no pronounced disintegration. This oil coating probably acts as a protection against seawater action, a condition also noted below in the Boston tests.

The condition of the piers is deplorable. With the exception of one completed only last summer, deterioration is marked and varies approximately as the age of the structure. In fact, it is almost possible to tell the age of the pier by the extent of the cracking. The failure is typical. In the most recent piers, there are to be found on practically every pile or post thin vertical cracks following approximately the probable line of the reinforcement and extending from low to high-water. Rarely does it drop down as low as the low-water mark or rise much above the high-water mark. With age these cracks increase in size; rust stains begin to appear and the concrete to scale off from the bursting pressure of expanding reinforcement. Whole slabs of concrete will be found missing occasionally and the exposed steel rapidly disintegrating, and in structures where this has occurred the number of piles affected is larger than in the newer piers. The final stage is the complete failure of the pier as in the municipal pier at Santa Monica, the collapse of which was described in *Engineering News-Record*, March 25, 1920, p. 621, and which is now being replaced by a creosote pile structure.

Most of these piers, as has been noted, have wood floor systems so that the deterioration is confined to the supporting piles but in some of them, notably the V-shaped pier at Redondo Beach, reinforced-concrete floor systems are used. At such places the under side of the floor generally shows signs of deterioration. Rust marks indicate clearly the location of reinforcement, if that steel has not already broken through the cracked concrete. Such floors are of course well above the seawater itself, although wet by spray and splash.

The deterioration is confined practically entirely to cracking, either obviously or presumably, over the reinforcement. That is to say, scaling of face concrete is not at all conspicuous although there are some evidences of it. As a rule, however, the condition of slabs on sea walls and of bulkhead walls apparently of mass concrete, or at least of concrete only lightly reinforced, is good. On the piles themselves corner scaling, in the case of square or hexagonal sections, is not especially notable, nor is there any pronounced deterioration of the face concrete. Cracks are without doubt over the steel.

No attempt was made to trace the history or learn the precise design of the structures. They vary in age from one to eleven years (the latter being the Santa Monica pier which has failed) and they were built by different people, under the design of different engineers. It is probable that there was little in common in the methods used, though the chances are that the materials used are the same. The concrete with hardly an exception is what would be called good; that is, it is superficially dense, smooth and hard, with no evidence of porosity. It is just the kind of concrete that would satisfy an inspector or which would be pointed to with pride by a builder. Any trouble with the concrete itself lies much deeper than can be determined by ordinary methods of inspection.

The depth of the steel cannot be determined accurately in every case, but all evidence points to a covering generally of less than 2 in. and in some of the badly cracked piles the steel will be found at a depth less than

TABLE I. CONCRETE TEST PIECES IN SEA WATER IN BOSTON HARBOR AND CONDITION IN 1912

(Pieces 16 x 16 in. x 16 ft. Placed Feb. and March, 1909, by Aberthaw Construction Co., Boston, Mass.)

No.	Cement	Mixture	Amount Water	Remarks	Condition—Oct. 31, 1912
1	Normal portland	1 : 1 : 2	Dry		Back and sides in good condition. Face porous and eroded.
2	Normal portland	1 : 1 : 2	Wet		Good condition.
3	Normal portland	1 : 1 : 2	Very wet		Back and face slightly eroded; otherwise good condition.
4	Normal portland	1 : 2½ : 4½	Dry		Face badly eroded entire length, most at mid-tide. Back and sides good as when placed, but poorly spaded.
5	Normal portland	1 : 2½ : 4½	Wet		Good condition.
6	Normal portland	1 : 2½ : 4½	Very wet		Good condition; edges at low tide slightly worn.
7	Normal portland	1 : 3 : 6	Dry		Very poor condition. Portions entirely submerged and entirely out of water in good condition, but portion affected by tide badly eroded to maximum depth of 9 in.
8	Normal portland	1 : 3 : 6	Wet		Face and sides good. Back eroded in mid-tide section, depth 4 in.
9	Normal portland	1 : 3 : 6	Very wet		Good condition.
10	No iron in cement	1 : 1 : 2	Wet		Good condition.
11	No iron in cement	1 : 3 : 6	Wet		Good condition.
12	High alumina cement	1 : 1 : 2	Wet		Good condition.
13	High alumina cement	1 : 3 : 6	Wet		Back slightly flaked at low tide, mid-tide edges eroded.
14	Low alumina cement	1 : 1 : 2	Wet		Good condition.
15	Low alumina cement	1 : 3 : 6	Wet		Back slightly flaked at low tide.
16	Iron ore cement	1 : 1 : 2	Wet		Good condition.
17	Iron ore cement	1 : 3 : 6	Wet		Slightly scaled on all sides, 3 ft. above low water.
18	Slag portland cement	1 : 1 : 2	Wet		Back slightly flaked at high tide for 3 ft.
19	Slag portland cement	1 : 3 : 6	Wet		Back badly eroded below high water mark, depth 3 in. Face and sides slightly eroded at low tide. Back very soft. Edges eroded below high water
20	Normal portland	1 : 3 : 6	Wet	Extra mixing	Four sides slightly eroded at low tide.
21	Normal portland	1 : 3 : 6	Wet	Sea water used	Lost.
22	Normal portland	1 : 3 : 6	Wet	Add 10% hyd. lime	Edges badly eroded at mid-tide, depth 4 in., length 2 ft. Low-water faces slightly eroded.
23	Normal portland	1 : 3 : 6	Wet	Add soap and alum	Edges badly eroded at low tide, depth 3 in., length 4 ft. Edges on front face slightly eroded for whole length.
24	Normal portland	1 : 3 : 6	Wet	Add 5% colloidal clay	Edges slightly eroded, otherwise good.

half that. But while the deterioration is more rapid and intense where the covering is light, there is evidence that the penetration of the corrosive salts can go much deeper than 2 in. at times, though the relation between the depth of penetration and quality of concrete is not well established. It is noteworthy that all along this shore well-made lamp posts of dense good concrete consistently show cracks, though the steel be well embedded and the post far back from the water itself.

The examination of these piers is a revelation as to what will happen to what may be called good journeyman concrete in seawater in a warm climate, for of course it never drops anywhere near freezing here. There are a dozen or more piers in this 30-mile stretch, costing well over a million dollars, and unless all present indications are wrong the whole lot will have to be replaced in ten years, just as the Santa Monica pier is now being replaced. In fact at least one of the piers is now in a dangerous condition and should be closed to the public. The failure is progressive and certain, for once the fine hair crack appears over the steel, the final result is as inevitable as a chemical reaction. With the high unbraced bents common to these piers it is probable too, that excessive vibration is set up in heavy weather which serves to hasten the separation of concrete and steel at the cracks.

Tests in Boston Harbor

The concrete test-pieces recently examined in Boston Harbor were placed there in February, 1920, as a part of an investigation into the effect of seawater on concrete, particularly in a freezing climate. The specimens were in the shape of square piles, 16 x 16 in. section and 16 ft. long, which were hung under the cap piece of a wharf in Charlestown Navy Yard, in such a position that the bottom would always be immersed while the top would always be above high water. Twenty-four specimens were made, using different kinds of cement, consistency and proportions. Reinforcement, in the way of two ⅝-in. twisted bars with a heavy embedment was added to strengthen the pieces in handling.

The pieces have been examined in 1910, 1912 and finally in June, 1920. The earlier examinations were reported in *Engineering Record*, Aug. 19, 1911, and *Engineering News*, Nov. 20, 1913. The latest inspection is covered most thoroughly in a booklet just issued by the Aberthaw Construction Co., from which the data given herewith is taken.

TABLE II. CONDITION OF BOSTON HARBOR TEST PIECES IN JUNE, 1920

Specimen	Condition June 9, 1920
1	Eroded no worse than 1913. Broke when placed on pier due to weight of one end. Concrete in center badly rotted along cracks which were invisible before specimen broke. Cracks existed for some time.
2	In good condition.
3	Unchanged since 1913. Good condition.
4	Bottom no worse than 1913. Large pits at back corners mid-height. Top half covered with oil.
5	Back at mid-height badly pitted. Otherwise in good condition as 1913.
6	Corners gone mid-height. Bottom sound. Front pitted. Reinforcement exposed mid-height. Fine aggregate rotted about ½ in. in depth mid-height.
7	Entirely gone between high and low water. Top of bottom part badly disintegrated. Fine aggregate rotted to about ½ in. in depth below high water.
8	Same condition 1913. Back badly gone 3 ft. from bottom to 3 ft. from top. Steel exposed in back face. One bad hole about mid-height halfway through. Another about three-quarters.
9	Front corners badly eaten between high and low water.
10	As good as 1913. Concrete solid.
11	Large hole in front face nearly half way through between high and low tide. Concrete worse at about high water.
12	Corners broken slightly. Face is slightly pitted about mid-height. Bottom and top good.
13	Badly eaten between high and low water. Concrete very rotten at depth of 1 to 2 in. in middle. Corners could be broken off in large chunks.
14	Good condition.
15	Pitted at low water on face and sides. Outer concrete of forners rotted ¼ in. in depth. Fairly good condition.
16	Good all over. Corners very sharp.
17	Badly pitted on faces between high and low water. Coarse aggregate exposed. Concrete fairly solid.
18	Good on face and sides, back slightly pitted. Concrete sound.
19	Specimen missing.
20	Pitted on all faces from high tide to bottom. Corners badly gone. Back corners badly pitted but not gone.
21	Lost.
22	Entirely gone in middle, about 4 ft. at top, 6 ft. at bottom remaining. What remains badly rotted.
23	Concrete between high and low water badly rotted. Less than half of original area of specimen remains between high and low water.
24	Face, side and back pitted between high and low water. Back corners badly eaten.

Table I shows the variation in composition of the specimens and gives a brief statement of their condition in 1912. The 1920 condition is given in Table II.

In the opinion of the engineers who examined the specimens the crude oil coating of the piles has something to do with their present condition. The increasing use of crude oil in and around the Charlestown Navy Yard has resulted in a great deal of it floating on the surface of the water. This, moreover, appears to have deposited on every one of the test specimens a coating of tar-like material varying from more than ¼ in. thick at the top to practically nothing at low water. This coating was found to be even more tenacious than ordinary tar and practically impossible to remove without the use

of gasoline or some other similar liquid. The engineers think that under present conditions very little seawater touches these specimens and the coating would make them almost permanent. It was noticed in the earlier inspections that there was a large number of barnacles covering all surfaces of the specimens. At the time they were inspected in 1920, however, there were no barnacles between high and low water, very few mussels below low water and a considerable amount of marine growth resembling jelly fish adhering to the specimens under water. Apparently the oil destroys all marine growth with which it comes in contact.

Study of the table and of the views of the specimens does not offer any definite reason as to causes of deterioration. The report itself says "While at this time it seems hardly advisable to offer an opinion as to the comparative quality of the various specimens, or even to imply that these test piers have, as yet, definitely proved any action or non-action of seawater, it seems reasonable to call attention to the fact that specimens 2, 3, 4, 16 and 18 show little or no effect from their twelve years' immersion." It will be noted that all of these specimens are of a 1:1:2 mix and were mixed "wet" or "very wet." Apparently, too, specimens 1, 7, 11, 13, 22 and 23 are in the worst condition. These are all 1:3:6 "wet" mixers, except No. 1, which is 1:1:2 "dry." Variations in cement or special additions seem not to have had any effect.

Unusual Trestle Filling Methods on the Soo Line

Dumping from Side and Main Trestles—Base Spread by Hydraulic Sluicing—Fill Material Rehandling by Steam Shovel

IN RECENT work of filling old timber trestles on the Minneapolis, St. Paul & Sault Ste. Marie Ry. the contractors have included combinations of hydraulic sluicing and dumping from both main and temporary tracks in order to meet local conditions.

Blackhoof Trestle—At Blackhoof, Minn., the railway crosses the Blackhoof River on a 500-ft. trestle 80 ft. high, with an approach 700 ft. long and 25 ft. high. The bents are of framed timber, set on a pile foundation and spaced 15 ft. c. to c. A 30-ft. steel span carries the track over the main river channel, but previous to the filling a 24-ft. concrete arch culvert 220 ft. long was built to take care of the river. To give clearance for the construction of this culvert, three trestle bents were

FIG. 1. BASE OF FILL [illegible]

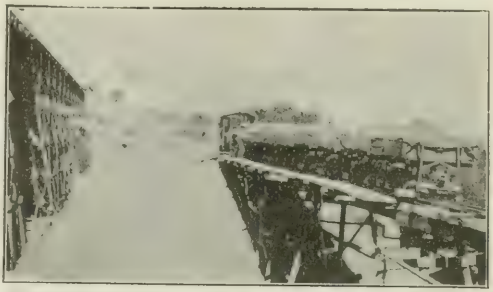


FIG. 2. ONE OF THE SIDE DUMPS FOR FILLING (MAIN LINE TRESTLE AT THE LEFT)

removed and replaced by a timber deck truss span, as shown in Fig. 1.

As no suitable filling material was to be had in the vicinity, the railway company hauled sand by work trains from its Moose Lake pit, about twelve miles distant. The slopes of the hills on either side of the river are very steep and the soil is a soapy red clay, making a treacherous foundation on which to place a fill. To put in the base of the embankment without endangering the concrete culvert or moving the bents of the bridge out of alignment, it was decided to spread the dumped material by sluicing, as river water was available and the filling material would flow readily. Two steam duplex pumps with 6-in. suction and 4-in. discharge were installed on the upstream side, the water being delivered through two 2½-in. hose lines with 1½-in. nozzles.

Cribs of old bridge ties were built on both sides in line with the headwalls of the culvert to hold the material, frequent openings being left in the cribs to allow the water to run off. These openings were blocked as the sand was filled up to them. Material was hauled onto the old trestle by work-trains and was plowed off to both sides with a center plow, being deposited on a sand bar between the concrete arch and the old river channel. In the intervals between trains the material was leveled by "washing," so as to maintain a uniform pressure on the culvert and on the bents of the bridge. The base was carried up in this manner to a height of twenty feet.

On this foundation temporary trestles 30 ft. high were constructed, from which the work of filling was continued. In this manner two separate fills were constructed, one on each side of the bridge, each 20 ft. wide on top and located so that the outside slopes would conform with the final slope line of the bridge fill. One of these side fills is shown in Fig. 2. The space between these two embankments and the filling up to the main line grade will be done next season by the railroad company, dumping directly from the top of the bridge. The stringers will not be removed until the season of 1922, thus allowing time for settlement of the fill.

Material for making the two side embankments was delivered at the bridge approach by the work trains, being plowed off to form a stock pile, from which a steam shovel loaded 1½-yd. dump cars of 24-in. gage, as shown in Fig. 3. Two ten-car trains were used, each hauled by an 8-ton steam locomotive. An under-crossing was provided by skewing two bents of the trestle, thus allowing material to be hauled entirely from one side of the approach. About 90,000 cu.yd. of filling have been placed during the past season.

FIG. 3. STEAM SHOVEL LOADS DUMPED MATERIAL

Beverly Trestle—At Beverly, Wis., a trestle 1,200 ft. long and 40 ft. high, with frame bents on pile foundations, carried the line across a muskeg or marsh bottom. Drilling tests indicated that hard bottom existed at 10 to 40 ft. below the surface. Material for the fill was obtained by widening a cut at one end of the bridge, borrowing on one side of the track only. This material varied from sand and clay to deposits of large boulders.

A pile trestle was built on each side of the bridge, just inside the prism of the new fill, these trestles being 20 ft. high, with pile penetration of 15 to 40 ft. The material was loaded by a steam shovel into 2-yd. dump cars of 24-in. gage. Three trains of fourteen cars each, with 10-ton steam locomotives, were employed. As the borrow pit was at the elevation of the main line, there was a 3 per cent grade down to the dumping trestle. Bents in the bridge were skewed to allow a construction track to pass through. Material was dumped from both trestles to maintain a uniform pressure.

In order to prevent the bridge from being raised by the settlement of these two side fills, material was dumped also from the main track on the bridge. The timber guard rails were removed and a rail was laid outside of each main line rail to form a 24-in. track on each side of the bridge. A movable rail section provided a crossing of the main-line rail. From these two narrow-gage tracks material was dumped outside the bridge on both sides and into the center, alternate bridge ties being removed to permit of dumping between the main track rails. With this system of tracks, material could be deposited wherever necessary to prevent crowding caused by unequal settlement. The trestle has been filled to the top, a total of about 150,000 cu.yd. being dumped, but owing to the continued settlement of the embankment it will be necessary for the railroad company to do some additional finishing next season. The stringers will not be removed before final settlement.

Morris & Dougherty, St. Paul, Minn., had the contract for filling both these trestles, the work being under the direction of J. E. Finley as their engineer. E. A. Whitman is chief engineer of the Minneapolis, St. Paul & Sault Ste. Marie Ry.; the assistant engineers in charge were W. H. Stedje at the Blackhoof bridge and D. McIntosh at the Beverly bridge.

Commercial Association and Engineering

More than one-third of the 70 activities of the Denver Civic and Commercial Association listed as accomplishments in 1920 in the *Denver Commercial* relate to engineering or is of vital interest to engineers. The association has an engineering section.

Leakage from Machine Banded Wood Pipe

By J. L. Campbell
Chief Engineer, El Paso & Southwestern Ry.

In discussing the relative merits of cast-iron and wood pipes J. W. Ledoux, in *Engineering News-Record*, Nov. 11, 1920, p. 932, says of leakage from wood pipes: "Under very favorable conditions it may be possible to obtain results where the leakage will not be greater than 500 gal. per inch of diameter per day per mile. With the best form of joint, pipe and quality of wood a very tight pipe can sometimes be secured."

Some twelve years ago a pipe line 140 miles long, of which 110 miles are machine-banded wood pipe, was built for the El Paso & Southwestern R.R. The construction of this pipe was under my direction, as has been its maintenance to date. Recently, I had made a test of leakage from this wood pipe on two sections, consisting of unbroken hourly weir measurements day and night for one week of the water delivered into and from the pipe. On the first section, the pressure varied from 1 to 125 lb. with a mean pressure of about 75 lb. On the second section pressures were 1, 125 and 55 lb.

The first section consisted of 11.5 miles of pipe, of which 51 per cent is 21, 28 per cent is 16 and 21 per cent is 10 in. in diameter, equal to a mean equated diameter of 17.29 in. The 21-in. and 5,000 ft. of the 16-in. pipe have cast-iron collars; 5,000 ft. of the 16-in. has wood collars and the balance of the pipe has mortise and tenon joints. The interior diameter of the iron collars is $\frac{1}{8}$-in. less than the exterior diameter of the spigot on the end of the pipe, making a tight driving fit.

On this section, the mean daily leagage was 3,000 gal. equal to 15 gal. per inch of mean diameter per mile per day. There was no measurable leakage from the pipes having the iron collars. These collars and the pipe on which they were placed were made of superior material under our specifications and inspection.

The second section of conduit consisted of 28.15 miles of pipe, of which 12.1 per cent is 14 in.; 7.8 per cent is 13, 10.4 per cent is 12; 25.4 per cent is 11; 3.2 per cent is 10; 20.7 per cent is 7.5 and 20.4 per cent is 5 in. in diameter, equal to a mean equated diameter of 9.64 in. The 14-, 13- and 4,800 ft. of the 11-in. pipe have wood collars. The balance has mortise and tenon joints.

On this section, the mean daily leakage was 71,000 gal., equal to 262 gal. per inch of mean diameter per mile per day. There was no material leakage from the pipe having the wood collars.

On the first section, the total loss by leakage was 0.20 per cent of the total water delivered into the pipe. On the second section, the loss was 6.35 per cent.

The first section of the line delivers the water from the source of supply in the mountains 8,000 ft. above sea level to a storage reservoir on the adjacent plateau 1,000 ft. below and the second section delivers from the reservoir to the railway in the valley 1,700 ft. lower than the reservoir.

My experience leads me to the conclusion that if wood pipe is satisfactory in the matter of leakage, its design, materials, construction and laying must be first class in all particulars. When so made and laid, it should be substantially water tight for the conditions for which it is properly designed, especially if it has good cast-iron collars for the joints. A good wood collar will keep the leakage within satisfactory limitations. All our wood pipe is now made under our own specifications.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

For the Use of the Personal Pronoun

Sir—I was taught in school that a letter should never commence with the word "I." I was also taught that to use the word "I" frequently during a letter indicated a certain amount of conceit on the user's part. I observe that the writers of the letters in your columns almost invariably abstain from the use of this word.

I wish to protest against this ridiculous custom. The only substitute for the offensive word "I" is the cumbersome expression "the writer" which is eight letters and a space longer. In these days of conservation and of high efficiency it is needless to emphasize the economic loss caused by this false modesty.

On p. 805 of your issue of Oct. 21, 1920, there are two letters dealing with the same subject in which the expressions "the writer" and "the author" simply confuse the reader as to what the letter writers are talking about. I tried to read them but my feeble brain could not keep track of the persons indicated by these expressions.

By the same token I would like to see the authors of your technical papers say "I think this" or "I believe that" instead of "the writer thinks," or "the writer believes," or "it is believed." If they did this the reader would never be in any doubt as to whose thoughts or whose beliefs were being put forward.

C. T. BRADY, JR.,
Resident Engineer, U. S. Steel Products Co.
Buenos Aires, Argentina, Nov. 20, 1920.

Gillette's "Earthwork and Its Cost"

Sir—Mr. Hammond's review of Gillette's "Earthwork and Its Cost" in *Engineering News-Record*, Sept. 16, 1920, p. 567, and Mr. Gillette's comments on the review, Nov. 18, 1920, p. 1001, open up a subject which merits additional discussion.

It is probable that if statistics could be assembled on the subject it would be found that much more harm comes from the lack of published cost data than from the misuse of what little is published. It is not customary for a contractor to allow an inexperienced man to prepare an important bid with the aid of a handbook. If the contractor keeps intelligible cost records of his own, they are used; if not, a more or less accurate guess is made, but the figuring or the guessing is always done by the most competent men in the organization. Sometimes these men hold stubbornly to ideas which are the result of their own experience, scorning the aid of a handbook which might give them valuable assistance. In any event the danger of the office boy wrecking the concern by the careless use of a handbook is very remote.

The span of a human lifetime is so short that one man can personally gather only a very small portion of the technical data which he must use in his work; this applies to cost data as well as to all other technical information. We must depend for a large part of our ideas on the experiences of others as we find them recorded on printed pages. As a man increases in experience he becomes more competent to intelligently interpret and use the results of others' experience, which ability is of vastly more value to him than his notebook record of his own personal experience.

It seems that the importance of cost data is not properly emphasized in our colleges. This is partly due to a feeling on the part of the professor that any cost figures he may give the student will be out of date and useless by the time the student is ready to use them, and partly because the professor very rarely has cost data in his possession. The result is that the subject is touched on very lightly and the young man goes to his first job with an exaggerated idea of the relative importance of pure technical knowledge as compared to a knowledge of costs and methods of doing work, and it is usually several years before he gets the proper sense of proportion.

Practically all decisions on questions of engineering design and construction, from the smallest detail of design to the question of the feasibility of a large project, are, in the final analysis, based on cost.

Most engineers need more knowledge of costs. We have no right to ask contractors, manufacturers, or railroad companies to publish the intimate details of their business, but we should have more cost data published on public works.

If anyone wants to publish reliable cost data let us not discourage him. CHARLES P. DUNN.

Seattle, Wash., Dec. 30, 1920.

A Few Lapses in Textbooks

BY R. FLEMING,
American Bridge Co., New York City

The writer has had the mortifying experience of having his attention called to errors on the printed page where he had given especial attention to the manuscript and had read the proof. If errors are found in articles of a few columns in length, is it surprising that they occur in textbooks of a few hundred pages? No author can claim infallibility. With the greatest care on his part some one is liable to find an occasional error or a statement expressed so that it may mislead. A few "lapses," to use a borrowed term, in leading textbooks will be cited.

Burr, in "The Elasticity and Resistance of the Materials of Engineering," gives formulas for the deflection of beams due to shearing stress. The deflections found by these formulas are but a small fraction of those obtained by other writers. Burr errs in introducing the Moment of Inertia of the beam into his formulas. The usual method of considering the shearing deflection to be the same as that of a beam of rectangular cross-section with depth and breadth equal to depth and thickness of the web is much more nearly correct.

In Heller's "Stresses in Structures" under "Columns in Towers" we read: "The bracing in the vertical planes holds the columns against buckling in two directions

only. To prevent buckling in a diagonal direction the horizontal braces *AC* and *BD* may be used." There can be no buckling in the direction of horizontal diagonals from wind forces. This is readily seen by passing a horizontal plane through a 4-post tower at a panel point. Each corner is held in place by the bracing in the adjoining vertical planes. To distort these corners in a diagonal direction the diagonal rods in the vertical planes must become longer, and this is impossible without stretching them beyond their elastic limit.

In this connection it may be noted that an adequate treatment of wind bracing in water towers is lacking in our textbooks. It is usually stated that wind stresses in a post are maximum when the wind is blowing in the direction of a diagonal passing through that post and the center of the tower. Attention, however, is not called to the side bracing, unless it is to special cases. In 3- and 6-post towers, wind stresses in side bracing are maximum when the wind is blowing in the same direction as for maximum post stress, but in 4- and 8-post towers the wind stresses in the members, exclusive of posts, of any side are a maximum when the wind is blowing in a direction parallel to that side.

Another subject needing fuller treatment in many textbooks and a more consistent treatment in others is that of initial tension. Merriman and Jacoby in "Roofs and Bridges, Part I" are in error when they state that if the wind tension in a diagonal of the lateral system is less than twice the initial tension, the maximum stress equals the initial tension. In accordance with their own presentation of the subject, the maximum tension in such cases is equal to the initial tension plus one-half the tension due to wind.

A paper in the "Second Annual Report of the National Advisory Committee for Aëronautics" (Washington, 1917), begins: "Ten years ago there was only one laboratory in France in which researches on the resistance of air were carried on in a systematic manner. . . . At this epoch they were still teaching in certain engineering schools, regarding the resistance of air upon planes inclined to the direction of the wind, the law of the square of the angle of incidence, although it had long been demonstrated that this law, applied to the flight of birds, led to absurd conclusions." Some textbooks, Spofford's "Theory of Structures" among others, still follow the teaching thus condemned.

A striking illustration of the difference between theory and practice is found in Johnson, Bryan and Turneaure's "Modern Framed Structures, Part III, Design." Appendix C gives a clear exposition of oblique bending moments as determined by the use of the S-polygon, and in Chapter XI this method is applied to the design of purlins for sloping roofs. As a result the author finds that for trusses 15 ft. apart, a slope of 6 in. to the foot and covering of No. 20 gage corrugated sheet metal, the purlins should be 8-in. I-beams, spaced 4.1 ft. apart. In practice 6-in. channels are used with tie rods extending from purlin to purlin and over the ridge of the roof. In an acquaintance with more than a thousand roofs the writer does not know of 8-in. I-beams being used for purlins under corrugated sheet metal where trusses are less than 20 ft. apart. Writers of textbooks give scant mention or neglect altogether the use of tie rods for connecting purlins of roofs.

Another instance where theory and practice are not in accord is in the specifications for steel frame buildings given by Professor Ketchum in his textbooks. He specifies, "No metal of less thickness than $\frac{1}{4}$-in. shall be used except for fillers." If this provision were followed the most commonly rolled channels under 12 in. and beams under 7 in. would be prohibited on account of their web thicknesses being less than $\frac{1}{4}$ in. The writer suggests the following clause be used instead:

"No steel in any structural member subject to stress shall be less than $\frac{1}{4}$ in. thick, except the webs of rolled beams and channels. Steel subject to the action of harmful gases or severe atmospheric conditions shall be not less than $\frac{5}{16}$ in. thick."

Many textbooks and handbooks give empiric formulas for the weight of steel roof trusses. As the writer has pointed out (*Engineering News-Record,* March 20, 1919, p. 576) these formulas are of little value. Some are greatly misleading. It is a sign of progress that in the 21st edition of the Carnegie "Pocket Companion" the absurd formula for the weight of roof trusses found in previous editions is omitted and none given to take its place.

Typographical errors are probably more annoying to the busy engineer than any others. A plus sign given instead of the multiplication sign, the decimal point misplaced, the parenthesis marks omitted, an "l" used instead of "/," or vice versa, all lead to wrong conclusions. Such errors can be avoided only by vigilant and repeated proofreading.

In conclusion, the writer acknowledges an obligation to each of the books mentioned. He has them all close at hand, and again and again have difficulties been cleared up by their help. In truth,

"Errors like straws upon the surface flow,
He that would search for pearls must dive below."

White Lead in Paint

Reviewed by A. W. Carpenter
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WHITE-LEAD: Its Use in Paint. By Alvah Horton Sabin, M. S., D.Sc., Author of "Technology of Paint and Varnish," "Red-Lead," etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall Ltd. Cloth; 5 x 7 in.; pp. 133. $1.25.

An interesting and useful little book written by a real authority on the subject is this work by Prof. Sabin. It shows a thorough belief in the superiority of the basic carbonate white lead over all other white paint pigments and presents that belief in a convincing and readable manner.

The author states that the book is "for the instruction and guidance of those whose need and use of this material [white lead] prompts them to seek knowledge about it of a simple but reliable sort rather than for the chemist and scientific expert." It certainly seems to attain this object.

Historical references to the manufacture and use of white lead are interesting and entertaining. Modern processes of manufacture of the material and the peculiar properties resulting from the different processes are described. Other white pigments—including zinc oxide, basic lead sulphate, lithopone, leaded zincs and auxiliary pigments (frequently termed inert pigments)—are described in turn more or less fully, with their characteristics as paint pigments.

Prof. Sabin is an advocate of basic carbonate white lead as the sole base pigment for house paints and does not admit any improvement, nor equality at reduced cost, by admixtures of white zinc, lead sulphate or inerts. He gives formulas for priming and succeeding coats for exterior and interior woodwork, new and repainting, and for plaster walls in gloss, egg-shell and flat

finish for interior work, always using the basic carbonate white lead as the sole pigment material with linseed oil, turpentine and drier for the vehicle (except in third-coat flat finish work where the linseed oil is replaced by a small proportion of varnish). He tells how one should proceed to mix and tint paint by hand after these formulas, and how the paint should be applied, what brushes are used and how they should be cared for, and other useful and essential information, together with scientific explanation. Ready-mixed paints are treated in a discussion which shows their merits and defects and points out the greater opportunity for profit ir selling inferior mixtures.

A feature of Prof. Sabin's paint formulas is the liberal proportion of turpentine in those recommended for the priming, first and second coats. It is rather to be regretted that nothing is said of the possibilities of single-coat work in repainting, which in these days of high cost is well worth considering and can be successfully practiced, according to the reviewer's experience.

A unique and useful feature of the book is a sheet of tabulations showing the various formulas and the costs of the ingredients thereof, from which the cost per gallon of the combined materials in the resultant paints can be readily derived from varying market prices of the component ingredients. The table also shows the amount of paint produced by each formula and the area in square feet that it will cover in spreading.

The book is to be recommended to the user of paint for wooden and plaster surfaces, either amateur or professional, and to others interested in paint technology and painting practice.

Planning for Minimum Service Cost

Reviewed by HARRY BARKER
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FINANCIAL ENGINEERING: A Text for Consulting, Managing and Designing Engineers and for Students—By O. B. Goldman, Consulting Engineer, Professor of Heat Engineering, the Oregon State Agricultural College, etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 271; illustrated. $3.50.

The more an engineer practices, the smaller becomes the proportion of cases where only one construction, layout, or procedure is feasible, or where temporary investment limitations dictate the design to the detriment of ultimate economy in service. More and more the problems of a public utility or industrial engineer become the selection of equipment from various available types and the design of works along alternative lines. Alertness is needed in planning to develop required service at a minimum of final expense. Generally speaking, a good grasp of matters of finance, earnings, true expense burdens and cost apportionments have been an attribute of mature years, experience and study, for comparatively little has been published except in scattered and incomplete papers, and knowledge has been passed along slowly in restricted measure from mind to mind in personal contact. Therefore Prof. Goldman's book will be specially welcomed by the younger engineer.

The author's plan in this book is to present certain data, axioms, corollaries and theories, all of which lead to computations illustrating how one scheme or another yields service at the lowest cost. Some readers may feel that he has been so specific and unqualifying in his tables, formulas, and solutions that from what is there given they may pronounce final judgment off hand; but only the veriest amateur would hazard, without making his own studies under his own local conditions, the dictum that (for instance) a high-speed simple engine renders ultimate service at less cost than a simple low-speed engine if the hours of service are more than 461.1 per annum and is in turn displaced by the compound engine at 532.1 hours' use. Few readers will have the temerity to look up from these pages and say that, for a 100-hp., 25-ft. head, centrifugal pumping installation, five 520-hp., 2,300-gal.-per-min. units produce cheaper service than two 50-hp. 4,800-gal. per-min. machines.

It is not extremely material, either, whether the book appears difficult in spots; or whether cvery reader agrees with every detail of the author's method or exposition. No book in this field can do better than to suggest explorations; each man must secure his own basic data, make his own assumptions, and pursue his own calculations until he is satisfied with his own answer.

The author's method is (1) to find the annual operating cost of a design and to capitalize it, on the assumption that the same service will continue indefinitely, and (2) to capitalize a cost of depreciation by taking the sum of present worths of investments and reinvestments. The sum of these two capitalized amounts yields the equivalent figure for an investment the income from which would pay for the service rendered. This equivalent investment, to which the author gives the name "vestance," is a measure of the comparative desirability of two designs.

The simple comparisons are extended by dividing this hypothetical *equivalent investment* ("vestance") by the hours of effective service per year, to secure a "vestance per hour" from which can readily be found the hours of service for which one design becomes more economical, all things considered, than some alternative. The scheme is extended in another way by dividing the equivalent investment ("vestance") by various service units, such as cubic feet per second of flow capacity for pipes, to locate that rate of service (velocity of flow in the case of pipes) which requires the least investment.

All this discussion fills 70 per cent of the volume. The rest of the book shows a study of cost apportionment with variable hours of service, with load changes and with operating costs fluctuating with the load changes. The author introduces a multitude of tables of approximate pre-war prices and operating data for boilers, engines, pumps, gas producers, dams, canals, hydroelectric plants, gas producers, etc.

The prospective reader should be warned that he may find the early part of the book disconcerting because of a few radical dicta, though these unaccepted precepts do not really interfere with the study of the author's way of analyzing a design. The author, for instance, early says that his "Financial Engineering" does not invade the field of economics. Yet later, speaking of demand and supply, he avers that "even the most elementary study shows that there is no such law." Also on p. 16, in speaking of risk, he says, "this is something evidently not the basis of interest but rather the want and distress of the user."

The author is not in harmony with a large company of engineers when he denies that "depreciation" can include loss of value from dilapidation (wear and tear) but must cover only obsolescence, inadequacy, and uselessness from lack of demand for service. He would place even major replacements of long-lived items in operating expenses, neglecting for the moment the fact that this would distort the annual expenses of certain

years and render precarious the sacrificed investment in equipment whose life is fixed by irreparable delapidation rather than obsolescence and inadequacy. But in arriving at depreciation as a real computation, the author employs a life table in which dilapidation theory evidently determines life as much as obsolescence and inadequacy. Moreover, the author regards depreciation as a "trust fund" solely for renewing property worn out, or crowded out, and denies the findings of economists and eminent jurists that it is a repayment of investment sacrificed in giving service, to be repaid to the investor and by him put back into renewals, or into his pocket if he pleases.

New Edition of Bellasis' Hydraulics

REVIEWED BY ROBERT E. HORTON
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HYDRAULICS WITH WORKING TABLES—By E. S. Bellasis, M.Inst.C.E., Recently Superintending Engineer in the Irrigation Branch of the Public Works Department of India, Author of "River and Canal Engineering," "Irrigation Works," etc. Third Edition. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 348; illustrated. 18/- net.

The first edition of this book, published in 1903, was marked by an unusual amount of original matter and concise and piquant descriptions and discussions of hydraulic features of Indian engineering works. The present edition possesses the same characteristics but is rendered somewhat more cosmopolitan by the inclusion of a critical discussion, somewhat after the order of that used by the late Philip A. Morley Parker in his well-known book on "Control of Water," and covering more recent investigations down to the time of going to press, in all countries, particularly in the United States.

The book is essentially a working manual rather than an exhaustive treatise. Details of experiments are rarely given but there are fairly complete tables of coefficients of various kinds, deduced from experiments on weirs or orifices, pipes and channels.

Glancing through the book, there appears to be an unusually small amount of mathematical discussion, but many of the minor formulas and numerical expressions are run in with the text, and formulas are printed in ordinary type, which renders them less conspicuous than in some other books on hydraulics.

Regarding flow in pipes and channels, the author quotes Houk's conclusion that "the Bazin formula is inferior to Kutter's for all types of open channels, and that although the Kutter formula is not ideal, it is the best available." The author accepts this conclusion. He also takes the position that for practical purposes it is preferable to retain the Chezy type of formula with the exponents of r and s each $\frac{1}{2}$, rather than to attempt to modify this formula by the use of other exponents in such a manner as to render the coefficient constant. However, he gives various other formulas, including that of Manning, and adapts the Manning formula to this viewpoint by expressing the coefficients therefor as a function of r with exponent $\frac{1}{6}$.

Extensive tables of values of coefficients for use in the Bazin and Kutter formulas, particularly the latter, are given, and also a table of the values of the coefficient c in the Chezy formula derived from Manning's formula. These tables afford a ready basis of comparison of the results to be obtained by the Manning and Kutter formulas for a given channel and value of n, and will be found very convenient to that numerous class of engineers which is in the position of making a transition from general use of the Kutter formula to the use of the Manning formula in their practice.

Forty-one pages are devoted to a discussion of variable flow, following generally the lines of discussion of this subject in the early editions of the book. In this discussion, the author attacks backwater problems by methods which are original and enlightening.

Other features of hydraulic practice receiving special consideration are the silting of irrigation channels and the design of non-silting channels. Considerable attention is devoted to hydraulic observations by means of floats, current meters, and other devices. The section on meters is based mostly on European practice.

A subject of great importance on which literature is exceedingly meager is that of unsteady flow in open channels. The problem of the downstream advance of changing stage in a river channel, when the gates of an upstream reservoir are opened or closed, is discussed in a section covering six pages. This discussion is clear and illuminating, but not based on experiments and is essentially hypothetical. It does not go far enough to serve as a reliable guide in practical calculations of the time required for waters from a reservoir to reach a point downstream, for the reason that it does not take into account the occurrence of pressure waves, nor the limiting conditions where the advance takes place in the form of a tidal bore. Experimental data to elucidate this problem are greatly needed.

On the whole, this book is commendable for its lucidity and conciseness. Typographical and numerical errors appear to be unusually rare. It is a book which the practicing engineer will do well to consult before making final decisions in regard to a given problem, if for no other purpose than to obtain the benefit of the new angles of view which it presents on many matters. It is a book which the young engineer seeking to lay the foundation for a broad knowledge of hydraulic practice will do well to read.

[The first edition of the book was reviewed by the late George W. Rafter in *Engineering News*, Aug. 20, 1903.—EDITOR.]

Autobiography of a Leading British Municipal Engineer

REMINISCENCES OF A MUNICIPAL ENGINEER—By H. Percy Boulnois, M. Inst. C. E. London, Eng.: St. Bride's Press, Ltd. Cloth; 6 x 9 in.; pp. 120.

Following his long career as a municipal engineer and an author on related subjects, Mr. Boulnois, by writing the present volume, has won the distinction of being the first city engineer to write an autobiography. Why Mr. Boulnois did this can be best expressed in his own words:

> One of my objects in writing this book was to give to the general public some better conception than they would seem to have at present of the work which devolves on a municipal engineer. Incidentally, its contents may show that such an official can take an interest in literature and in other subjects outside the scope of his daily duties. I am not aware that any other engineer has ever been sufficiently venturesome to write his life, and in this respect, I believe, the book is unique. My aim has been to make these reminiscences not only interesting but amusing, and as to how far I have been successful in this I must leave my readers to decide. "Nil sine labore."

Unless by the words "any other engineer" Mr. Boulnois means it to be understood any other *municipal* engineer had previously written his own life, he is in error, as witness at least the one example of McCarthy's

two lengthy volumes of "Incidents" noted in this section Dec. 11-18, 1919, p. 1021, and Oct. 21, 1920, p. 807. This oversight, however, in no way detracts from the value and interest of Mr. Boulnois' "Reminiscences." In fact, it only reinforces the general argument for more autobiographies by engineers since the "Incidents" as well as the "Reminiscences" so greatly enrich engineering literature. It may be noted in passing that another British municipal engineer rendered a distinctive service to engineering literature a few years ago. We refer to "The River Irwell: Pleasant Reminiscences of the Nineteenth Century and Suggestions for Improvement in the Twentieth Century," by J. Corbett, borough engineer of Salford (*Engineering News*, April 16, 1908, p. 441). Mr. Corbett's book was to some extent autobiographical, since among other things recorded he told of work he had done as member of the Salford Council for five years and as borough engineer for fifteen years to clean up and improve the River Irwell.

During his forty years in municipal engineering work, Mr. Boulnois was successively surveyor of Exeter (1874-83), engineer of Portsmouth (1883-90), engineer of Liverpool 1890-7 and inspector and then deputy chief engineering inspector of the British Local Government Board, retiring from the latter position by age limitation in 1911. From that date until the war broke out Mr. Boulnois was in consulting practice.

Mr. Boulnois' engineering education, so far as schooling was concerned, was obtained in the School of Applied Science of King's College (London), which at that time shared with Trinity College (Dublin) the distinction of being the only university where engineering was taught in England, Mr. Boulnois states. When Mr. Boulnois entered the school mentioned, in the spring of 1862, the staff consisted of Charles Percy Bysshe Shelley, brother of the celebrated poet, as professor of mechanics, and four others who taught (1) geometry, (2) chemistry, (3) surveying and (4) geology and mineralogy. There was "no chair of sanitary science, and in those days," Mr. Boulnois states, "it is doubtful if there were many men in the whole of the United Kiugdom who knew anything at all about sanitation."

Leaving King's College toward the end of 1863, Mr. Boulnois was engaged, for about a year, "as a sort of unpaid assistant" to a French engineer who had charge of some railway construction in France. On Jan. 1, 1865, Mr. Boulnois was articled to Joseph Bazalgette, who was then engaged, besides his private practice, as chief engineer of the London Metropolitan Board of Works. The pupilage expired in 1869, but Mr. Boulnois was retained by Mr. Bazalgette for another year as an assistant on various private works. Of his articles to Mr. Bazalgette, Mr. Boulnois writes:

> One of the few documents I have preserved is that of my articles, in which I am described as "an infant of the age of 19 years," and in which it is stated that the premium paid was £420. Further, that I became his "pupil and apprentice in the profession, business, or employment of a civil engineer," and that I bound myself to "faithfully, diligently, and honestly serve him and obey his lawful commands," and also that I [illegible] and behave myself as a good, true and faithful pupil and apprentice." At the same time my guardians, who were my mother and my eldest brother, undertook to "find and provide me sufficient meat, drink, lodging, clothes, washing, medicine, medical attendance, and all other necessaries." For all this my "master" agreed that he "should and will according to the best of his skill and knowledge, teach and instruct, or cause to be taught and instructed the said (me) as his pupil and apprentice in the practice, profession, business, or employment of a civil engineer," and a great deal more of the usual legal jargon.

Mr. Boulnois gives as one of the reasons for quoting extracts from his articles the fact that "the question of the proper wording of articles of indenture of engineering pupils is being considered at the present time."

Between the period of his service with Mr. Bazalgette, Mr. Boulnois was for a year or so in Jamaica as district engineer under the surveyor general, engaged chiefly on construction and repair of government buildings, bridges, etc., and for a few months he was in Buda Pesth with a former fellow pupil who had a contract for asphalt pavement construction.

While at Exeter Mr. Boulnois conducted one of the earliest water-main scraping operations for the removal of incrustation. This was "about the year 1880." The work is described in some detail in the book before us. Donald Cameron, who later on introduced the septic tank, was chief assistant to Mr. Boulnois at Exeter.

In the portion of his book devoted to his experiences at Liverpool, Mr. Boulnois gives some very interesting information regarding the Liverpool Health Act, passed by Parliament in 1842, which he says was "the first act ever obtained which contained power to enforce sanitary regulations." In 1846 the Liverpool Sanitary Act empowered the council to appoint, subject to approval by one of the principal secretaries of state, "a person duly qualified as a civil engineer to act as local surveyor" and by an act of Parliament in 1854 it was provided that this official should be known as "the borough engineer."

Here and there through the volume, and particularly in its closing chapter, Mr. Boulnois recounts various literary activities, not all of which were confined strictly to engineering subjects. In 1883 he published "The Municipal and Sanitary Engineers' Handbook." His "Modern Roads" was noted in this section, April 15, 1920, p. 784.

One of Mr. Boulnois' more distinctively literary efforts was a paper before a literary and scientific society on Du Maurier's "Peter Ibbetsen." This paper, having been sent to the author, brought out a very interesting letter which is published in Mr. Boulnois' "Reminiscences," followed by a critical comparison by Mr. Boulnois of "Peter Ibbetsen" and "Trilby." Mr. Boulnois prints in his concluding chapter some verses entitled "The Tale of a Newly-Made Road," beginning:

> Scarcely had the roller left it, left it a compacted mass,
> Than a dark-browed man surveyed it, said there was a smell of grass—
> Sent for ruthless men who dug it, dug it out in trenches wide,
> Filled these chasms up at random, caring not if they'd subside.
> Forthwith came a gaunt inspector, said a water-main had burst,
> Followed suit, and dug more trenches—of the two he was the worst.

There is also reprinted a short story by Mr. Boulnois and a single-act play taking off a local government board inquiry.

We have given a large amount of space to this little book because of its interest and in the hope that by calling attention to it there may be stimulated further additions to the scanty list of engineering autobiographies.

Iron and Steel Making

REVIEWED BY W. P. BARBA
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THE MAKING, SHAPING AND TREATING OF STEEL—By J. M. Camp and C. B. Francis. Second Edition. Pittsburgh, Pa.: The Carnegie Steel Co. Leather; 5 x 8 in.; pp. 614; illustrated. $5.

Characterized briefly, this book, now in its second edition, is a much-needed contribution to the elementary literature of iron and steel making. In the reviewer's forty years of active experience in the making of fine steels, there has always been apparent the utter lack of a book so elementary that it could be given to a man not specifically trained in the art. There was no book that did not demand a basic knowledge of chemistry, of physics and of mechanical practice, including a good deal of electrical engineering.

The book under review, primarily prepared to instruct the large sales force of the U. S. Steel Corporation, has largely a local application in its descriptions of plants and equipment. However, it has been broadened and amplified so that it almost covers the requirement noted. The definitions are in plain language and are complete and highly informative. Although in some cases they do require further research by the reader into the original sources, this further research is stimulated, and the direction well indicated.

All praise is due the authors for the illuminating and interesting way in which they have handled in ten pages of the first chapter what a second-year college student would take a term to acquire from the original sources. In the chemical section, covering the atomic theory and the laws of combining by definite proportions, a more difficult task is set the student; the description of elements and the basic definitions, however, is particularly concise. The section on ores, raw materials and refractories, again, is plain, easy reading.

"Fuels" begins with an introduction, comprising in the briefest form known to the reviewer the laws covering the use of fuel and the data necessary to support these laws. Down to where pyrometers are treated, this chapter is wholly commendable. But as to pyrometers, the whole book is deficient in its treatment of the requirements and usefulness of pyrometric measurement, and it is recommended that when the third edition is brought out, the section on pyrometric work be amplified.

There is some redundancy in the description of the composition and chemical makeup of the compounds entering liquid fuels, and the effect on the reader is likely to be confusing. But when gaseous fuels—chiefly those prepared from coal—are treated, the book is complete and informing. The powdered coal section might well be amplified in a later edition, since there is within reasonable view an end of the natural gas supply in the iron and steel district, and recourse is even now being had to powdered coal and colloidal fuels. The chapter on "Fluxes and Slags" is, if anything, too detailed, yet somewhat incomplete. The casual reader must discriminate between the excellent short definitions and the widely extended chemistry of these difficult compounds.

Manufacture of pig iron is treated in an easy, intelligent manner, and the only lack noticed by the reviewer is that no particular mention is made of the Gayley method of refrigerating the blast, in order to remove moisture and standardize the water content of the air sent through the blast furnace. Particular commendation should be given the very comprehensive collection of data carried by Fig. 23 on p. 168, since the number of men, even metallurgists, who know that it requires 16,458 lb. of material to produce 2,240 lb. of pig iron is limited. The whole chapter on the reactions of the blast furnace is very useful and easily understood.

Under the head of the Bessemer process, particular attention is directed to the authors' definition of "steel," (a difficult matter), which will leave no doubt in the mind of even a court or a jury as to the distinction between steel and the other varied forms of iron manufacture.

The authors give an adequate historical description of the basic openhearth process and its principles. While it does not pretend to be a comprehensive study of steelmaking in the basic openhearth, there is inherent evidence that the authors have complete knowledge of good practice in the making of basic steel. In turn, they make the statement that in no plant of the Carnegie Steel Co. is there an acid openhearth furnace at work, and in so far as they fail to deal with acid openhearth practice the book is not a comprehensive compendium of the steel manufacturing industry.

Attacking the comparatively new subject of electric furnace manufacture of steel, the authors have seen fit to give a great deal of space to a discussion and development of technical laws which, in the opinion of the reviewer, serve to complicate the thought of the untrained reader before he approaches the fundamental statement that in the electric furnace the electricity is merely a superior and easily controlled form and source of heat, enabling high temperatures to be reached and controlled, and in a controlled atmosphere, as required for the ultra-refinement process looked for in the electric furnace. The diffuse statements concerning the use of electric current for the production of this heat might well be modified. As to furnaces and their operation, however, the descriptions of the authors are most satisfactory. The chapter is closed by an excellent summary, and but one suggestion needs to be made: The summary should state that the electric furnace process does not of itself guarantee that the product is of ultra-refinement.

The largest single section of the book is taken up with the shaping of the steel and the mechanical properties of steel. This is easy, plain reading. Chapter IV on the Making and Preparation of Ingots, with a large amount of information, makes but one reference to bottom-poured ingots, although in the East most ingots for the rolling of plates are bottom-poured, while in the West this is less usual. It is the reviewer's belief that in a subsequent edition the authors should give some attention to bottom pouring.

Attention may be directed to the instructive diagrams of rolls, roll passes and the manner of the reduction of section.

The discussion of defects and their causes, p. 413-415, should be studied and memorized by everyone using or producing steel. These short three pages give a common meeting ground which will solve more sales difficulties, if thoroughly absorbed and practiced, than any other three pages in the book.

The section on forging of axles, etc., is rather too detailed a description of a particular plant to be useful in a general textbook, and hence must be considered mainly as special information, but interesting in that

the practice described is advanced practice. The last paragraph of this section, Advantages of Heat Treating Axles, is one of the few instances in this book of argumentative reasoning, but the reviewer bears testimony to the soundness of the argument here advanced.

Part III, The Constitution, Heat Treatment and Composition of Steel, is one of the most fundamentally difficult sections of the book. The authors essayed to make plain to the casual reader many of the newer and most abstruse observations developed by the use of microscopic research methods and of the theories which underlie them. Again the authors have done a good piece of work, and one who reads what they have offered and supplements it with even a little special following-up from original sources will have a knowledge of a subject which only a very few years ago was confined to a few highly specialized laboratories in large universities.

Thin paper, good printing and flexible back combine to make a convenient light-weight book of 614 pp., which should be in the traveling bag of every salesman and on the desk of every purchasing agent and works executive handling steel products. Its contents should be in the possession of everyone who produces, uses or deals with this material, which is the base of the business pyramid of the world.

A Memorial Pamphlet

THE DISCOVERY OF ELECTROMAGNETISM MADE IN THE YEAR 1820—By H. C. Oersted. Copenhagen, Denmark: Published for the Oersted Committee at the Expense of the State by Absalon Larsen.

Facsimile reproductions of the original Latin pamphlet of the Danish physicist Hans Christian Oersted; entitled, "Experimenta Circa Effectum Conflictus Electrici in Acum Magneticam" and of translations published soon afterward in French, Italian, German and English, together with a Danish reprint. The English translation appeared in 'Annals of Philosophy," Vol. XVI, pp. 273-76, London, 1820. A short preface in French and in English gives a biographical sketch of Oersted.

Oersted's essay is worthy of a high place in technical literature, not only because of its historical and scientific importance but also as an example of clear and concise writing. The biographical preface says: "The pamphlet is very much condensed; in fact, it is so brief that in many parts of it each line can be said to describe an experiment."

It may be added that Oersted was professor of physics at the University of Copenhagen; made many researches and wrote numerous technical works; was of "a very poetical nature"; "stood in close relation to most of the leading intellectuals of the day; was the "good genius of the world-famed poet, Hans Andersen," and wrote a pamphlet on "The Spirit in Nature."

Naval Consulting Board

NAVAL CONSULTING BOARD OF THE UNITED STATES—By Lloyd N. Scott, Lieut. Commander, U. S. N., and Liaison officer to the Naval Consulting Board and War Committee of the National Societies, from Inventions Section, General Staff, U. S. A. Washington, D. C.: Navy Department. Cloth, 6 x 9 in., [illegible] pp.; illustrated.

Although the preliminary chapters on the remarkable work of the industrial preparedness campaign of the Council of National Defense are somewhat fulsome, the main part of this book, describing the activities of the Naval Consulting Board, is well worth while. The author assumes personal responsibility for all of his statements but the publication is official. It reveals many of the secrets of war invention and illuminates the difficulties of the inventions boards which had to deal with thousands of patriotic citizens whose zeal to help the Government far outweighed their technical ability or knowledge of the state of the arts they were trying to improve.

Library of Reclamation Service

A reference library of 3,000 volumes is maintained at the Washington office of the U. S. Reclamation Service. Every year a history of the progress of each project is prepared by the engineer in charge. There are now more than 1,000 of these project histories on file. In the section devoted to the histories there are included specifications, plans, photographs and cost data. The engineering section contains 400 selected books on irrigation and engineering subjects. Other sections relate to public documents of the Reclamation Service, related departmental publications, state publications and periodicals. More than 100 foreign engineers and officials have taken advantage of the library's facilities.

For schools, colleges and associations the library has a dozen motion picture films which it loans on request. Official photographs and slides of construction, operation and settlement are on sale at estimated cost.

In the recently issued *"List of Publications No. 5,"* a 6 x 9-in. pamphlet of 95 pp., there is noted a list of standard designs on which the Denver office has been at work for several years. These designs are the "shelf hardware," so to speak, of an irrigation works for they represent the combined experience of all the projects. The subjects include gates, bridges, buildings, checks, drops, pipe, concrete turnouts and weirs.

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other person indicated.]

THE ATLAS HANDBOOK ON CONCRETE CONSTRUCTION—New York: The Atlas Portland Cement Co. Flexible Cover; 4 x 7 in.; pp. 144; illustrated. $[illegible]

A very complete condensation of the art and practice of making concrete. Useful for the amateur and with some information of value to the professional. Announced as costing $2 but probably available for nothing to those who deserve it.

BUREAU OF MINES: Report by the Director to the Secretary of the Interior, 1920—Washington, D. C.: The Bureau. Paper; 6 x 9 in.; pp. 149; illustrated. Free from Superintendent of Documents.

CANADIAN CANAL STATISTICS, 1919: Prepared in collaboration with the Department of Railways and Canals, Ottawa, Can.: Dominion Bureau of Statistics. Paper; 7 x 10 in.; pp. 55.

CHIEF OF ENGINEERS, U. S. ARMY: Report to the Secretary of War. Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 2088.

COMMISSION ON WATERWAYS AND PUBLIC LANDS: Report. Boston, Mass.: The Commission. Cloth; 6 x 9 in.; pp. 96.

COMPRESSED AIR PLANT: The Production, Transmission and [illegible] Compressed Air and Special Reference to Mine Service—By Robert Peele, Mining Engineer and Professor of Mining in the School of Mines, Columbia University. Fourth Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 506; illustrated. $4.50.

In this edition a chapter on "Measurement of Air Consumption" has been added and a note on compressed air lift-work at a

mine in Mexico has been inserted. The first edition was reviewed in *Engineering News*, Sept. 17, 1908, p. 319, and in *Engineering Record*, Sept. 26, 1908, p. 363.

CONFERENCE ON EMPLOYMENT AND EDUCATION: Held by the American Association of Engineers, Report, 1920—Chicago, Ill.: The Association. Paper; 6 x 9 in.; pp. 48.

CONTRACTS IN ENGINEERING: The Interpretation and Writing of Engineering-Commercial Agreements—By James Irwin Tucker, B.S., LL.D., Assoc. M. Am. Soc. C. E., Chief Engineer, Continental Asphalt & Petroleum Co., etc. Second Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 331. $4.

The first edition was noticed in the Engineering Literature Section of *Engineering News*, Oct. 13, 1910, p. 25, and in *Engineering Record*, Nov. 12, 1910, p. 558. The present edition contains approximately 25 pp. more than first.

DEPARTMENT OF HIGHWAYS OF THE PROVINCE OF SASKATCHEWAN, CANADA: Report, 1919-20—Regina, Sask. Can.: The Department. Paper; 7 x 10 in.; pp. 113; illustrated.

DER EISENBETON SEINE BERECHNUNG UND GESTALTUNG—Von Rudolf Saliger, Dr.-Ing., ord. Professor der Technischen Hochschule in Wein. Vierte nn e Bearbeitete und Erweiterte Auflage. Stuttgart, Germany: Alfred Kröner. Paper; 7 x 10 in.; pp. 552; illustrated. Paper, 44m. Bound, 54m.

DIE MASCHINEN-ELEMENTE IHRE BERECHNUNG UND KONSTRUKTION: Mit Rücksicht Auf Die Neueren Versuche—Von C. Bach, Dr.-Ing., Württ, Staatsrat, Professor Des Maschinen-Ingenieurwesens, Vorstand Des Ingenieurlaboratoriums Und Der Materialprüfungsanstalt Der Technischen Hochschule Stutthart. Swölfte, Stark Vermehrte Auflage. Erster Band, Unter Mitwirkung von Dipl.-Ing. Julius Bach, Stuttgart, Germany: Alfred Kröner. Paper; 8 x 11 in.; pp. 504; illustrated.

THE ESSENTIALS OF DESCRIPTIVE GEOMETRY—By F. G. Higbee, M. E., Professor and Head of Department of Descriptive Geometry and Drawing, The State University of Iowa. Third Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 218; illustrated. $2.25.

In this edition changes in text and illustrations have been made along lines indicated by classroom use. The first edition was noticed in *Engineering News*, Sept. 16, 1915, p. 551.

THE ELECTRIC FURNACE—By Henri Moissan. Authorized Translation by Victor Lenher, Ph.D., University of Wisconsin. Second Edition. Easton, Pa.: The Chemical Publishing Co. Cloth; 6 x 9 in.; pp. 313; illustrated. $3.50.

Apparently a reprinting merely of a translation first published in 1904. Describes various forms of furnaces employed by the author in research work and the researches made therewith.

THE FEDERAL WATER POWER ACT: With a History of Water Power Legislation and a Topical Synopsis—Washington, D. C.: Black, McKenney & Stewart, Engineers. Paper; 6 x 9 in.; pp. 37.

A useful codification of the water-power act, and a reprint of the act itself.

FRANKLIN AND MacNUTT'S PHYSICS TEXTS: For Colleges and Secondary Schools—By William S. Franklin and Barry MacNutt. LESSONS IN MECHANICS: pp. 221; $2. LESSON IN ELECTRICITY AND MAGNETISM, pp. 254; $2.25; LESSON IN HEAT, pp. 147; $2. Bethlehem, Pa.: Franklin and Charles. Cloth; 6 x 9 in.; illustrated.

HOW TO KEEP INVENTION RECORDS: Together with an Explanation of the Nature of Industrial Property—By Harry A. Toulmin, Jr., J.D., Litt.D.; with an Introduction by James T. Newton, Sometime U. S. Commissioner of Patents. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. $3. $2.

INDUSTRIAL MACHINERY IN FRANCE AND BELGIUM—By Charles P. Wood, Trade Commissioner. Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper; 6 x 9 in.; pp. 61; illustrated. 10c. from Superintendent of Documents.

INLAND AND COASTWISE WATERWAYS SERVICE: Report of the Chief to the Secretary of War, 1920—Washington, D. C.: The Service. Paper; 6 x 9 in.; pp. 138; illustrated.

INTERSTATE COMMERCE COMMISSION: Report, 1920—Washington, D. C.: The Commission. Cloth; 6 x 9 in.; pp. 205.

LANDSCAPE-GARDENING—By O. C. Simonds—New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 338; illustrated. $6.

LEHRBUCH DER MATHEMATIK HERAUSGEGEBEN VON ESSELBORN: Erster Band; Algebra, Geometrie der Ebene und des Raums, Darstellende Geometrie, Schattenkonstruktionen, Perspektive—Bearbeitet von F. Meisel, H. Roth, E. H. Schutz; pp. 613. Zweiter Band; Trigonometrie, Analytische Geometrie, Differential- und Integralrechnung, Mechanik, Festigkeitslehre, Baustatik—Bearbeitet von G. Ehrig G. Chr. Mehrtens; pp. 770. Leipzig, Germany: Verlag Von Wilhelm Engelmann. Paper; 8 x 11 in.; illustrated. Each volume; paper, 64m.; bound, 79m.

LOUISIANA ENGINEERING SOCIETY: Proceedings, Dec., 1920—New Orleans, La.: The Society. Paper; 6 x 9 in.; pp. 328; illustrated.

THE MINING LAWS OF THE BRITISH EMPIRE AND OF FOREIGN COUNTRIES: Vol. I. Nigeria—By Gilbert Stone, Sometime Scholar of Caius College, Cambridge, Tancred Student of Lincoln's Inn, of the North-Eastern Circuit, etc. London, Eng.: Imperial Mineral Resources Bureau. Cloth; 6 x 9 in.; pp. 254.

MODERN WELDING METHODS: Oxy-Acetylene, Thermit, Electric Arc and Resistance; A Complete Treatise of the Art of Joining Metals Based on Data Furnished by the Leading Authorities on This Subject—By Victor W. Page, M.S.A.E., Author of "The Modern Gasoline Automobile," etc. New York: The Norman W. Henley Publishing Co. Cloth; 6 x 9 in.; pp. 292; illustrated. $3.

MUNICIPAL LANDING FIELDS AND AIR PORTS: With Chapters by the Chief of the Army Air Service, the Director of Naval Aviation, and their Officers in Charge of Landing Field Operations—Compiled and Edited by Gearge Seay Wheat. New York and London: G. P. Putnam's Sons. Cloth; 5 x 8 in.; pp. 96; illustrated. $1.75.

NATIONAL ASSOCIATION OF RAILROAD TIE PRODUCERS: Proceedings, 1920. St. Louis, Mo. E. E. Pershall, Secy. Paper; 6 x 9 in.; pp. 138.

NEW YORK PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT: Report, 1917—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 1047.

NEW YORK STATE CITY PROBLEMS: 1920 Proceedings of the Eleventh Annual Meeting of the Conference of Mayors and other City Officials. Albany, N. Y.: Secy., Wm. P. Capes. Paper; 6 x 9 in.; pp. 146. $1.

NEW YORK STATE DEPARTMENT OF HEALTH: Report, 1918. Albany, N. Y.: The Department. Cloth; 6 x 9 in.; pp. 365.

ONTARIO PROVINCIAL BOARD OF HEALTH: Report, 1919—Toronto, Can.: The Board. Cloth; 7 x 10 in.; pp. 295; illustrated.

PENNSYLVANIA DEPARTMENT OF LABOR AND INDUSTRY: Vol. VII, No. 6; Report of the Activities of the Industrial Board; pp. 46; No. 7: What Pennsylvania is Doing for Safety and Safety Codes—By Dr. Clifford B. Connelley, Commissioner. pp. 20. Harrisburg, Pa.: The Department. Paper; 6 x 9 in.

THE PRACTICAL DESIGN OF PLATE GIRDER BRIDGES—By Harold Hughes Bird, Assoc. M. Inst. C. E., Assoc. M. Inst. Mech. E. Philadelphia, Pa.: J. B. Lippincott Co. London: Charles Griffin Co., Ltd. Cloth; 6 x 9 in.; pp. 180; illustrated. $4.

For "young engineers and draftsmen engaged on the design of constructional steel work," particularly "for those whose training has been more on the theoretical than the practical side."

THE PRACTICE OF RAILWAY SURVEYING AND PERMANENT WAY WORK—By S. Wright Perrott, M. A. I., M. Inst. C. E., Professor of Civil Engineering in The University of Liverpool and F. E. G. Badger, A. M. Inst. C. E., Director of Housing of the City of Liverpool, etc. New York: Longmans, Green and Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 303; illustrated. $10.50.

PRINCIPLES OF HUMAN GEOGRAPHY—By Ellsworth Huntington, Research Associate in Geography, Yale University and Sumner W. Cushing, Late Head of the Department of Geography in the State Normal School, Salem, Mass. New York: John Wiley & Sons, Inc. London: Chapman & Hall Ltd. Cloth; 6 x 9 in.; pp. 430; illustrated. $3.50.

PUMPING BY COMPRESSED AIR—By Edmund M. Ivens, B.E., M.E., M. A. S. M. E. Second Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 226; illustrated. $4.

Some 30 pages of text and 18 illustrations, together with several formulas and tables have been added to this edition, consisting "principally of some very reliable and carefully compile operative data." The first edition was noticed in *Engineering Record*, Oct. 30, 1914, p. 494, and in *Engineering News*, Nov. 19, 1914, p. 1048.

REORGANIZATION OF SCIENCE IN SECONDARY SCHOOLS: A Report of the Commission on the Reorganization of Secondary Education, Appointed by the National Education Association. Washington, D. C.: Bureau of Education. Paper; 6 x 9 in.; pp. 61. 10c. from Superintendent of Documents.

RESEARCH AND METHODS OF ANALYSIS OF IRON AND STEEL—Second Edition—Middletown, Ohio: The American Rolling Mill Co. Limp Karotel; 6 x 9 in.; pp. 220; illustrated. $4.

SOUTH AUSTRALIAN RAILWAYS COMMISSIONER: Report, 1919-20—Adelaide, Australia: The Commissioner. Paper; 8 x 13 in.; pp. 53.

STATISTICS OF EXPRESS COMPANIES IN THE UNITED STATES: Report, 1919—Washington, D. C.: Bureau of Statistics. Paper; 8 x 10 in.; pp. 12.

STRAIGHT BUSINESS IN SOUTH AMERICA—By James H. Collins. New York and London: D. Appleton and Co. Cloth; 5 x 8 in.; pp. 305. $2.50.

The publisher's wrapper describes this book as one that gives practical information as to exactly what business conditions are in South America, and a first-hand account of how business is best conducted there, either on the spot by the traveling man or from the home desk.

TASMANIA HYDRO-ELECTRIC DEPARTMENT: Report, 1919-20—Hobart, Tasmania: The Department. Paper; 8 x 13 in.; pp. 39; illustrated.

TESTS OF METALS AND OTHER MATERIALS: Report made in the Ordnance Laboratory at Watertown Arsenal, Mass., 1918—Washington, D. C.: War Dept. Cloth 6 x 9 in.; pp. 329; illustrated.

UNITED STATES COAST AND GEODETIC SURVEY: Report of the Director to the Secretary of Commerce—Washington, D. C.: Department of Commerce. Cloth; 6 x 9 in.; pp. 173; folding maps.

WATER PURIFICATION PLANTS AND THEIR OPERATION—By Milton F. Stein, M. Am. Soc. C. E. Second Edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 270; illustrated. $3.

Notices of the first edition of this valuable work appeared in *Engineering Record*, Aug. 28, 1915, p. 268, and in *Engineering News*, Dec. 16, 1915, p. 1172. In the present edition, Chap. IV., on bacterial tests and parts of Chap. V., on interpretation of such tests have been entirely rewrittten to cover changes in technic and interpretation.

WIE MACHT MAN ZEITSTUDIEN? Arbeits- und Zeitstudien zur genauen Festsetzung von richtigen Stückkohnen in Maschinenfabriken—Von Oberingenieur Eduard Michel, Beratendem Ingenieur, Obmann des Ausschusses für Zeitstudien heim A. w. F. Berlin. (Nach Taylor und Merrick) Nach einem Vortrage vor dem Ausschuss für wirtschaftliche Fertigung mit Aussprache und Nachwort. Berlin, Germany: Vereines Deutscher Ingenieur. Paper; 6 x 9 in.; pp. 167; illustrated. Paper; 20m.; Bound 23m.

WIRTSCHAFTLICHE VERWERTUNG DER BRENNSTOFFE: Kritische Betrachtungen Zur Durchführung Sparsamer Wärmewirtschaft—Von Dipl-Ing G. De Grahl, Baurat Berlin-Schöneberg. Zweite, Den Schwierigen Wierigen Wirtschaftlichen Verhältnissen Angepasste und Daher Vollständig Neu Bearbeitete Auflage. Berlin. Germany: Druck und Verlag Von R. Oldenbourg. Paper; 8 x 11 in.; pp. 487; illustrated.

THE WORLD ALMANAC AND ENCYCLOPEDIA, 1921—New York: The Press Publishing Co., Pulitzer Bldg. Paper; 5 x 8 in.; pp. 896; illustrated. 65c. postpaid.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worthwhile letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Revenue from Garbage Incineration Uncommon This Side the Atlantic

Sir—In an editorial note in your issue of Jan. 6, 1921, p. 6, you state: "The installation and operation of incinerators or destructors requires much capital and yields no revenue." The record of many destructor installations in England shows that they have yielded a revenue for years, and whereas the art of building and operating destructors has not received so much attention in this country as it has in England, revenue in the form of steam for power has certainly been produced for a term of years at Westmount, Que., Milwaukee, and Savannah. The experience gained at these plants has pointed out the way to production of greater revenues in future installations, which condition will be automatically improved by the rising cost in fuel.

Furthermore, it may be said that no discussion of the various means of disposal of city refuse is fair to the destructor which does not call attention to the advantage which the destructor possesses, in that it does not need to be located at a point remote from the collection district, thus saving cost and nuisance of the long haul, which would stand on the same side of the balance sheet as a revenue.

E. H. FOSTER,
New York City, Jan. 10. Power Specialty Co.

[Space limitations confined us to broad generalizations in the note in question. It is quite true that in Great Britain the utilization of heat from refuse destructors is common. But in the United States and Canada, most of the garbage furnaces are of the low- or medium-temperature type which produce no steam while of the thirty high-temperature destructors in the two countries, the three named by Mr. Foster are the only ones so far as we know that produce steam that is used commercially. At Milwaukee the steam went to waste for some time after the destructor was put in use, and although we have tried repeatedly we have never been able to get any figures showing definitely what the net gain to the city is from the destructor steam, after taking into account the extra capital and operating expenses necessary to generate and utilize the steam.

As to haulage economies due to the central location of refuse destructors, both at Milwaukee and Savannah (we cannot say as to Westmount), sites for the destructors might have been used for garbage reduction works with little if any more reasonable ground for complaint. The new sewage-works at Milwaukee will be close by the destructors. Furthermore, reasonable complaints against garbage disposal works of any kind, properly designed and operated, are generally due more to the concentration of the garbage than to its treatment. But public sentiment and prejudice have to be reckoned with, and these are stronger against reduction works than furnaces—largely because popular conceptions of garbage disposal are due to uninformed and ill-informed medical men whose limited teaching on the subject has been to the effect that burning garbage is a sanitary rite, a burnt offering to Hygeia.

Nevertheless, the relative lengths of haul to garbage disposal sites available for hog feeding, reduction or incineration, should always be taken into account in comparing the total costs of garbage collection and disposal, as we intimated, at least indirectly, in the closing words of the note in question.—EDITOR.]

Pulling Stumps With Gin Poles

Sir—In the issue of *Engineering News-Record* of Dec. 9 an article under the heading of "Stumps Pulled by Gin Poles" on p. 1153, written by Jacob L. Crane, Jr., gives credit to Thomas Kelshaw as having devised this scheme. Speaking in the vernacular, this scheme is covered with gray whiskers.

For the past 15 years, where extensive clearing operations were carried on in this Province, it has been performed in most cases by a method similar to that described in the article referred to, generally upon a larger scale.

Large logging donkey engines were used and the gin poles of sufficient length to enable the contractor to pile up the logs and stumps from a radius of 1,500 ft. around the gin pole—these piles sometimes being built up to a height of over 100 ft. A patent grabhook was generally attached to the log or stump, by which means it was released (after being placed on the pile) when the haulback line was put into operation. This system obviated the necessity of keeping a man up on the pile to release the "choker." The crew necessary for the work was usually as follows: One foreman, one engineman and fireman, one powder man, two men preparing stumps for blasting, three chokermen and one roustabout—a total of ten men.

Extensive areas of the Vancouver townsite and the adjoining municipalities were cleared in the manner above described.

H. M. BURWELL,
Dec. 18, 1920. Consulting Engineer.

Highway Research

Sir—In *Engineering News-Record* Nov. 18, 1920, p. 1010, there appears an interesting news item under the caption "National Research Council Forms Comprehensive Highway Investigating Body, Advisory Board on Highway Research to Co-ordinate All Research Agencies, Federal Aid to Be Sought." The object to be attained through the investigations proposed are certainly worthy. For a long time it has been a source of regret to those who are interested in developing the best plans for highway building that there has been no such central research body as is proposed by the National Research Council. Unquestionably the research work has been inefficient through the multiplicity of agencies—generally with insufficient funds—making the investigations. Unquestionably, also, the public generally has not understood the reasons for highway construction as practiced because there has been no authoritative central body to give out clear-cut statements showing why it was necessary to undertake the plans followed. It seeems only fair, however, to offer a word of warning at this time when it is so clearly incumbent upon Congress to economize in every possible way. It would seem since there are already governmental agencies making such investigations as are discussed in the article referred to that these agencies should be clearly specified as the proper ones to carry on the research work in the most thorough manner possible and that all other agencies cooperate, and perhaps combine with this agency, in making the desired investigations. It is unfortunately often true that it is easier to get funds from Congress for something that is new, and perhaps spectacular, than it is to provide adequately for the bureaus and divisions already organized for work, and doing, probably, much more than could be expected with the insufficient funds available.

Several years ago the writer wrote an article, which was widely copied at the time, urging a general plan of road buidling with research work supervised by the federal government and carried on under a bureau of roads. He still believes that plan to be the logical one to be pursued rather than to scatter the funds through the creation of new agencies. Should a U. S. department of public works be established it would obviously be the proper agency for having general supervision of such investigations as are proposed; but the establishment of a new research body within one of the existing departments, or independent of all of the departments, would probably be the addition of one more unit to an already inefficient system.

Denver, Dec. 27, 1920. HIGHWAY ENGINEER.

Air-Inlet Valves for Pipe Lines

Sir—In the article by H. L. Thackwell, in *Engineering News-Record*, Jan. 13, p. 76, the rule for designing air-inlet valves for pipe lines, credited to the "American Civil Engineers' Pocket Book" is not correctly quoted. That rule is found on the bottom of p. 1246 and reads: "As a general rule air valves with a diameter of one inch for each foot in diameter of the water pipe are sufficient." The rule calls for one inch in diameter instead of one square inch in area for each foot of diameter as wrongly quoted by the author.

This rule is empirical, but it is not as bad as the author makes it. Under it, with the entrances or escapes of air at a rate corresponding to a movement of water at a velocity of 4 ft. per second in the pipe, air will pass the valve at a velocity of 576 ft. per second and will require a head of about 10 ft. of water, or one third of an atmosphere, to make it pass the valve. Practical experience with pipe lines has convinced the writer that valves materially smaller than this are not satisfactory. On the other hand, larger valves are required only at the top of high and steep slopes where a break in the pipe, in the valley below, might result in a collapse of the pipe. Even in this case a valve of the size suggested, if it works, will do much toward breaking the vacuum and in most cases would be sufficient.

In a search of the literature on air inlets just made in my office by far the most complete discussion of the subject found was the article by M. L. Enger and F. B. Seely, of the University of Illinois, in *Engineering Record*, May 23, 1914, pp. 594-96. ALLEN HAZEN,

New York City, Jan. 14. Consulting Civil Engineer.

Primitive Wheel-and-Bucket Pumps Used in China

Sir—Having seen in your issue of Sept. 2, 1920, p. 448, an article about different methods used in China for raising water for irrigation and other purposes, I am sending you photographs showing other pumping arrangements used in various places in China. The wheel shown in the view has buckets fastened to the rim. These buckets are so shaped and placed that they are filled when in the water and commence to empty when they get to one end of the trough along side and near the top of the wheel and are empty when the other end of the trough is reached. A dam designed for the passage of boats gives the head that drives the wheel.

The wheels vary in size, but have a diameter up to about 30 ft. They run unceasingly without any care or attention until stopped or a flood puts them out of order.

WHEEL-AND-BUCKET PUMPS IN CHINA

A number of wheels are placed along the rivers and, as they are never greased, they make a squeaking sound that can be heard for a considerable distance. These wheels are used in the province of Hunan; in the province of Szechnan more or less similar wheels are used. The pumps shown on the other two photographs [not reproduced] are similar but worked differently—one with man power and one by oxen. These pumps raise water some 5 to 6 ft. While excavating for bridge abutments in Hunan, and not having any other kind of pumps, I used the man-power pumps and by repumping every 5 ft. lifted water about 20 ft.

There are various other ways of raising water, all suited to the condition of the place. In some places, where the ground is too high for the man-power pumps and also too uneven for ditches leading to all the places where water was to be used, one can see many poles put up all over the country. Another and smaller pole, to the middle of which is tied a rope, is hung from the top of the pole standing in the ground. On one end of the small pole is put some clay-like earth which when dry adheres to the end of the pole; to the other end is hung a bucket. By this arrangement water is easily raised from wells for irrigation.

The Chinese are on the whole good mechanics and workmen. If you give a foreman a drawing to a scale of ⅛ or ¼ in. to the foot he or some of his men will nail some boards side by side on planks and on them will make full-sized drawings of cornices, pillars, bases, doors, windows, etc., for foreign style brick buildings. His drawing instruments consist of a brush such as is generally used for Chinese writings, a square and a rule. While on railway building in Hunan, I had only two men who had been on such work and one who had been in a shop and one on housebuilding. The rest were natives, who had never seen a railway before; but we did all the work required—grading, bridges, of which there was quite a number, tracklaying and station buildings. O. SHERVEN.

Bergen, Norway, Sept. 27, 1920.

Pavement Type Nomenclature

Sir—Mr. Pennybacker's letter printed in *Engineering News-Record*, Nov. 4, p. 908, has been read with some interest. The writer is of the opinion that, although perhaps from a strictly technical standpoint Mr. Pennybacker's contention that qualifying adjectives should precede the word "concrete" in naming pavement types has some merit, yet, as generally understood and accepted, the term "concrete" is sufficiently explicit to convey the meaning.

Not only engineers and contractors, but the general public as well, have become so thoroughly accustomed to thinking of a concrete pavement as one composed of portland cement, sand and stone as to make any further qualifications superfluous. In an experience of over twenty years the writer cannot recall a single instance of a misunderstanding arising from the use of the word concrete in this connection.

Would it not seem more logical to accept the word concrete as the definite name of a particular type of pavement and only qualify by such words as "asphaltic" when the cementing material is other than portland cement? or better still, adopt more definite names for the so-called "concretes" of other materials? Thus, machine-mixed bituminous pavements of asphalt or tar could be called "mixed-asphaltic-macadam" or "mixed-tar-macadam," to differentiate them from those built by the poured method.

E. G. ORBERT,

Milwaukee, Wis., Parsons & Orbert,

Dec. 15, 1920. Consulting Engineers.

The Mass Diagram in Railroad Grading Computations

Sir—Referring to an article on p. 1172 of your issue of Dec. 16, 1920, entitled: "Mass Curve Ordinates Computed by Aid of Adding Machine," I wish to call attention to the unprecedented wholesale use which has been made of the mass diagram in the distribution of grading quantities for the work of the Bureau of Valuation, Inter-State Commerce Commission.

In the Pacific district alone over 50,000 miles of railroad grading computations were handled in this manner. As may be imagined when a work of this magnitude was contemplated, it was necessary to systematize the computing and adopt all possible short cuts. Among these was the use of a computing machine, but, instead of using an ordinary adding machine, which was used by the author of the article referred to, it was found much easier to use a calculating machine of the Monroe type, which permitted the necessary subtractions by a simple reversal of direction in the turning of the crank, and made it unnecessary to "throw in" the nines. Another advantage in using this type of

machine on our work was that of making the necessary computations to take care of shrinkage and swell. No difficulty has been experienced in plotting the minus ordinates downward.

The specifications as finally adopted in the Pacific district include the following:

Free haul, team—500 ft.
Maximum haul, team—2,500 ft.
Swell, solid rock—10 to 35 per cent.
Swell, loose rock—10 per cent.
Shrinkage, all embankments—10 per cent (if over 5 years old.)

A number of rules for making a theoretical and economical distribution of material were adopted so that the same methods would be followed consistently on all our overhaul computing work.

On diagrams covering a series of cuts and fills balancing lines were drawn so that the economical haul was obtained. Briefly the location of these lines was determined by the following rules:

1. From one cut to one fill, make the maximum haul 2,500 ft.
2. From one cut to two fills, make the maximum haul equal in each direction.
3. In a series of cuts and fills, if the number of cuts is equal to the number of fills, or vice versa, make the sum of the maximum hauls in one direction 2,500 ft. greater than the sum of the maximum hauls in the other direction.
4. In a series of cuts and fills, if the number of cuts is one greater than the number of fills, or vice versa, make the sum of the maximum hauls in one direction equal the sum of the maximum hauls in the other direction.

H. J. SAUNDERS,
Supervising Engineer,
Interstate Commerce Commission.

San Francisco, Cal., Dec. 30, 1920.

Concrete T-Beam Designed as Truss

Sir—Recent communications to your journal regarding simple and safe methods of designing reinforced concrete seem to be much to the point. In an effort to arrive at the design of large T-beams by short but rational calculations the writer was led to the method shown in Fig. 1. The values shown in the stress diagram are slightly in excess of the actual stresses. The diagonal stresses in the middle half of the beam can safely be taken by the web.

Beams such as shown in Fig. 2 were designed and successfully built. They carry a dancing and drill floor. A heavy rain washed out the forms the night after these beams were poured, but a level failed to show any deflection the next day. Under full load the deflection was in the neighborhood of ⅛ in. No cracks have shown in five years that are discernible to the unaided eye. The beams were built with a camber of ½ in.

It is recognized that the truss analysis does not apply rigidly to the beam. However, there are a large number of variables in such a beam, and also in any solution for same. The concrete itself may easily vary 5 per cent from its assumed value—or may vary that much in different beams. The load will never be exactly as assumed in the calculations, and, we have taken care of the variable effect of vibration by our "factor of doubt" (factor of safety).

We have also to consider that where a *simple* (approximate) method is used we may require a small additional amount of steel, or concrete, as the case may be, and we *save* the *value* of this on the drafting table and in the field.

JOHN B. HUTCHINGS, JR.

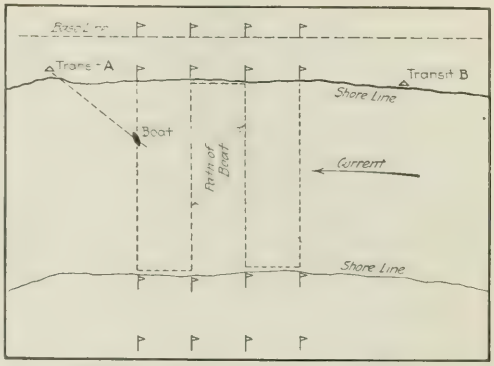
Asheville, N. C., Dec. 10, 1920.

Locating Soundings on Ohio River

Sir—I was interested in reading Mr. Thackwell's "A Few Useful Dodges in Surveying" in your issue of Dec. 16, p. 1164, especially "locating soundings." I would like to describe the method of locating soundings used in connection with preliminary and location surveys for the Ohio River locks and dams, as well as surveys for cross-sections for use in estimates.

A point on the shore was located and a base line run with stakes every 1,000 ft. for preliminary, 200 ft. for location and 50 ft. for construction. From these stations, lines were laid at right angles to the base line across the river and two stakes set for locating flags. The sounding party consisted of six men, as follows: [illegible] man, one recorder; at transit, one observer, one recorder.

The recorder in the skiff directed the oarsmen to row across the river as indicated by the flags set on the shore



METHOD USED IN LOCATING SOUNDINGS

and recorded the readings as given him by the soundsmen. The observer at the transit kept the transit directed at the soundsman and at the moment of sounding stopped its movement, saying "read." The recorder at the transit read the angle, and said "check." Immediately the observer again moved the transit so that the center hair was on the soundsman and the operation was repeated. At every fifth sounding the recorder in the boat waved a flag and this was noted by the observer at the transit so that there was no chance that the soundings and the readings would not agree when they were plotted. By this method soundings could be taken very rapidly and as close together as the soundman could handle the rod.

This method gives very little chance for error unless the boat gets too badly off the line indicated by the flags on shore.

One season when considerable new blood was in the organization and more men were available a check survey was made as follows: Two men were added as another transit party located above the area to be sounded and the soundings located by the intersection of the two transit readings. The boat was held as nearly as possible to the cross lines as before, so that a check on the single intersection method was obtained. The result was very interesting. While plotting the soundings such remarks as: "That is where Jack nearly fell overboard"; "This is where that big log hit them," or "Remember how hard they had to row there to keep on the line" were frequent. The results showed that at no place were the soundings taken more than 15 or 16 ft. off the lines, and as the river bed was fairly uniform up and down stream it made no material difference which method was used.

C. R. ANDREW,
Miller, Holbrook, Warren & Co., Designing Engineers.

Decatur, Ill., Jan. 1.

The Hydraulic Jump

Sir—In your issue of Nov. 25, Julian Hinds, in his article on "The Hydraulic Jump," says near the bottom of p. 1039, "the first derivative of the area with respect to the depth is the width at the water surface." This would only be true in a rectangular section or where

$$A = d \times T$$

In case of a triangular section, for example,

$$A = \tfrac{1}{2} \times d \times T$$

and

$$\frac{dA}{dd} = \frac{T}{2}$$

This would give as a final formula

$$\frac{2A}{T} = \frac{Q^2}{g}$$

or

$$\frac{A}{T} = \frac{V^2}{2g} = h_v$$

Equation (9) will be different for each type of section unless T is defined, not as the width at the water surface but as the average width.

JEPTHA A. WADE.

New York City, Dec. 17, 1920.

Bulking of Sand Noted Years Ago by Feret

Sir—In a note of yours entitled "Wet Aggregates Make Concrete Too Strong," in *Engineering News-Record*, June 24, 1920, p. 1267, the statement is made "When aggregates were proportioned by volume measure, as is customary on most construction work, it was found that the use of wet aggregates requires ½ to 1 bag more cement per cubic yard of concrete than do dry aggregates."

This statement is misleading, and contradicts not only the caption but also other statements in the text. Wet aggregates volumetrically proportioned do not require more cement per cubic yard of concrete than do dry aggregates; but, on the contrary, they require less, for the reason that a unit volume of moist aggregate contains a smaller mass, and consequently less surface area of aggregate than does a unit volume of dry aggregate.

TABLE I.

Weight of water contained in 100 kg. of dry sand (wt. in kg.)		0	0.500	1	2	3	5	10
Loss in weight of 1 kg. wet sand after drying (in grams)		0	5.0	9.9	19.6	29.1	47.6	90.8
Dune Sand	Weight of one cubic meter of wet sand (kgs.)	1.458	1.310	1.238	1.213	1.209	1.208	1.266
Dune Sand	Weight of sand (dry) contained in cubic meter of wet sand (kgs.)	1.458	1.304	1.226	1.189	1.174	1.151	1.149
Beach Gravel	Weight of one cubic meter of wet sand (kgs.)	1.514	1.463	1.412	260	1.221	1.229	1.305
Beach Gravel	Weight of sand (dry) contained in one cubic meter of wet sand (kgs.)	1.514	1.456	1.398	1.235	1.165	1.171	1.187

The importance of noting the percentage of moisture in sand for concrete work, so far as I know, was first emphasized in print twenty-eight years ago, by Feret, the French investigator. This authority on the properties of concrete aggregates and mortars, whose work might be profitably read by modern investigators, published an excellent paper (Sur La Compacité des Mortiers Hydrauliques, M. Feret, *Annales des Ponts et Chaussées*, Mémoires et Documents 7e série, Tome IV, 1892, 2e semestre, pp. 5-164.) supplemented with numerous ingenious curves and diagrams. Among other epoch-making experiments he described in detail the influence that various percentages of moisture exercise on the weight of sand and gravel contained in a unit volume, and in a table he showed the effect of moisture contents up to 10 per cent by weight. I have translated several paragraphs from Feret's paper and make the translation a part of this letter. These paragraphs deal with the effect of moisture on the weight of sand contained in a unit volume in one instance, and with the effects of moist sand upon the richness of mortars in another.

"*Influence of Moisture.*—One of the principal causes of error in the proportioning of mortars may be that there is extreme variation in the settling of the sand in the measuring boxes, this depending upon the percentage of moisture carried by the sand. Up to a certain limit, moisture has the effect of impeding the movement of the grains past each other, and consequently prevents the sand from being compacted.

"We have experimented with two samples of different sands, one being very fine, coming from Boulogne, and the other very coarse obtained on the coast, and used almost exclusively in construction at that port. These sands were shoveled as uniformly as possible into a box having a capacity of 50 liters similar to the standard wheelbarrows which are generally employed for measuring sand used in the mixing of mortars. Each kind of sand, previously well dried so that a sample taken from it lost no weight when heated to 100 deg. C., was mixed with progressingly increasing percentages of water. After each new addition of water, the moistened sand was mixed to perfect homogeneity, and the weight of 50 liters determined. There was then calculated the weight of one cube meter of sand as measured under the conditions prevalent in the field, as well as the weight of dry sand contained in a cubic meter of moist sand. The weights found were as in Table I.

"It is apparent that a very small percentage of water suffices to lower enormously the weight of dry sand contained in a cubic meter. Thus with 2 per cent of water, this weight is about 20 per cent less than the weight of the same sand measured dry. As the percentage of moisture is increased, this weight tends to become constant, increasing but slightly."

"Table II, deduced from the same figures, shows how the richness of mortars may differ, varying, with the percentage of water contained by the sand."

From Feret's data obtained more than a quarter of a century ago, it is evident that mortar and concrete mixtures, in which the sand and gravel are volumetrically measured in the moist condition, will be richer in cement than similar mixtures measured in the dry state.

I would be much obliged to you for publishing this comment in your columns, if for no other reason than that of bringing before the readers of *Engineering New-Record* the much neglected but masterly work of Feret on concrete aggregates and mortars. Much information that has appeared in the recent scientific press in the light of original discoveries will be found lucidly expounded in his paper.

Yours truly,

ALFRED E. W. KING,
Chemist and Testing Engineer,
Bureau of Science.

Manila, P. I.,
Sept. 2, 1920.

TABLE II.

Dune Sand	Mixture sought (Weight of cement required for one cubic meter of dry sand)	Mixtures Actually Obtained by Using Moist Sand Instead of Dry Sand					Weight of Cement Required by One Cubic Meter of Moist Sand, to Obtain Mixtures Sought				
Quantity of water used to moisten 100 kg. dry sand		0	0.5 kg.	1 kg.	2 kgs.	3 kgs.	5 to 10 kgs.	0.5 kg.	1 kg.	2 kgs.	3 kgs.	5 to 10 kgs.
	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.
	200	224	238	245	249	254	179	168	163	161	158
	300	335	357	368	373	381	269	253	244	241	236
	400	446	486	490	497	508	359	336	326	321	315
	500	559	595	612	621	634	448	421	408	402	394
	600	670	714	735	745	761	538	505	489	482	473
	800	895	951	980	995	1,015	716	671	652	643	630
	1,000	1,119	1,190	1,226	1,242	1,270	895	840	816	804	788
	1,500	1,676	1,784	1,839	1,864	1,902	1,342	1,261	1,223	1,208	1,183

[While the title to the note referred to is possibly misleading, the main criticism in Mr. King's letter is due to a confusion in expression. Feret's tests confirm the Bureau of Standard statement that more cement is required (i.e., used under the usual system of proportioning in a given volumetric mix when the aggregate is wet than when it is dry and that, therefore, the concrete is stronger than it is intended to be. If the exact bulking effect of the wet sand was known in each case and the amount of cement varied accordingly, there would be no difficulty.

Mr. King is correct in stating that too little credit is given M. Feret for the remarkable investigations he carried on 20 years before the rest of the profession began to appreciate their importance.—Editor.]

HINTS FOR THE CONTRACTOR

Milk Pan for Reflector for Flood Light

ON THE Caribou development of the Great Western Power Co., on the Feather River in California, ordinary milk pans are used with great success as reflectors for flood lights throughout the work. One of these pans mounted on a standard is shown in the accompanying view. It is of bright new tinplate and carries six bulb sockets with lamps of varying intensity according to the needs of the work. The results are reported to be eminently satisfactory.

MILK PAN REFLECTOR FOR FLOOD LIGHT

Large Concrete Box Culvert Poured at Below Freezing Temperature

By S. W. Aldrich

Resident Engineer, Illinois Division of Highways

IN the construction of a section of Federal-Aid Project 14, Fayette County, Illinois, installation of a number of large concrete box culverts was necessary. Inasmuch as the work was done during November and December, 1920, the method of protecting concreting during cold weather, herein described, is considered unique.

Board slats were nailed on to the 2 x 4 in. uprights—the form supports—and the interior of this space was securely and tightly packed with dry straw. Culvert openings were closed up by heavy canvas sheets. The top of the box also was covered with canvas. Inside the box, three medium-sized oil stoves were kept heated continuously during pouring and for a period of five days after the culvert was poured.

STRAW PACKING ENTIRELY SURROUNDS FORM

During the pouring and until the box was stripped, 6 days later, the lowest temperature was 22 deg. F. No heating of materials was necessary as the day temperature was from 5 to 10 deg. F. above freezing point. On stripping the forms a thorough inspection was made and no effects of frost were noticeable. The writer believes that this method of concrete protection is reliable to temperatures above 15 deg. F.

Five other boxes of approximately the same dimensions as the one here illustrated were constructed at the same time and under the same conditions. The results were similar in each case.

Hoolan Bros., of St. Louis, were the contractors, with R. J. Monahan as foreman in charge.

Old Turntable Girders Used for Bridge

IN THE construction railroad which leads from Howells, Cal., to the Caribou plant of the Great Western Power Co. several rivers are crossed. When the railroad was built it was very difficult to get steel for bridges. The construction engineers, however, in scouting around the country found an old railroad turntable which could be purchased. This was bought and the main girders installed as shown in the view for one of the bridges in two of the lines crossing. The railroad is standard gage and about ten miles in length up the Feather River valley.

TURNTABLE GIRDERS USED FOR BRIDGE

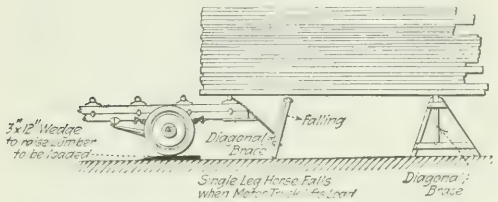
Simple Method Used To Load Lumber on Trucks

A FOUR-LEG lumber horse, a two-leg lumber horse and a 3 x 12-in. wedge are the only necessities for loading lumber upon motor trucks, according to a recent issue of *Lumber*. A description of the method used in loading lumber in this fashion is as follows:

A four-leg horse, built so as to sustain the heaviest lumber loading, is placed at any location accessible by motor truck and within range of the material to make up the delivery order. The horse so placed will then constitute the back support for the load of lumber. A special two-leg horse of strong heavy stock, well braced, is made of the same height as the back four-leg horse, both of these horses standing a little higher than the bed of an auto truck. The two-leg horse will constitute

the front support for the load of lumber. Lumber is piled upon these horses so that the front one is vertical, making the pile and its connection with the two braces rigid.

The motor truck is backed into the load, it being necessary for the back wheels to mount the wedge pieces which are so placed that the extreme back end



TRUCK BACKING UNDER LOAD, RELEASES FRONT SUPPORT

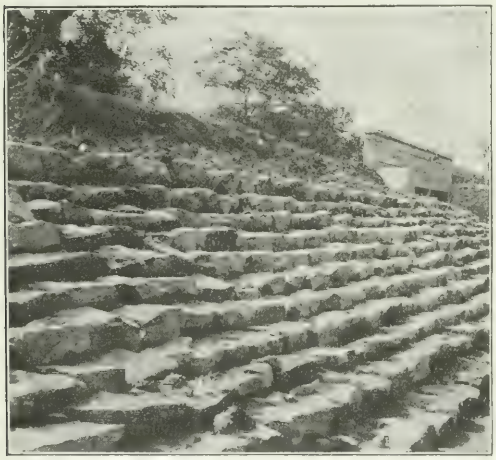
of the truck is well under the load before the wheels mount them. In mounting the wedges, therefore, the truck will lift the entire load, pivoting it on the rear support. With the load thus elevated the two-leg horse is released. The truck can then be backed under the entire load.

This method of operation, however, can only be used to advantage in the case of auto trucks whose beds are fitted with rollers.

Stepped Rip Rap of Large Stone Retains Highway Fill

By F. W. Epps
Bridge Engineer, Kansas Highway Commission

THE accompanying photograph shows a system of using rip rap which was employed on a 2 : 1 fill on a Federal-aid hard-surfaced project in Bourbon County, Kansas. A large amount of fairly uniformly



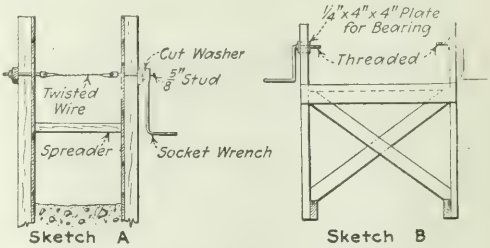
RIP RAP LAID UP IN STEPS ON KANSAS ROAD

sized rock about 8 in. in thickness was available near the site. It was decided to lay the rip rap in steps, a system which proved to be very satisfactory, as it gives a good appearance and fairly uniform slope.

Job-Fabricated Wire Ties for Wall Forms

By Donald G. Coombs
Office Engineer, Braden Copper Co., Rancauga, Chile

WIRE ties, with malleable iron socketed heads, were used for wall forms on the Lake Keechelus dam, with an advantage over both the ordinary tie wired to the studs and the bolt tie, with a pipe spacer. Sketch *A* indicates the method of applying the tie to the form. These ties, wire and heads, complete to length, were cheaply fabricated with the device shown by sketch *B*.



METHOD OF FABRICATING AND APPLYING WIRE TIES FOR WALL FORMS

As shown dotted on the sketch, the heads are threaded onto the projecting ends of the handles, the tie wire is threaded through the holes in the ends of the heads, and the handles are turned in opposite directions until the wire is sufficiently taut. Two laborers with this rig were able to make enough ties for the entire job in less than three days.

New Process for Rapid Kiln-Drying

DEVELOPMENT of a new kiln-drying process for lumber, which makes use of superheated steam, is announced by the Forest Products Laboratory, Maadison, Wis. The process is capable of drying 1-in. softwood lumber green from the saw to 10 per cent moisture in 24 hours. It consists in forcing superheated steam at high velocity through the pile of lumber in the kiln first in one direction and then in the opposite, and accomplishes verp uniform drying with a minimum of checking and warping. The process is more costly in fuel than present processes, and is not considered to be adapted to lumber more than 2 or 2½ in. thick, on account of the danger of injury to the wood from excessive length of exposure to the high temperature. The new process has been found applicable to Douglas fir as well as other firs, Western (but not Eastern) hemlock, white cedar, sugar pine, and yellow pine, but there are some important soft woods to which it is entirely unsuited. It reduces the toughness of the wood slightly, and therefore should not be used for airplane or wagon stock.

Properly Constructed Jetties

Results obtained in securing the passage through the bar at the mouth of the Columbia River are a splendid example of what may be accomplished by properly constructed jetties. Before the jetties were put in the greatest difficulty was experienced in maintaining a depth of 20 ft. across the bar and that channel was irregular and shifting. Now a straight channel of 40 or more feet in depth and 3,000 ft. wide is maintained almost automatically.

NEWS OF THE WEEK

New York, January 20, 1921

G. S. Webster New President of Am. Soc. C. E.

Chief of Bureau of Surveys, Philadelphia, Has Served City Continuously for 46 Years

Forty-six years of continuous service in the engineering departments of the city of Philadelphia is the outstanding feature of the professional record of George S. Webster, who was elected president of the American Society of Civil Engineers at its annual meeting in New York City Jan. 19. Mr. Webster is best known for his work as chief of the Philadelphia Bureau of Surveys, in which capacity he has been the directing head of many large municipal projects, including sewerage and sewage treatment, bridges, city planning, dock and harbor improvements. Mr. Webster was born in Philadelphia in 1855 and was graduated from the University of Pennsylvania in 1875. He entered the city's engineering service as transitman immediately after leaving college and was assigned to work on gravity railroad surveys in Fairmount Park. Until 1876 he served as assistant engineer on surveys for buildings, grounds, railroads and drainage for the Philadelphia Centennial Exhibition, after which, for a few months, he became assistant on the U. S. Coast and Geodetic Survey of Eastern Pennsylvania. When the Lombard St. outlet sewer work was undertaken in 1876 Mr. Webster was appointed assistant in the Philadelphia Survey and Engineering Department, where he continued until 1880 on this project, in addition to the Wingshocking main sewer, and also prepared

(Continued on p. 1[illegible])

Newly Elected President of the American Society of Civil Engineers and Former Chief Engineer, Bureau of Surveys, Philadelphia

GEORGE S. WEBSTER

Civil Engineers Hold Annual Meeting

Factions Avoid Clash at Opening Session — Committee on External Relations Discontinued—New Constitution To Be Drafted and Sumbitted by Original Committee

A victory for the "progressive" group of the American Society of Civil Engineers was won at the annual meeting which opened yesterday at the Engineering Societies Building in New York City when George S. Webster, of Philadelphia, was elected president, with 4,046 votes in opposition to J. Waldo Smith, of New York, for whom 2,819 ballots were cast. The other candidates of the progressive group were also carried into office by substantial margins. A record vote of 7,008 ballots was polled in this year's annual election.

Before the result of the election was announced Gardner S. Williams, speaking for that group which terms itself "progressive" and is designated by its opponents as "radical" pledged pholehearted support for any program which the majority of the society, as shown by its vote for the election of officers, might decide upon. Mr. Williams' declaration came during the discussion of the proposed new constitution for the society and was received with great enthusiasm by an audience which filled the main auditorium and a large portion of the gallery in the 39th St. building. Contrary to predictions of a factional fight, the business meeting, after a period of parliamentary discussion which threatened to stifle constructive work, passed off smoothly, culminating in the announcement of the election to the presidency of Mr. Webster. With President Arthur P. Davis in the chair the meeting opened with the annual report of the Board of Direction, which will be summarized in next week's issue of this journal. The election of the following members of the nominating committee, to serve during the ensuing year was announced, the number preceding each name being that of the district represented: (1) W. T. Chevalier; (3) A. L. Johnson; (5) J. H. Van Wagenen; (6) George H. Tinker; (10) F. E. Weymouth; (11) J. H. Brillhart; (13) T. H. Means.

Speaking for the committee on the bearing value of soils, R. A. Cummings, chairman, presented a digest of six

appendices which represented the year's work. The first of these related to definitions of soils, the second to their mineral composition, the third to the relation of color and its importance, the fourth to factors in soil classification, including the influence of capillary water, water content, texture and size of grain, influence of colloid clay and porosity; while the fifth dealt with definitions of settlement, allowable loads, etc., and the sixth with the laboratory apparatus developed by the committee during the year. In the latter connection, Mr. Cummings spoke of a high speed centrifuge by which it was possible to secure a precipitation of microscopic particles of colloidal clay not hitherto found feasible. The report was accepted and the committee continued in existence.

Stresses in Railway Track

For the committee on stresses in railway track, Prof. A. N. Talbot supplemented the elaborate report submitted last year by a statement of progress, in which it appears that tests have been conducted to demonstrate the effect of curves on track stresses on the Illinois Central, the Delaware, Lackawanna & Western, and the Atchison, Topeka & Santa Fe. The committee also studied the effects on track of flat spots in wheels. The report was accepted and the committee continued.

For the committee on highway engineering, H. Eltinge Breed presented a review of federal-aid work, dealing with the original federal-aid bill passed in 1917 and with the later Townsend bill providing for a national highway system and the creation of a federal highway commission. Two amendments to the national highway bill are needed, he said, the first authorizing an increase over the amount of $20,000 per mile for federal-aid roads and the second a larger appropriation for roads passing thorugh public lands. The committee's report was received and the committee continued.

A progress report, only, was submitted for the committee on bridge design and construction, H. B. Seaman, chairman, stating that one meeting had been held but that work had not yet progressed sufficiently to warrant a detailed report. The committee was continued.

No report was received from the committee on the Alfred Noble memorial. This committee also was continued.

External Relations

Speaking for the Board of Direction, Leonard Metcalf, of Boston, presented a digest of the reports on external relations prepared by a committee of corporate members and reviewed by a committee of past-presidents. The committee of corporate members recommended that the best interests of the society demanded the appointment of an aggressive committee to initiate and consummate through the Board of Direction all matters connected with external relations and to co-operate actively with other allied technical organizations. Such a committee, it was advocated, should be composed fo corporate members of whom one should be a member of the Board of Direction, two from District 1, and one from each of the other districts, appointed by hte Board of Direction and acting with the advice of the membership of each district.

The committee of past-presidents which reviewed the foregoing report, however, concluded that it was not desirable to appoint a continuing committee on external relations and advocated that the Bard of Direction keep in touch with the activities of the Federated American Engineering Societies and co-operate with this and other national organizations with the aim of promoting harmony on questions in which the profession may be of service.

The past president's committee favored the establishment and encouragement of local sections under rules adopted by the Board of Direction.

Acting upon these two reports the Board of Direction, at a meeting Jan. 17, passed a resolution suggesting to the incoming board that matters of external relations be handled by the Board of Direction sitting as a committee of the whole and that local committees be named to work with the board member in their districts, with a view to securing co-ordinated action.

Amendment of Constitution

A report of the committee on amendments to the constitution was presented by Col. Peter Junkersfeld, in which it was recommended that the various suggested amendments on which action is now pending be not adopted, in view of the fact that the committee has practically completed an all-inclusive study and revision of the existing constitution and has had printed a draft of a new document to replace the existing constitution and by-laws.

A long parliamentary squabble on the propriety of discussing the proposed amendments to the constitution, in view of the fact that Col. Junkersfeld's committee had prepared a complete new document which will be presented at the next annual convention, followed the presentation of the committee's report. Under the present constitution a number of proposed amendments to the constitution must go out to the society in the form of letter ballot. George W. Fuller recommended that this letter ballot be sent out with the recommendation that all amendments be defeated, thus clearing the way for the committee's report. It was at this point that Gardner S. Williams made the declaration that the division of the society with which he had been associated—the "radical element," as the opposition called it—would accept the decision of the majority of the membership, as indicated by the election, and work in harmony with the new administration.

The upshot of the discussion was the passage of a resolution, offered by Mr. Fuller, continuing the committee on the revision of the constitution so that it may present its report in time for the next annual convention. Proposals to discuss pending amendments were defeated, as was also a resolution seeking to change the composition of the existing committee by requiring in its membership representation from each of the thirteen districts of the society. It was pointed out by Allen Hazen, Col. F. A. Molitor and others that an attempt now to alter the committee or interfere with its work would result in the utmost confusion.

Wellington Memorial

It was announced that the Board of Direction had accepted the offer of *Engineering News-Record* to contribute $2,000 for the establishment of a memorial to Arthur M. Wellington, an award to be made annually for the best paper submitted, either by a member or non-member of the society, on any subject relating to Transportation, either on land, water, or in the air.

Prizes

The committee on prizes announced the following awards for papers published by the society from January, 1918, to May, 1920, inclusive: Norman medal to J. A. L. Waddell, for paper "The Economics of Steel Arch Bridges"; J. J. R. Croes medal to B. A. Smith, for paper "Arched Dams"; Thomas F. Rowland prize to Charles E. Fowler, for paper "Revision of the Niagara Railway Arch Bridge"; the James Laurie prize to Dabney H. Maury, for paper "Water Supply for the Camps of the United States Army"; Collingwood prize for juniors to Floyd A. Nagler, for paper "Verification of the Bazin Weir Formula by Hydro-Chemical Gagings."

Results of Election

The election of officers, in which a record total of 7,008 votes were polled, resulted as follows:

President—George S. Webster, of Philadelphia, who received 4,036 votes as against 2,819 for J. Waldo Smith.

Vice-presidents—E. E. Wall, St. Louis (4,003), and Andrew M. Hunt, New York (3,947), who defeated Allen Hazen, New York (2,947), and Frank G. Jonah, St. Louis (2,971).

Treasurer—Otis E. Hovey, New York (4,093), who defeated Arthur S. Tuttle, New York (2,793).

Directors—District 1, John P. Hogan, New York (6,643), and Ira W. McConnell, New York (4,052), who defeated Robert S. Parsons, New York (2,740). District 4, Richard L. Humphrey, Philadelphia (4,001), who defeated Harry A. Lane, Baltimore (2,449). District 9, Baxter L. Brown, St. Louis (3,883), who defeated Alexander Maitland, Jr., Kansas City (2,609). District 10, Frank T. Darrow, Lincoln, Neb. (6,689). District 11, George G. Anderson, Los Angeles (4,046), who defeated Richard D. Parker, Austin, Tex. (2,538).

George S. Webster

(Continued from p. 139)

plans and strain sheets for arches of various sizes and assisted on a variety of large municipal engineering works.

After a brief period as cement inspector Mr. Webster was appointed, in 1880, as a member of the Philadelphia Board of Surveyors and as surveyor and regulator of the tenth Philadelphia survey district, comprising about one-third of the total territory of the city. In this capacity he served until February, 1892, in direct charge of all surveys of property and municipal engineering work. He prepared city plans of street lines and grades for that large territory and provided for a system of drainage and avoidance of all railroad grade crossing. One of his principal tasks was the direction of the design of 50 miles of sewers, in addition to surveys for bridge and highway improvement work in Philadelphia.

Heads Bureau of Surveys

Mr. Webster's familiarity, through many years of service, with Philadelphia's municipal problems led, in 1892, to his appointment as principal assistant engineer in the Bureau of Surveys, and he was quickly advanced in this organization to the post of acting chief engineer, which he assumed in 1892. The following year he was given the title of chief engineer, Bureau of Surveys, and upon him was placed the responsibility of all bridge designs and construction, sewerage design and works, and surveys of every description. As president of the Philadelphia Board of Surveys he was in full charge of the city plan and was also ex officio member of the Board of Harbor Commissioners and the Fairmount Park Commission.

Design and construction of many large bridges have been a feature of Mr. Webster's work. Among the most notable are the concrete arch bridge over Wissahickon Creek, the Falls, Gray's Ferry and the Passyunk Ave. bridges over the Schuylkill River.

As the city's representative Mr. Webster has supervised the elimination of many grade crossings in Philadelphia, the most important being the New York division of the Pennsylvania R.R., Philadelphia & Reading Ry. on Ninth St. and Pennsylvania Ave., the Richmond branch of the Philadelphia & Reading, Philadelphia & Trenton R.R. on Trenton Ave., and other important work in South Philadelphia. The widening of Delaware Ave. also was instrusted to him, in addition to the erection of large municipal piers and the dredging of the channel of the Delaware River.

Mr. Webster's most recent work has been as a member of the Delaware River Bridge Joint Commission.

He was elected an associate member of the American Society of Civil Engineers Sept. 7, 1892, a director in 1904, and vice-president in 1917.

Plan Irrigation System on San Joaquin River

New California Project Will Have Dam 325 Ft. High, 4,200 Ft. Long and 1,400,000 Cu.Yd. Volume

Plans are about complete for the construction of the Madera irrigation project on the San Joaquin River near Fresno, Cal., one of the largest private irrigation projects ever undertaken. The project will comprise 350,000 acres and will cost about $28,000,000. A vote is about to be taken in the district for the issue of the bonds and the prospect for the construction is good.

The San Joaquin River is the main source of the water supply, but there will be diversion from Fresno River, Chowchila River, Merced River and about 150,000 acre feet pumped from underground sources. The main storage will be near Friant, Cal., on the San Joaquin River, where a reservoir of 450,000 acre-ft. will be provided by a gravity masonry dam 4,200 ft. long, 325 ft. above bedrock, and storing 285-ft. head of water. From this dam there will be a high level irrigation canal served from the reservoir and two power plants, of total capacity of 65,000 kw. One plant will utilize the power from water delivered downstream under an average head of 200 ft. The other will utilize the water delivered to the upper canal from the reservoir under a 115-ft. head. These plants will provide 200,000,000 kw. hrs. per year average.

The dam itself will contain 1,400,000 cu.yd. of concrete and will have a spillway consisting of sixty-five 5 x 10-ft. siphons, supplemented by 100 ft. of gate to take care of dirt. These spillways will provide for the passage of 100,000 sec. ft. It is intended to build the dam with sand-cement, using a fifty-fifty mixture to be ground at the site. The engineers are testing now various mixtures, but it is thought that the even mixture will be used. A special concreting plant must be provided because it is necessary to lay 400,000 cu.yd. of concrete per year; that is an average of 1,200 yd. per day. In order to take care of contingencies a plant providing a sure capacity of 2,500 yd. per day is to be built. It is intended to lay the concrete from a railway spanning the dam site which will be supported on steel trestle built into the dam structure. As the dam rises the cross braces and horizontal members of the trestles can be removed, but the posts will remain in the concrete. Vertical openings will be left in the concrete as the dam rises and will serve not only as bypasses for the river during construction but also as final contraction joints. It is expected that the work will be started inside of a year and will take four years to finish. The estimated cost of putting the water on the ground is $80 per acre.

F. M. Carter is chief engineer, Thos. H. Mean of Cope, Rand & Means, San Francisco, is consulting engineer on land and canal system, and Quinton, Code & Hill of Los Angeles are consulting engineers having charge of the design and construction of the dam and power plants.

New Standardization Work

Standardization of terminal marking for electrical apparatus has been initiated under the jurisdiction of the American Engineering Standards Committee. The Electric Power Club has been designated as sponsor. The work grew out of a proposal made at the Brussels meeting of the International Electrotechnical Commission in March, 1920, when a standard method of marking transformer terminals was asked for, but broader standardization was then approved and delegated to the Americans. The result of the work conducted under the sponsorship is to be presented at the next meeting of the international commission.

Requests from the electrical industry for standards of rating electrical machinery have led to the formation of a committee under the sponsorship of the American Institute of Electrical Engineers. This work also originates from proposals made at the Brussels congressss. The committee will contain official representatives of the Electric Power Club, the National Electric Light Association and various other interested bodies.

In the field of zinc a number of questions pertaining to grading, thicknesses of sheets, methods of sampling and analyzing ores and finished material, and the like are to be dealt with by a standardizing committee working under the sponsorship of the American Society for Testing Materials and the American Zinc Institute.

Suggests State Board to Control Intercounty Bridges

Difficulties between Essex and Morris counties, New Jersey, over the question of whether several bridges crossing the Passaic River on the dividing line between the two counties shall be repaired or rebuilt, have led County Engineer F. A. Reimer (Essex) in his report to the freeholders to propose that control of intercounty bridges be placed by law in the hands of a state board.

The dispute in question, in which Essex County holds that the bridges should be rebuilt, while Morris County considers it sufficient that they be repaired, resulted in the former county closing the roads leading to the bridges, but nearby residents later destroyed the barricades. A commission, appointed by the Supreme Court, is now considering the situation with a view to deciding on reinforcement or reconstruction, as provided for by the present laws. Since the report of such a commission is not mandatory on the counties, however, Mr. Reimer proposes that a state bridge board be created to take charge of jointly controlled bridges throughout the state.

Begin Foundation Borings for Philadelphia Bridge

Contract for borings at the sites proposed for the Philadelphia-Camden bridge has been awarded to Ridpath & Potter, Philadelphia, and work began on Jan. 6. The contract covers 1,260 ft. of casing sunk to ledge rock and 160 ft. of core boring to prove the rock. Six bids for the work had been received, from H. F. Dougherty, Wilmington; J. B. Rulon, Philadelphia; Artesian Well Drilling, Philadelphia; Ridpath & Potter Co., Philadelphia; Sprague & Henwood, Inc., Scranton, and T. F. Edwards, Jersey City. The totals range from $4,367 to $11,990. For sinking casing the unit price bid ranged from $1.95 to $5 for work on land and from $2.45 to $12 for work in the river. For core boring the prices ranged from $4.20 to $5 for work on land and from $6 to $16 for work in the river.

A three-day traffic census was conducted by the Board of Engineers during the Christmas holidays with the assistance of University of Pennsylvania students. Count was taken on three days of all vehicles using the ferries, and origin, destination, route, etc., recorded. The results will be considered in determining on questions of the approaches, but future traffic development rather than present traffic is likely to have a determining weight.

Paul P. Cret, Philadelphia, has been appointed architect to the Board of Engineers, and E. B. Bergenthal, Chicago, chief draftsman.

Nominate Officers for A. R. E. A.

The nominating committee of the American Railway Engineering Association has selected the following candidates for 1921. President, L. A. Downs, vice-president and general manager, Central of Georgia Ry., vice-president, E. H. Lee, vice-president and general manager, Chicago & Western Indiana R. R.,; secretary, E. H. Fritch; treasurer, G. H. Bremner. A list of nine names is also reported from which to select three directors. The election will occur at the annual meeting in Chicago on March 15-17.

St. Louis Societies Affiliate

The Associated Engineering Societies of St. Louis, modeled along the lines of the Federated American Engineering Societies, was brought into being and given permanent form at the first meeting of the joint council, composed of two delegates from each of the member societies, held at the Engineers' Club of St. Louis Jan. 5. H. W. Eales, who is president of the Engineers' Club of St. Louis, was elected president of the new organization, and W. W. Horner, chief engineer, sewers and paving, of St. Louis, was elected vice-president. The members of the new association are the Engineers' Club of St. Louis and the local sections of the A.S.C.E., A.S.M.E., A.I.E.E. A.I.M.M.E., and A.S.R.E.

Minnesota License Bill Introduced

A registration law for architects, engineers and land surveyors has been introduced into the Minnesota Legislature. It follows closely the model law of Engineering Council and was prepared by the legislative committee of the Minnesota committee of the Minnesota Joint Engineering Board. The bill was recently revised to meet the objections of several socieites, as mentioned in *Engneering New-Record* Nov. 11, 1920. Copies may be obtained from the secretary of the Board, 811 Guardian Life Bldg., St. Paul.

New York Section Am. Soc. C. E. Meeting Date Advanced

In order to avoid a conflict with the annual meeting of the American Institute of Electrical Engineers and the American Institute of Mining & Metallurgical Engineers the February meeting of the New York Section of the American Society of Civil Engineers has been postponed from Feb. 16 to Feb. 23. The subject of the meeting is "Light, Heat and Power." The principal paper will be by Colonel William Barclay Parsons. Representatives of the local sections of the mechanical, electrical and mining societies have been invited to attend and send delegates to discuss Colonel Parsons's paper which will apply to the problem of the New York metropolitan district.

Road Congress Prize To Be Awarded in 1922

The sum of 4,500 francs is available for distribution as prizes during the 1922 meeting of the Permanent International Association of Road Congresses. The money will be awarded either in a single prize or may within the discretion of the jury be divided among a number of contestants submitting the best discussions having in view the encouragement of progress in the construction, maintenance and administration of roads, and the improvement of traffic.

The first award of this prize was made during the Third International Congress in London in 1913. The prize usually is 1,500 francs. Inasmuch as no awards were possible either in 1916 or 1919 there are now 4,500 francs which may be awarded.

Authors of papers must have been members of the Permanent International Association of Road Congresses since Jan. 1, 1919. Members of the Permanent International Commission will not be allowed to compete. The competing papers should reach, post free, the secretary-general of the association before Nov. 1, 1921. The prize papers will be published during the year the competition is held, under the auspices of the association and at its expense.

Additional information regarding the competition may be secured from the secretary-general of the association, whose address is 1, Avenue d'Iéna, Paris.

Syracuse Takes State Canal Lands for Grade Crossing Elimination

Work on clearing titles to the Erie Canal lands in New York has been started. This is the first actual development in the taking over from the state by the city of lands to be used in the prospective grade crossing eliminations of the railroads running through Syracuse.

New Jersey Highway Requirements

In his recent annual message to the New Jersey Legislature Governor Edwards stated that $55,000,000 is needed to complete the present proposed state highway system in New Jersey, bringing the total cost up to $73,000,000, the sum of $18,000,000 having already been spent.

Gulf Coast Bridges Ordered Rebuilt

In a decision just rendered by the Louisiana Railroad Commission on complaint that the bridges of the Louisville & Nashville R.R. over Chef Menteur and Rigolets Pass on the Gulf Coast southeast of Lake Borgne are unsafe, the commission decides that the bridges are safe, "possessing sufficient strength to withstand almost any weather disturbance, except, of course, the violent tropical hurricanes which in the past have appeared at periods about five or six years apart." However, in order to hasten the replacement of the bridges by permanent structures as planned by the railroad for some years past the decision orders the company to begin construction of new bridges by July 1, 1921.

Housing Problems to Come Before Washington Conference

A conference on the national housing problem will be held at Washington, D. C., Jan. 27 and 28 under the auspices of the Chamber of Commerce of the United States. There will be discussions by representatives of various business industries, members of Congress and government executives, housing specialists and others. The national chamber announces that "representatives of 100 or more chambers of commerce through the country that have organized housing corporations will give the conference the benefit of their experiences." Among the topics announced for discussion are the housing problem in relation to the welfare of the American people, to construction industries, to employers, to standards of living and to the immigrant. Questions of legislation, taxation, co-operation or mutual financing of housing developments, labor, available supplies of building materials and future price movements will be taken up. One of the special subjects for presentation is "Effect of the New York Building Investigation Upon Costs of Construction."

Fail to Agree on Uniform Vehicle Law

National Conference on Highway Traffic Regulations Approves General Principles Only

Delegates representing thirty national and regional organizations at the National Conference on Highway Traffic Regulations held in Washington, D. C., Jan. 10-12, failed to agree on a specific form of uniform vehicle law presented by a drafting commitee, the net result of the meeting being the endorsement of a declaration on "general principles" which were a practical duplication, in general phrases, of the specific language of the uniform law prepared last year by the Joint Committee on Uniform Vehicle Laws, of which H. G. Shirley was chairman.

Such diversified interests as state highway departments, agricultural implement associations, automobile organizations, insurance companies, electric railways, police departments, and trailer manufacturers were represented at the conference. At one time it appeared that the meeting might end abruptly when the charge was made that the conference was merely an attempt to appropriate the uniform vehicle legislation work done last year by the joint committee representing the American Association of State Highway Officials, National Automobile Chamber of Commerce, American Automobile Association, and the Highway Industries Association. The model bill prepared by the Washington conference's drafting committee was discussed and was then quietly interred when a deadlock was avoided by the expedient of endorsing a set of "general principles."

The following temporary officers were named at the opening session: Chairman, C. M. Talbert, director of streets and sewers, St. Louis; secretary, D. R. Faries, general counsel, Automobile Club of Southern California, Los Angeles; assistant secretary, S. J. Williams, National Safety Council, Chicago.

Discussion of Uniform Law

A drafting committee, consisting of Mr. Faries, chairman; David Van Schaack, representing the National Workmen's Compensation Service Bureau; W. H. Maltbie, American Electric Railway Association; and Harry Meixell, Jr., National Automobile Chamber of Commerce, met in Washington prior to the conference and prepared the uniform law that was printed and submitted to the conference for disscussion at its opening session.

While the uniform act was submitted as a piece of state legislation a defect in it, according to Henry G. Shirley, of the Federal Highway Council, lay in its neglect of municipal traffic problems. He suggested that a proper law should consist of two parts, the first dealing with state matters and the second with city traffic regulation, the latter part to be worded in very general terms so as to meet the conditions in cities of different sizes.

It soon developed in the discussion that there could be little hope of reconciling the interests of the state highway officials, the automobile and truck associations, and the agricultural implement organizations in the approval of a specific bill. The farm implement delegates demanded either a separate law relating entirely to agricultural machinery or a separate section in any proposed uniform law which should deal specifically with this class of equipment.

Highway Engineers Object

A strong objection to the use of cleated farm tractors on highways was voiced by John N. Mackall, chairman of the State Roads Commission of Maryland and representing the American Association of State Highway Officials, who classified them as one of the greatest menaces to public roads.

Discussion of the reciprocity feature of the proposed act brought out an objection by Mr. Mackall to the proposed period of 90 days for motor trucks. While satisfactory for passenger cars, the 90-day allowance for trucks he believed should be revised to a basis of one round trip per week.

An amendment proposed by Messrs. Mackall, Upham and Monroe, representing the state highway departments respectively of Maryland, Delaware and West Virginia, suggested reducing the maximum weight of vehicles as proposed by the drafting committee from 28,000 to 20,000 lb. for four-wheeled vehicles and from 40,000 lb. to 30,000 lb. for six-wheeled vehicles. They advocated reducing the permissible weight per inch width of tire from 800 to 650 lb.

Mr. Mackall cited the case of Maryland, which had been called upon to expend $600,000 in the repair and rebuilding of its 1,700-mile system of state highways damaged during the last few years by heavily loaded motor vehicles. Maryland restricts the gross weight to 20,000 lb. per vehicle, and under these conditions Mr. Mackall finds that the roads can be adequately maintained.

Future Activities

The committee on future activities, consisting of C. E. More, David Van Schaack, David R. Faries, George C. Diehl, H. G. Shirley, H. W. Perry, and John Rynerson, recommended: (1) That the conference adopt only general principles for a uniform vehicle law; (2) that no final vote on the proposed law be taken; and (3) that it would be unwise to set up any new organization to continue the work of the conference and that the conference should adjourn without provision for future meetings.

Harry Meixell, Jr., representing the National Automobile Chamber of Commerce, threw a verbal bombshell into the meeting by declaring that its efforts were a duplication of those begun by a group of other organizations three years ago and which had been crystallized in the publication and distribution by the Federal Highway Council of a proposed uniform vehicle law of which between 30,000 and 40,000 copies had been distributed. (The main features of the proposed law referred to are given on p. 112). Mr. Meixell charged that a group from California in calling the conference had endeavored to seize upon the work of the Motor Vehicle Conference Committee, formed last year, and appropriate it as their own. He asserted also that if another uniform vehicle law should be issued now it would create in state legislatures the utmost confusion.

The "general principles" which were endorsed by the conference are not here reproduced, inasmuch as they deal only in generalities and are, as a matter of fact, covered in specific terms in the proposed uniform law of the joint committee prepared last year by representatives of the state highway and motor vehicle interests.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; seventh annual convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; New Orleans, Feb. 9-12.

The New York Post, Society of American Military Engineers, will hold its annual meeting and election of officers in New York City, Jan. 26 at Keen's Chop House, where a beefsteak dinner is scheduled for 7:30 p.m.

The Kentucky Engineers Club was organized Dec. 20 with the following officers: president, C. W. Lovelle; vice-president, V. P. Ligon; secretary, W. M. Jarvis; Treasurer, W. O. Snyder.

The Kentucky Highway Contractors Association, at a recent organization meeting elected George N. Eady, president; Henry Bickel, first vice-president; and George Carey, second vice-president.

The Illinois Section, Am. Soc. C. E., Jan. 13, elected C. B. Burdick, president for the ensuing year. J. N. Hatch was elected vice-president for two years. A. J. Hammond, vice-president, and W. D. Gerber, secretary-treasurer,

still have one year to serve. A. S. Baldwin, a member of the national committee on constitution, spoke on the work of the committee, no part of which has yet been finally decided upon. The request of the Texas Section for favorable action looking toward the defeat of bill in Congress (H.R. 12,466) authorizing utilization of the Yellowstone Park for water storage was considered the province of the parent society. In accordance with that principle the board of directors was asked to take up with the American Institute of Architects the question of uniform specifications for building in an effort to reduce the high cost of building construction.

Personal Notes

A. H. Dimock, city engineer of Seattle, has been reappointed by Mayor Hugh M. Caldwell for a three-year term. The salary of the position has been increased from $5,000 to $7,500.

Henry W. Blake, editor of the *Electric Railway Journal*, was the guest of honor at a dinner given Jan. 6 by his associates in the McGraw-Hill Co. in recognition of his 30 years of service on the editorial staff of that publication.

John P. Leo, chairman of the Board of Standards and Appeals, has been appointed commissioner of street cleaning, New York City, to succeed Arnold B. MacStay.

George S. Witters, formerly lieutenant, Engineers, U. S. A., has been appointed engineer of Ida County, Iowa.

Prof. F. E. Giesecke, head of the engineering division of the bureau of economic geology and technology, University of Texas, has been appointed chairman of the problem committee, Federal Highway Council, Washington, D. C.

D. O. Lewis, civil engineer, Victoria, B. C., has been elected president of the Association of Professional Engineers of British Columbia.

M. E. Hiet, formerly engineer for Pawnee County, Oklahoma, has been appointed engineer of Nowata County, in charge of road construction.

Dudley P. Babcock, formerly assistant engineer, New York State Highway Commission, is now assistant engineer, Bronx Parkway Commission, Bronxville, N. Y.

Jesse A. Jackson has been appointed engineer of the Seattle City Zoning Commission and is developing a plan for laying off the city in zones. Mr. Jackson has been in the employ of the engineering department of Seattle since 1902, except for the time spent in military service. He commanded the 116th field signal battalion of the A. E. F. in France, returning to Seattle in April, 1919, to resume the position of chief draftsman in the Seattle engineering department.

Gannett, Seelye & Fleming, engineers, have been retained to make a report and recommendations on new sources of water supply at Greenville, Tenn., Eureka Springs, Ark., and Rouzerville, Pa.

C. C. Boyer, formerly with the California Highway Department, has been appointed district engineer, Nevada Highway Department, with headquarters at Las Vegas.

Horton, Barker & Wheeler is the name of a firm recently organized to continue the consulting engineering practice formerly carried on under the names of Robert E. Horton, consulting hydraulic engineer, Albany, N. Y., and Harry Barker & Robert C. Wheeler, engineers, New York. The firm will have headquarters at Albany, with offices in New York and Harrisburg, Pa., and an engineering laboratory at Voorheesville, N. Y. It will specialize in power development and transmission, water supply, sewerage and sewage disposal, public utility rates and valuations.

Louis S. Levin, formerly engineer of Allegan County, Mich., has been appointed roads engineer for Chippewa County.

W. A. H'endry of Halifax, N. S., has been appointed chief engineer to the Provincial Highways Board of Nova Scotia. He has had long experience as a railway construction engineer in the Maritime Provinces and Newfoundland.

C. R. Wright, formerly engineer for the ports of Toledo and Newport, in charge of harbor improvement work on Yaquina Bay, Ore., is now assistant engineer for the Port of Grays Harbor at Aberdeen, Wash., in charge of all harbor improvement work under the direction of C. A. Strong, consulting engineer, of Tacoma, Wash.

J. W. Holman has resigned as superintendent of the Culbertson Construction Co., Youngstown, Ohio, to form the J. W. Holman Co., with office at Youngstown. The new company will engage in contracting, particularly railroad construction.

Russell S. Wise has been appointed city engineer of Clifton, N. Y.

Robert McFarland has been appointed superintendent of waterworks, Brandon, Manitoba, Canada.

Charles B. Hawley, formerly assistant hydraulic engineer, Aluminum Co. of America, has entered private engineering practice with offices in Washington, D. C.

Arthur H. Blanchard, consulting highway and transport engineer, Ann Arbor, Mich., has been retained by the city of Colorado Springs in connection with its $1,200,000 paving program.

W. D. Johnston, who has been connected with the Iowa State Highway Commissison for nine months, has been appointed engineer of Black Hawk County, Iowa. Mr. Johnston was formerly city engineer of Waterloo.

Obituary

Harry L. Marsh, vice-president Thompson-Starrett Co., New York, died Jan. 13 at Summit, N. J. He was born at Ithaca, N. Y. in 1875 and had been a resident of Summit since 1912. His early work was as civil engineer with the Chicago & Northwestern Ry. The principal projects under his direction during his term of office as an executive of the Thompson-Starrett Co. were the Woolworth Building, Hotel McAlpin and the Municipal Building in New York City and the Hotel Ambassador in Atlantic City, N. J. He was elected vice-president of the Thompson-Starrett Co. in 1915.

Charles E. Smith, former secretary of the Master Builders' Exchange, and later secretary of the National Association of Builders' Exchanges, died Jan. 1 at his home near Camden, N. J.

David C. Humphreys, dean of the School of Applied Science of Washington and Lee University, died Jan. 11 at Roanoke, Va. He was born at Chatham Hill, Va., in 1855. For about six years he was U. S. assistant engineer on improvements on the Missouri River. He became adjunct professor of applied mathematics at Washington and Lee University and in 1889 was elected professor of civil engineering. He became dean of the school of applied science in 1904. From 1895 to 1908 he was resident hydrographer, U. S. Geological Survey.

Samuel M. Foust, city engineer, Connellsville, Pa., died Jan. 5. He was born in Saltlick township in 1846 and had been a resident of Connellsville since the age of 19, for the greater part of the time employed by this city.

Bradford D. Pierce, for 14 years director of public works of Bridgeport, Conn., died Jan. 12. He was born in Providence, R. I., in 1842. As a young man he was associated with his father, M. R. Pierce, in the contracting business in New York on drainage and sewerage projects. In 1862 he founded the contracting firm of Pierce & Co. at Bridgeport. About twenty years ago he was appointed director of public works.

Dr. Henry A. Bumstead, professor of physics and director of the Sloane Physical Laboratory at Yale University, and for the past half year on leave from the university as chairman of the National Research Council of Washington, D. C., died Dec. 31, while returning to Washington from Chicago, where he had been in attendance at the meetings of the American Association for the Advancement of Science and affiliated societies.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

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Experimental Data

FEW hydraulic engineers know of the many experimental investigations that are continually under way by the engineers of the U. S. Reclamation Service. The résumé of this work on p. 161 is impressive. The main office of nearly every private irrigation project has in its files similar valuable experimental data but unfortunately much of it never gets beyond the files.

World Economies

THE pessimist who believes the engineer's regard for economics must have changed his attitude if he listened on Thursday night of last week to the address of Francis H. Sisson, vice president of the Guaranty Trust Co. of New York, before a packed auditorium at the smoker of the American Society of Civil Engineers. He spoke on world economics, on the reasons for our present business situation and that of Europe, on the fundamental conditions here and upon the business future. He was applauded to the echo; seldom has any speaker before a general meeting of the society received so enthusiastic approval of his effort. It is a great regret that the address was not taken stenographically and we trust that Mr. Sisson can be induced to put it in writing so that engineers throughout the country may have the same benefit and pleasure as was enjoyed by those who heard it. It's reception was proof that engineers will gladly take more of the same kind of information.

The Cement Inquiry

ASK a large number of engineers and contractors whether there is collusive fixing of cement prices, and the answer from many of them, possibly from most of them, will be yes. This being quite a general opinion, the quizzing of the cement manufacturers by the New York legislative committee was viewed with much approval. This approval was the more hearty when the press reports indicated that the cement men had "been found with the goods." Examination of the testimony in full, as is set forth elsewhere in this issue, fails to substantiate the impression that a case was made against the cement manufacturers. Surely it was shown that there was in effect—uniform prices—that *might* have come from collusive control, but there was absolute failure to show that these uniform prices *did* result from collusion. The cement manufacturers had an explanation for the uniformity, and that explanation was not controverted by other testimony. Obviously, if there was failure to prove price fixing, there was also failure, because there was no opportunity afforded, to prove that there was no price fixing—evidence of uniform prices on the one hand, and the manufacturers' explanation on the other. The point is this: no matter what was the cause of uniform prices—whether collusion or mere competition on a standardized product—the Lockwood investigation has failed to disclose it.

The Sacramento Underdrain Tests

BASED on the results of experiments on perforated-pipe filter underdrains conducted at Sacramento, as detailed by Harry N. Jenks on p. 162, designers may now feel warranted in departing from precedents established fifteen years ago. The theory that small holes closely spaced are necessary seems to be fairly well exploded. So long as the ratio of length of a lateral to its diameter lies between certain limits, the uniformity of discharge regardless of rate of wash is maintained. From the practical standpoint this means dollars and cents saved. For a 4-in. size a 16-ft. lateral may be used, thus materially increasing the size of bed to be operated from one stand. Similarly, the indicated permissible increase in the size of perforations and their spacing is a distinct economic advance. Fewer pipe units have to be handled and fewer points need attention. The small size of the Sacramento plant limits the size of filters it is advisable to build but in a large plant larger sized units cut down operation. In the design of underdrains there seems now no limiting factors within reason and the larger the size of filter units the cheaper will be the installation per square foot. The Sacramento tests show anew that research pays. The results of the questionnaire on filter operation presented in *Engineering News-Record*, Nov. 11 and 18, 1920, point to several other important filtration problems that need attack.

Two Earthwork Hints

SETTLEMENT and slipping of new railway fills are commonly regarded as inevitable occurrences, and probably are so under ordinary methods of construction. The engineers of an English railway having to build large clay fills and wishing to eliminate supplementary work after completion made a study of old banks of the same material and adopted a slope conforming to that of the latter, the inclination decreasing progressively from the top to the toe. This was noted in our issue of Dec. 30, 1920, p. 1284. These fills were made in 10-ft. lifts with slopes dressed to the required shape by means of templates. As the results are said to have filled the expectations the slight additional construction cost is probably well warranted by the saving in trouble and cost of keeping roadbed at grade after the line is in operation. This practice calls attention, too, to the common method of widening fills. It is usual simply to dump material down the slope, without even the simple precaution of roughening the old surface to allow of a bond for the new material. As a natural result much of the material slips directly to the bottom and beyond the slope lines, while such material as remains on the slope is likely to crack and slip down because it is formed in inclined layers. Future trouble and expense may be saved where the new loose material is shoveled or chuted down the slope and built up in successive horizontal layers.

Bad for New York Highways

ONCE again the engineer's claim to political recognition has been ignored. That claim rests upon entirely impersonal grounds. It relates in no way to seeking a job for an individual, but rests upon the broad, sound business basis of putting into an office which requires certain special qualifications a man who, by training and experience, is fitted to administer the duties of that particular post. The newly elected Governor of New York has seen fit to select as his state highway commissioner a man with no experience in the location, design or construction of roads, or familiarity with the vital questions of highway economics which are becoming more pressing each year as the volume of vehicular traffic becomes greater. The chief claims to recognition of the incoming highway commissioner appear to lie in the fact that he has served as state excise commissioner, county superintendent of the poor and chairman of a county Republican committee.

Shortly after his induction into office Governor Miller issued a constructive message stressing the need for efficiency and economy in the administration of the state's affairs. It is impossible for engineers, who are concerned not with politics but with getting the state's highway system built properly and without waste, to reconcile the Governor's words with his acts. They know that the head of one of the greatest state road-building agencies of the country should, first of all, be a technically trained man with a thorough knowledge of the problems which he will be called upon to solve—one who will not require a protracted course of education, depending in length upon his own intelligence and desire to learn, before he becomes in the slightest degree familiar with the principles of highway economics, which, rightfully, he should bring to his office.

We have no grievance against Mr. Sisson, the new appointee. But we resent the Governor's double-faced policy in first pledging himself to businesslike methods in handling the state's work and then naming a layman to a post which demands engineering training. His action is an affront to the entire profession.

The highway commission is one of the state's greatest spending agencies. During the last decade many millions have been put into road construction and maintenence, some of it good and some of it bad. In that time here have been no less than six different highway commissioners, one of whom died in office, the others replacing one another in steady succession. The result has been that New York State has had no stable highway policy and the constant changes in administration have naturally resulted in enormous waste. Only a few days ago New York's Governor naïvely issued a "thrift proclamation." Can he be so lacking in a sense of the ridiculous as to believe that the sham of his present position is not generally apparent?

The proper administration of road-building in New York State is of immediate concern not only to engineers but to the great automobile and motor truck interests, and the public at large. In failing to place a man with engineering training at the head of a department whose work is distinctly of an engineering nature Governor Miller has broken faith. The days of post-war extravagance are over and the people are now watching their pennies. In the matter of the state's road-building program the Governor may rest assured that the electorate is certain to demand an accounting.

The Am. Soc. C. E. Meeting

IT IS WITH the utmost pleasure that we are able to record the happy ending of last week's annual meeting of the American Society of Civil Engineers. There were fears of a storm. In fact, there was a period of theatrical tension, but it passed away happily and the meeting concluded not only without bitterness, but in a spirit of cordiality. There may still be differences in point of view, but they are overshadowed by the desire on the part of all to achieve the best interests of the society. There is good reason to hope that the organization will quickly settled down to its technical work.

Aside from this harmonious conclusion of the meeting, the outstanding event was the election of the candidates on the progressive ticket. It was generally expected that the election would be close. Moreover, the progressives feared that their candidates would be defeated, for they had failed to muster the needed two-thirds vote for the amendment and their proposal that the society enter the federation was defeated. But the election was not close and the progressive candidates won every place.

There is ground for much speculation on the result. It is difficult, for example, to reconcile the votes in the federation and on the election. One of the reasons for the victory of the progressives was probably their possession of the "official" ticket. Another factor that had very great weight was the desire to be rid of all trace of a régime of which a certain individual at New York was commonly held to be the embodiment. The belief that the leaders of the group which sponsored the "nominations by declaration" were in sympathy with that régime and would perpetuate its ideas counted heavily against the "declaration" ticket. As a matter of fact, we feel certain that the great majority of the backers of the "declaration" ticket are not standpatters, but do favor a sound expansion of the work of the society.

If these statements be correct, if all the progressives and all but possibly a small minority of the supporters of the "declaration" ticket are of one mind on the subject, it is the society's duty to eliminate all vestige of the influence of that former régimé.

With the close of this annual meeting the society sets its face forward. All amendments, both those reported by committee and those proposed anew at the annual meeting, will probably be defeated in the letter ballot (as the annual meeting recommended), thus opening the way for consideration of a broad and co-ordinated revision of the constitution at the annual convention in Houston in April. With the good feeling displayed at New York, one can safely look for the same spirit at Houston—a spirit particularly needed in studying the society's fundamental document.

Obviously the new board has heavy responsibilities. Among the first, is the selection of a new secretary. It must get the society back to work. It enters upon these responsibilities, we confidently believe, with general support. There is not now victor and vanquished—but just Am. Soc. C. E. members, all united in an earnest desire to see the society prosper. The fears once expressed by conservatives that a "progressive" board of direction would be a great danger to the society have diappeared. They were never sound fears, of course, but merely the "thunder" of an active campaign. The same

sanity, the same regard for the society's prestige that has always marked the action of the board will prevail.

One further bit of comment is called for—on the size of the vote for officers. A total of 7,008 ballots were counted, representing 80 per cent of the corporate membership, which sets a new record. When it is considered that among the corporate members are about 500 residing outside the United States and Canada and that only a small percentage of these voted, it is probable that the votes of 85 per cent or more of the eligible voters in the United States and Canada were recorded.

This indicates an extraordinary degree of interest. If this same interest or a goodly portion of it could be mobilized for the solid work of the society, great progress could be made. The vote was brought out by intensive work, and past experience indicates that such an interest cannot be sustained. Nevertheless, that it has been once manifested is an indication of a mark at which the management of the society should aim.

Is There a Best System of Heavy Electrical Traction

BETWEEN ten and fifteen years ago electrical engineers were waging a verbal warfare over the relative merits of direct- and alternating-current for heavy traction. The feeling was freely expressed that electrification might profitably wait until the "battle" smoke cleared away. The matter was not simplified by the fact that alternating-current was championed by one of the great electrical manufacturing companies, direct-current by the other.

To obtain a proper perspective of the development of heavy electric traction, still in its infancy but covering a period of about thirty-five years, it is necessary to go back to the 1895 B. & O. tunnel electrification in Baltimore. This was, of course, a 600-volt direct-current installation, nothing else being available at the time. During the following ten years this and other lighter applications of the electric locomotive demonstrated the possibilities of heavy electric traction. When the New York Central in 1902 found it necessary to electrify its New York Grand Central Terminal the well-tried direct-current was adopted, although interest in single phase had begun to manifest itself. The proposed electric zone was not so extensive but that direct-current promised reasonable power-distribution efficiency; moreover, the time available gave no opportunity for experimentation.

The New Haven, which planned to use the Grand Central Terminal, of course had to electrify also. But having more time and with a view to ultimate electric operation to Boston the engineers of this road were attracted by the high transmission efficiency of the single-phase and adopted it.

Then began the merry debates as to the wisdom of the New Haven's choice, especially in view of the necessity for developing equipment that would operate on both kinds of current. An announcement that the subject would be discussed always brought out a capacity house—and would do so even today.

The discussion was based on 600-volt direct-current as compared with 6,000- to 15,000-volt alternating-current. As 600 volts is an uneconomical pressure for distribution, single phase, by comparison, was very attractive from the power standpoint, although the possible effects upon telephone and telegraph circuits were considered with some apprehension. This apprehension was well founded, but methods were in due course devised greatly to mitigate the inductive interferences. In the meantime direct-current voltages higher than 600 were being tried and in due course, in 1912 and 1913, the Butte, Anaconda & Pacific was electrified successfully at 2,400 volts. This led to the application of 3,000 volts on the Chicago, Milwaukee & St. Paul, which has since been the talk of the world in heavy traction.

The New Haven gradually extended its single phase and the Norfolk & Western put into operation a single-phase three-phase scheme, the single phase from the overhead being changed to three phase on the locomotives by means of a phase converter. This plan permitted the economical power distribution of the one with the mechanical-power-producing possibilities of the other. The Pennsylvania Railroad is today experimenting with this type of electric locomotive for possible use on the heavy grades in the Allegheny Mountains. And straight single phase has been very greatly perfected in the past sixteen years.

This long introduction leads up to a consideration of the relative status of direct and alternating-current heavy traction today. Obviously it is entirely different from what it was fifteen years ago. The argument that the single phase alone permits the use of an overhead contact system no longer holds. The transmission efficiency of high-voltage direct-current is good enough for practical purposes. And the success of automatic control of even rotating apparatus eliminates another "talking point" for single phase.

From the power standpoint single phase has been a serious problem due to the unbalanced load which it imposes upon the three-phase generators of the power plant. To permit economical operation of the latter the use of rotating "phase balancers" has been introduced. Furthermore, the power supply of this and other countries is tending toward a 50-cycle or a 60-cycle frequency. As single-phase equipment must be designed for a lower frequency, its use will involve rotating apparatus at substations in the form of frequency changers if power is drawn from a general power source. These facts will militate against widespread use of single phase. And last but not least the freedom from inductive interference is a great asset to the direct-current.

From the standpoint of over-all cost, which after all will be the ultimate determining factor as to system, there are undoubtedly some roads that are still best fitted for single phase. Its field would appear to include principally long lines with light traffic. The single-phase three-phase is, of course, best adapted to the forcing of track to its utmost capacity. The general trend, however, is distinctly toward direct-current. To be sure Sweden and Switzerland are committed to a single-phase, and Italy to a three-phase program, but there are some signs of weakening in the alternating-current countries. France appears to have swung over within the past year, while England has come out in favor of 1,500-volt direct-current. The success of the Milwaukee electrification, even with the existing dearth of operating data regarding it, has had great weight with the foreign railway engineers and managers. And the fear of inductive interference effects from single phase is a highly potent influence in this connection.

Concrete Bricks Made Without Forms on Commercial Basis

Horizontal Knife Cuts from Concrete Column Slice Which Vertical Knives Divide Into Standard Size—100,000 Bricks Per Day Plant Capacity

CONCRETE brick, made without forms, is being produced commercially in Brooklyn, N. Y., by the Brooklyn Crozite Brick Corporation. The company's plant, which has been in operation about three months, has a capacity with its four brick machines of 100,000 bricks per day of eight hours.

In general design the brick machine is somewhat similar to a bulldozer, all parts being of substantial and rigid construction. Briefly, the essential parts of the machine are as follows: An 8-ft. vertical column above the machine and leading from the mixer, whose cross-section is the width of ten standard-sized bricks and the length of one brick; a forming head upon which the column rests; a table or support carrying the pallets and which moves up and down so as to bring the pallets in contact with the bottom of the forming head, and again lowers them away from the forming head after the brick has been cut; a horizontal knife, ½ in. thick, arranged to pass between the bottom of the column and the top of the forming head, thus cutting off a section of the concrete mass from the bottom of the column and retaining it within the forming head; nine vertical knives, each ⅛ in. thick, attached to the horizontal knife and arranged to pass through the forming head, thus dividing the concrete previously cut off by the horizontal knife into ten brick; the mechanical means for feeding empty pallets to the pallet table, and mechanical means for removing the pallets with their loads of brick after the forming of the bricks in the machine has been completed.

Considerable experimentation was necessary before it was found possible to produce a concrete brick without forms, using the wet-mix method. A wide variety of aggregate was used as well as cement from various mills. Variation naturally occurred in the strength of test pieces made even with the same aggregate and cement from the same mill, but by varying, not more than one and one-half per cent, the amount of water used, practically equal results were secured. In the plant at Brooklyn the water content in the mixture is rarely varied more than one-half of one per cent. Such a variation depends upon the greater or less amount of fine material in the ⅜-in. screened aggregate. The aggregate is closely watched to determine when a change in water content is needed.

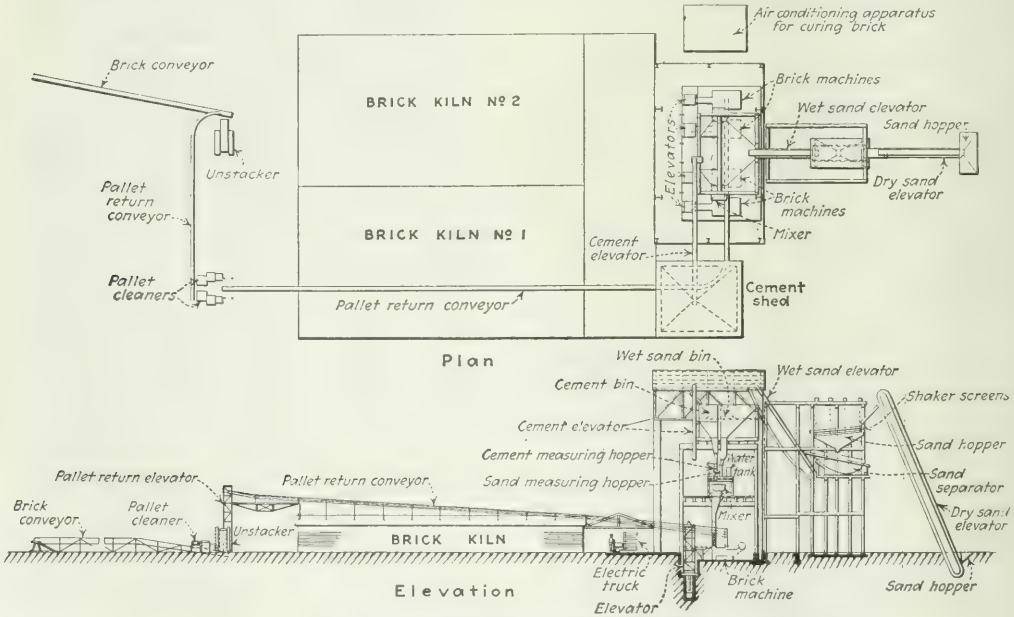


FIG. 1—GENERAL LAYOUT OF BRICK PLANT

The densification and unwatering of the concrete is accomplished in the column above the brick machine through the continual falling of newly mixed concrete in the column, by the weight of concrete within the column and by the sliding pressure exerted upon the mass cut from the bottom of the column by both the horizontal and vertical knives. As each successive layer of material is cut from the bottom of the column the horizontal knife is withdrawn and the mass in the column drops vertically a distance equal to the height of the forming head. This action also has the effect of greatly densifying the concrete, some of the excess water at the same time being expelled.

With the forward and reverse motions of the cutting and forming knives additional pressure is exerted upon

the mass in the forming head, increasing the densification, as the vertical knives cut the concrete slice into ten pieces, compressing that slice 1⅛ in. The cutting also tends to draw some of the finer aggregate and cement particles to the surface of the brick, in a manner similar to that effected through the use of trowel or float in the usual hand-finishing of concrete. This action gives the finished brick a stippled surface.

As a result of the action of the knives and the head of concrete in the column, the finished brick, though saturated with water and unset, is left upon the pallet in such a dense condition as to stand alone. This feature overcomes the principal difficulties which have been previously encountered in attempts to use wet-mix concrete for the manufacture of brick, block, tile, and other materials on a commercial scale.

The aim of the manufacturer is to produce for local markets building materials which satisfy the specifications for approved masonry, contained in building codes of those cities in which the manufacturing plants are located. Though the Brooklyn plant is manufacturing at the present time a cement-sand brick, the new brick, known as "crozite," may therefore contain different material such as—besides cement and water—sand, crushed rock, screenings, granulated slag, cinders or other fine materials suitable for making concrete and which will pass through a ⅜-in. screen. Three factors which, therefore, determine the sort of brick to be produced in any particular section are: (1) availability of sand or other fine aggregate; (2) city specifications covering approved masonry; (3) the market to be served.

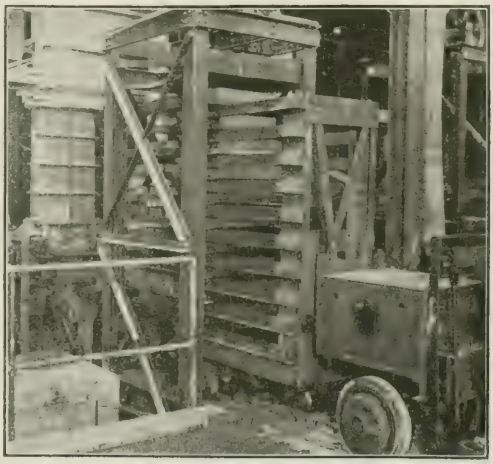


FIG. 3—BRICK MACHINE, ELEVATOR ONTO WHICH UNSET BRICKS ARE STACKED AND TIER LIFT TRUCK WHICH TAKES THEM TO CURING SHEDS

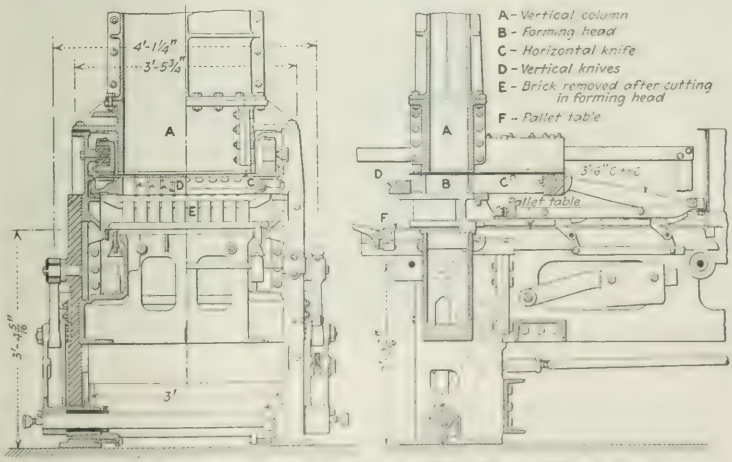


FIG. 2—DETAILS OF BRICK MACHINE, SHOWING ESSENTIAL PARTS

By carrying on a series of tests of different mixes and materials, it has been found possible to meet various building specifications without much further experimentation. Thus, it is possible for the manufacturers in Brooklyn to meet the New York specifications which demand a brick with a compressive strength of 3,000 lb. per square inch.

The Brooklyn plant is located at the site of a sand pit of good quality and practically inexhaustible supply. One electric shovel handles the sand from the bank to a small temporary storage bin which regulates the flow of sand over a belt conveyor to the screening and washing plant. All material passing a ⅜-in. screen is used. Overs are at present being spoiled, though it is the intention of the manufacturer to install a crushing plant so that there will be no waste of aggregate. After being screened and washed, the sand is diverted to one of two bins—one being on either side of the screening and washing plant. While the sand from one bin is being used for the mix, it is also being deposited in the other bin, where it is allowed to drain.

Washed sand from these temporary storage bins is elevated by bucket conveyors to hoppers above each of the two mixers which supply the four brick machines. These hoppers are located at about the third floor level, the mixers being at the second floor level, approximately 15 ft. above the brick machines. Cement is also elevated in the same manner as the sand, from a storage shed and large bin to a hopper above the mixer. Both these hoppers are fitted with cut-off gates so that the mixer operator is able to regulate exactly the amount of sand and cement for any particular mix. Water for the mix runs from a small tank above the mixer. The tank is provided with an overflow pipe and is filled for each mix, water being shut off as soon as the overflow begins. Thus, the amount of cement, sand and water is automatically regulated for any particular mix according to predetermined volumetric ratios.

Mixture of the materials is effected in a batch mixer of 21-cu.ft. capacity, with two sets of paddles operating eccentrically and in opposite directions. The mixer

is cradled to discharge easily into the chute almost directly beneath it. A complete cycle of mixing operations consumes, on the average, four minutes, the actual mix always being given at least one and one-half minutes. The concrete is chuted from one of the two mixers to one of the vertical columns above the brick machines, each mixer serving two machines. Waste from the brick machines and any unset, deformed bricks are deposited in a steel bucket which is elevated from the machine to the mixer, where it discharges its load.

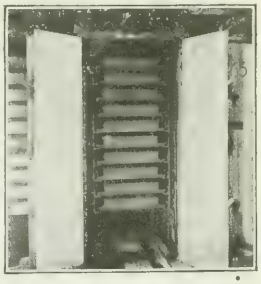


FIG. 4—ONE AISLE IN THE CURING SHEDS

In the complete operation from the placing of the aggregate in the bins over the mixers until the bricks are stacked in the yards or shipped for use, materials including the finished bricks and the pallets are handled entirely mechanically, the arrangement of mechanical devices being such as to reduce to a minimum hand labor required in the process of manufacture.

With each stroke of the knife in the brick machine, the material deposited upon the pallet is divided into ten bricks. Each machine operates at the rate of 4,000 bricks per hour. The racks upon which the pallets with their bricks are deposited, while the setting of the concrete is taking place, are inclosed in a suitable building so as to protect the material from the weather and undue drafts, and so that uniform results may be obtained. Means have been provided for supplying the building containing the racks with moist or humidified air of any desired temperature. The temperature is usually kept around 80 deg. F., and the atmosphere is continuously kept at the dew point. This arrangement has been provided; first, for the purpose of insuring that the concrete material be in a moist condition while setting and hardening; and second, for the purpose of hastening the set of the concrete and thus reducing the time required between the forming of the bricks and their removal from the pallets for use. Uusually, bricks, remain in the curing shed for a period of 48 hr. before being delivered to the storage yard.

Brick machines and the handling devices at the machines are controlled from a central point of the plant by means of compressed air, one operator being in control of four machines. The bricks on pallets are conveyed from the machines to the racks by means of specially constructed storage battery cars which handle pallets aggregating 500 brick to a load. Bricks are removed from the racks after setting by this same type of tier-lift truck.

After leaving the curing sheds the pallets with the bricks upon them are deposited by the tier-lift trucks in a tier-lift elevator. From there they are run on a conveyor through a device which separates the brick from the pallet, cleans the pallets with revolving wire brushes, oils them and elevates them for return to use at the brick machine. The bricks are further conveyed to a stacking bench through belt conveyor and gravity rollers where they are handled by a compressed air handling device onto industrial cars, 930 bricks being stacked on each car.

The surface of the storage yard is covered with a timber grillage. Bricks being moved out into the yard on industrial cars are so stacked that the top layers have elevations and depressions corresponding to this grillage that covers the storage area. A steam driven gantry spans the storage yard, which it serves. It is fitted with a C-grab whose bottom surface is so constructed that it dovetails with the grillage in the storage area and the open spaces left in the top surface of the brick stacks on the industrial cars. This C-grab is slipped under a load of 930 bricks, both to store in the yard and to remove it from the yard to auto trucks for delivery upon order.

As previously noted, materials used in the manufacture of products by the crozier system, due to their wide and general distribution, are such as to permit the location of the manufacturing plant, if desired, near to, or immediately at, the market and center of distribution, thus permitting a very material saving in transportation. The installation of mechanical appliances and labor-saving equipment in the plant has been carried out in unusual detail. The expense of this equipment is largely offset by the fact that the cost of coal, which is a big factor in the production of clay products, is practically elminated in the manufacture of concrete bricks, while labor is reduced to a minimum.

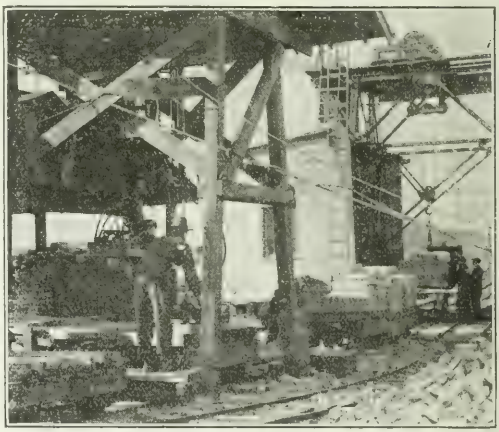


FIG. 5—PNEUMATIC STACKERS, AND C-GRAB OPERATED BY THE GANTRY

Various tests have been made upon crozite products by the testing engineer of the company itself and by representatives of the Robt. W. Hunt & Co., The Lewis Institute, the Pittsburgh Testing Laboratory and the testing laboratory of the civil engineering department of Columbia University. These tests indicate that crozite bricks can be made to meet easily New York specifications, and they also have indicated that the absorption, as compared with clay brick, is quite low, from 4 per cent to 10.81 per cent—dry weight percentage—depending on the mix. This fact tends to make them of a much higher fire resisting power, and less subject to weathering.

The natural color of the product, as in all concrete, depends on the aggregate used and varies somewhat with different aggregate. For use as face brick a large variety of different color effects may be obtained by adding to the aggregate in the mixer various mineral colors.

FIG. 6—GENERAL VIEW OF STORAGE YARD

The color may be varied at will to meet the requirements of the builder and architect and at very small additional cost of manufacture. In addition to this variation of color a process has been worked out for applying facings of various materials to the bricks as they are removed from the brick machine and while the concrete is still west, thus insuring a complete and proper bond between the body of the brick and the facing layer.

The manufacturers of crozite have found that they can very well meet with their cement-sand brick as manufactured in Brooklyn, the present price quotations on clay products of a similar nature.

Better Freight Handling Methods by Mechanical Equipment

Important Economies Effected by Adapting Existing Terminal Facilities to More Efficient Methods of Operation

By O. W. Stiles
Manager, Industrial Transportation Department, Lakewood Engineering Co., Cleveland

An IMPORTANT lesson of the war, and one still more forcibly brought to our attention by the recent congestion on the railroads, is the need of better terminal facilities. Here, in the terminals, transportation charges, as an element in the cost of production, can be reduced by the installation of proper mechanical handling equipment in present plants with economies that are astonishing. The recent congestion of the terminals proved conclusively that the freight traffic of the country is so dependent upon terminal facilities that congestion at any one point affects the entire system. But how is the difficulty to be remedied? Radical changes in our terminals are not practicable and for this reason the average terminal must be subjected to evolutionary changes.

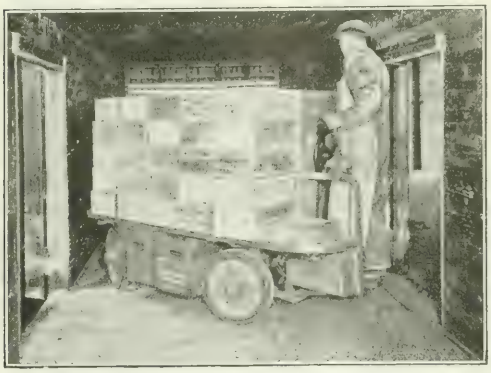
Our railroads are recognized as the best equipped in the world, but they are still using stations built fifty years ago and the methods of handling freight are in keeping with the stations. New freight stations involving huge investments would be no guarantee of any great reduction in terminal costs, which are largely in proportion to the number of interchange switching combinations. While freight-station labor cost is relatively a small item compared to the total terminal expenses, mechanical handling equipment, where installed in present terminals and freight stations, has shown remarkable economies.

A study will determine if mechanical equipment can profitably meet the conditions and requirements of each case. However, the subject necessitates a careful analysis of the movements of freight: First, to determine whether the work can be done more profitably by mechanical methods than by hand; second, the amount of saving possible; third, where this saving can be effected; fourth, the amount of investment justified by the saving; fifth, the best type or combination of types of equipment and whether such equipment will fit in with plans for future development.

Types of Equipment.—Mechanical handling equipment may be divided into three general classes: Portable, semi-portable, and stationary. The portable consists of such equipment as sectional power conveyors, gravity carriers and chutes, tiering machines, portable cranes, hoists, loaders and unloaders, lift trucks, platform trucks, and tractors and trailers. The semi-portable class includes most track devices, such as overhead traveling cranes, half-, full-arch and portal cranes, and industrial railroads with various types of cars. The stationary class includes fixed cranes, derricks, hoists and winches, overhead monorail and telpher systems, gravity chutes, built-in conveyors, elevators, etc. All of these types have their individual use, or may be combined or dove-tailed to effect a complete cycle of operation. The big problem is the prompt movement of freight to permit new freight to take its place and utilize the equipment to full capacity. This necessitates visualizing the terminal as a whole and working out a plan whereby freight proceeds from source to destination, in the shortest possible time, with a minimum of effort, and without conflict with other freight.

A complete and efficient mechanical freight handling system cannot be designed by the average engineer. The success of a system depends upon many factors, and requires specialized knowledge, creative vision, and a knowledge of mechanical and elec-

TRACTOR-TRAILER METHOD REDUCED HANDLING COSTS 35 PER CENT



TRUCK DELIVERS FREIGHT TO POINT OF UNLOADING

trical engineering, as well as practical experience. With the application of such knowledge and experience, the efficiency of a number of terminals and freight houses has been much increased, reducing the cost of operation from 25 per cent to 75 per cent, releasing a large number of men for more productive work, and retiring the investment in from six to eighteen months.

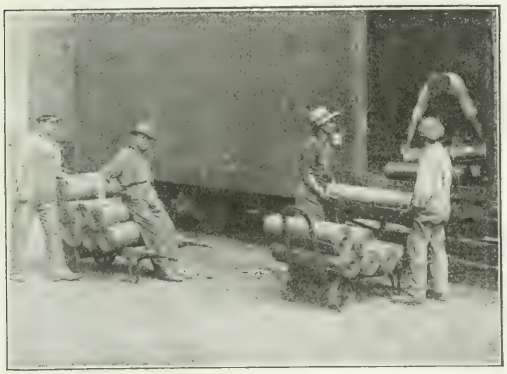
Economy of Tractors.—Frequently the installation of one type of equipment alone will accomplish striking economies. At one large, double-deck terminal freight house on a Middle Western road, an analysis of operating conditions showed that during one month in 1917 eighty men handled a total of 6,798 revenue tons of l.c.l. freight through the house, or approximately 85.3 tons per man, with hand trucks, at a cost of 99.6c. per ton, including supervision. The study also indicated that the same tonnage could be handled with electric storage battery tractors, trailers and hand trucks, using forty-eight men, at a cost of 72c. per ton, including supervision.

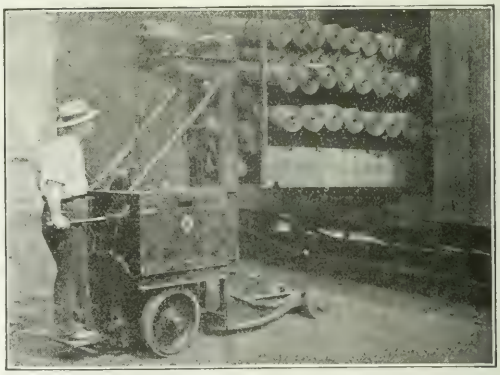
A suggested plan was approved and equipment purchased and installed. A check for the year 1919 showed 71.8 men handled 13,578 revenue tons at a cost of 74.2c per ton. This included all increases in wages granted up to Jan. 1, 1920. Compared with the 1917 operation with eight less men, 6,780 tons more freight were handled monthly, at a decreased cost of 25.4c. per ton, or 189 tons per month per man in 1919, against 85.3 tons per month per man in 1917. In March, 1920, another check showed 67.5 men handled 17,025 revenue tons at a cost of 79.9c. per ton, an output of 225 tons per man per month. With 12.2 men less in 1920 than in 1917, almost three times as many revenue tons were handled, the cost still remained 20c. per ton less, and with 300 per cent greater output per man per month than in 1917.

The Port of Charleston, South Carolina, is utilizing the Army Supply Base as a municipal terminal, and with the use of electric storage battery tractors and trailers has reduced the cost per ton of handling miscellaneous freight from shipside into warehouse or cars over 50 per cent, greatly reducing the number of men required, and permitting quick turn-around of vessels. A careful record of maintenance, including interest, depreciation, repairs and current for charging batteries, indicated an average cost of 33c. per hour per tractor.

At one of the small terminals of a central Western road, the use of four tractors and two hundred trailers reduced the labor force from sixty to ten men, and the cost of freight handled, per ton, from 64c. to 34c.

These tractors have been in constant use for from five to seven years. At this terminal, the freight house facilities, previous to the introduction of mechanical equipment, were inadequate to handle the volume of freight with hand trucks. The use of mechanical equipment made possible a great increase in capacity on account of lessened congestion. This increase in freight handling capacity was attained without any addition to, or enlarging of the existing freight house or platform.





TIER-LIFT TRACTOR-TRUCK CUTS COST AND SPEEDS UP LOADING INTO BOX CARS

A recent study of an important terminal at one of the Gulf ports indicated that by simply installing tractors, trailers and lift trucks, a saving could be made of approximately sixty thousand dollars per year; the cost per ton of freight handled could be reduced from 61c. to 46c.; 65 men released for other work and the investment retired in a little over one year's time. Another study of a small inland freight house on the same road indicated an approximate saving of twenty thousand dollars per year, a reduction in cost of freight handled of 12c. per ton, release of twenty-two men, and retirement of the investment in less than one year. An analysis of a large transfer station on an Eastern road indicated a saving of $82,000 per year, a reduction in

cost of 30c. per ton of freight handled, release of thirty men for productive work, and retirement of the investment in six months. These cases are cited merely to indicate the savings possible by the installation of but one type of equipment.

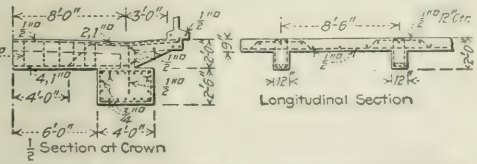
The motorizing of the Cincinnati Terminal resulted in speeding up the dispatch of freight; saved two handlings; decreased damage to freight in loading and unloading 50 per cent, and saved several hundred thousand dollars per year.

It is at present costing approximately $6 per ton, including cartage, to deliver freight from the outer classification yard to point of delivery in New York. Normally, fifty thousand tons of freight are moved daily, an item of $300,000 per day. With the same methods and type of equipment as installed in Cincinnati, the total cost would not exceed $3 per ton. Assuming the same daily tonnage, this indicates an annual saving of $45,000,000 per year.

The superiority of machinery over present methods will lead to its general adoption, resulting in time saved, important economies and terminals in keeping with an efficient transportation system.

Sidewalk Separation on Concrete Bridge

IN THE new Millwood bridge recently completed by the city of Spokane across the Spokane River a special detail of roadway and sidewalk separation has been adopted. This detail is shown in the accompanying sketch. The bridge is in a country district where there is little pedestrian travel. The prospects for the future, however, were thought to be sufficient to warrant the



SIDEWALK AND ROADWAY OF BRIDGE CONTINUOUS WITH BREAK OF GRADE AS SEPARATION

separation of the slope of the outside 3 ft. of the roadway so as to provide a place for pedestrians and also to confine so far as possible the vehicle traffic to the middle 15 ft. This arrangement consisted in crowning the roadway for this 15 ft. and breaking the grade over the center of the arch rib, from which point the sidewalk section arises on a slope to the balustrade. The middle slab and the cantilever slabs are each 9 in. thick and carry an asphalt surface continuous from balustrade to balustrade. It is hoped that the break in the grade will serve to keep vehicles away from the sidewalk, although in case of necessity the absence of a curb will permit them to run there for passing another car or wagon coming in the opposite direction. The work was done under the direction of A. D. Butler, city engineer, with B. J. Garnett as bridge engineer.

Trent Activated Sludge Plant, Turlock, Cal.

A Trent activated-sludge plant for treating the sewage of Turlock, Cal., is being built and is expected to be in use by Feb. 15. At first it will handle 500,000 gal. per day, but it is designed for an ultimate capacity of 1,000,000 gal. It is similar to the test plant at Pasadena, Cal.

Trend of Highway Development —A Survey

THIS IS THE TWELFTH *of a series of staff articles on the highway situation. It deals with the rapid strides made in Delaware in the construction of a hard-surface highway system, of refinements in specifications for concrete roads, of surveys made upon concrete slabs, and other studies which have in mind a development of the best obtainable design for concrete roads.*

This is the concluding article of the series.

Delaware's Practice

DELAWARE stands alone in highway practice. Committed by law to the construction only of modern type surfaces—a program that has developed into an almost exclusive use of concrete—the state's highway engineers are studying causes for concrete road failures and are focusing their attention upon refinements in design, construction methods and specifications in order that the highest type of concrete slab may be secured. Though various other details make the position of Delaware unique and must be discussed in connection with Delaware practice, the state's progress in concrete-road construction is the outstanding feature.

Highway construction, financed by state funds and superintended by state engineers, is new in Delaware. The state highway commission built its first roads in 1918. However, in 1918, 1919, and 1920 it completed 86 miles of concrete, 6.3 miles of brick, and 10 miles of bituminous macadam roads, of a total of 154 miles contracted for, of which 124 miles are of concrete. Had the construction season of 1920 been a favorable one Delaware would have practically completed her trunk line system.

Concrete Prevailing Type

There are, apparently, at least two good reasons why Delaware is committed to the construction of modern-type surfaces. Delaware is a rural state, about 60 per cent of its population living outside of Wilmington, the seat of the du Pont industrial interests, in towns of less than 5,000 population, or in strictly rural communities. Inasmuch as the community is largely agricultural, has limited rail transportation, and is within easy access by motor truck of such market centers as Wilmington, Baltimore, Washington and Philadelphia, a hard-surface type was deemed expedient to care for expected commercial truck traffic. In the construction of the du Pont Highway, built with private capital, a precedent for durable types had been established.

In choosing concrete for almost all state work several factors entered. First, Delaware has little local commercial stone, depending upon foreign stone for almost all state highway construction. The average materials haul is 100 miles. Therefore, even a waterbound macadam road is, in Delaware, an expensive type. When construction first started on the Delaware system alternate bids were called for. Brick, concrete, sheet asphalt, penetration macadam, and bituminous macadam were the most popular types proposed. In the submission of bids it was discovered that, partly because of the long materials haul, there was little to choose between the various types. Inasmuch as concrete was considered highly from the point of view of durability it was adopted as the prevailing type, even though expensive.

Having accepted concrete as a prevailing type practically the entire personnel of the highway department began the development of the most durable design. The smallness of the highway organization has induced a noticeable co-operative effort. The bridge, construction, design, testing and maintenance divisions, whose chiefs and immediate subordinates are in almost daily informal conference, are pretty well informed as to the studies and investigations carried on and the results obtained by each other. The result of the co-operative effort is marked.

The size of the highway department has also allowed personal inspection by a representative of headquarters of every highway project under construction. Practically every job in the state can be reached by automobile from the chief engineer's office within two hours. The result of this personal observation of construction methods is seen in the refinement of specifications. For instance, for each 1,000 ft. of uncured concrete the contractor is now required to keep at least one man whose entire time is taken up in watering the concrete during its 14-day curing period. If concrete is hand-finished the specifications require that three men be kept ahead of the templet, leveling, tamping, etc. Another specification is that the screed must be a heavy channel iron with at least an 8-in. face. The usual screed used weighs approximately 450 lb. and can, with practice, easily be operated by two men. All these refinements in the specifications only go to show that the engineer is endeavoring to make the specifications as definite as possible, eliminating all the contractor's risks except those which are basic.

Various Practices

Another variation from the usual specifications is that which demands the use of 10 per cent by volume of hydrated lime in all concrete mixtures. Experience in the use of hydrated lime has led the Delaware engineers to conclude that not only can the workability of the mixture be increased, but that the strength of the concrete is increased as well. Experiments that have been carried on indicate the usual results—variation in strength according to aggregate and also the amount of lime used, results with tho different aggregates always being erratic. It is believed, however, that, after experiments in the use of lime have been carried further, local sands, not now usable, may be utilized in state highway work.

With the results that have been achieved in Delaware neither reinforcement of slabs nor the use of expansion joints is considered necessary. Expansion joints were used in some of the earlier pieces of construction, though now they are entirely omitted. Now, at the end of each day's run, ⅝-in. round iron rods, each 4 ft. long, are imbedded in the green concrete and allowed to project so that 2 ft. of the rod will extend into the newer slab. The rods are wrapped in tar paper or some similar material so that they will slide after the concrete has set. Before each day's run the inspectors test these rods to see that they are loose. It is believed that these rods, when placed so as not to form a rigid connection between slabs, not only prevent the slabs from rising when temperature variations are great and tend to cause slabs to buckle, but also offer resistance to truck impact.

The highway department maintains a crack survey which has been termed the "post-mortem" sheet. Upon sheets of standard size are placed the alignment and profile of each newly constructed road. Descriptions and proportions of materials used, the type of mixer, weather conditions, temperature variations during construction, and similar details are noted also on the sheets. As cracks occur the point of cracking is noted on the sheet and its station is indicated. The history of each crack is followed from time to time and the engineers have in many instances determined to their satisfaction causes of the cracking.

Delaware has adhered to a 1:2:4 mix in all its concrete road work. Results secured so far have been so satisfactory that a change to a richer mixture has not yet been deemed necessary. With that mix it is estimated that a saving of $1.50 per cu.yd. is effected over a 1:2:3 mixture. The thickness of slabs, when a 14-ft. roadway width was being used, was 5 in. at the sides and 7 in. in the center. With 16 and 18 ft. now as standard widths, the thickness has been increased to 6 in. at the sides and 8 in. in the center.

Though among the youngest of the highway organizations Delaware has conceived what are considered broad principles upon which a modern highway system should be constructed. For instance, main trunk lines pass outside centers of population wherever it is possible to make them do so. Thus through traffic never interferes with local traffic in congested town streets. Straight alignment, flat curves and low gradients and wide rights of way—never less than 60 ft.—are other principles to which the department adheres. As the highest point in the two southern counties of the state is 65 ft. above sea level, and as it is not necessary to follow section lines in new construction, these principles can be adhered to with regularity.

Boulevard Corporation Roads

Prior to 1917, when the Delaware General Assembly enacted a law establishing a state highway department, road construction was confined to that undertaken by the three counties of the state, and to those constructed through private means. During the 1911 session of the assembly, there was passed a law known as the boulevard corporation act, the two main features of the act being the authorization of corporations composed of private citizens to construct a state road, and provision that after the road was constructed, or any section of it exceeding 10 miles, it should be conveyed to the state free of cost, for the state to maintain.

Pursuant to this act the du Pont Boulevard Corporation was formed, them ain incorporator being General T. Coleman du Pont. Various surveys were made in all the counties with a view to finding the best place for making a beginning of a north and south state trunk line. From the creation of that corporation until the state began constructing roads work was done, intermittently, on a road extending north from the Maryland border toward Dover. When the state highway commission began functioning approximately 28 miles of 14-ft. concrete pavement on this route was completed and had been conveyed to the state for maintenance. That road has been extended until there is practically a hardsurfaced trunk line extending from the north to the south of the state, General du Pont contributing the funds for the construction of this highway up to a cost of $44,000 per mile, the state paying any costs in excess of that figure.

Money for the construction of roads in Delaware by

the state is provided from the receipts of automobile taxes and from the state income tax in excess of $250,000. During the war there was some money available from the state income tax, but since the war the receipts have failed to exceed $250,000. From these receipts the state must set aside $250 per mile for the maintenance of roads already taken over. Expenses of administration of the state highway department are then budgeted and the remaining money is available for construction purposes. During 1917 approximately $84,000 came from the automobile tax fund. In 1918 this increased to $232,000, in 1919 to $286,000 and in 1920 up to Dec. 1, $330,000. In the past this money has been used to finance bond issues, so far $2,100,000 of forty-year sinking fund bonds having been sold and $500,000 more in bonds advertised. Thus the state is allowed to proceed on a much larger construction scale than were it to use the automobile funds available only from year to year. With these funds the state has reconstructed a portion of the Philadelphia Pike just out of Wilmington, expending more than half a million dollars on approximately six miles; and has built a portion of a second north and south trunk line from Dover and to the west of what is called the du Pont road.

Delaware has undertaken no specific mileage to build in order to get a state highway system. Roads requiring construction are built and as constructed are added to the system, which now includes approximately 300 miles of highway. Highways constructed also by state aid are, when completed, added to the system, though part of the maintenance cost is paid by the county in which the roads are located. Most of these state-aid roads are east and west laterals and often of a bituminous type. The sum of $300,000 per year is available for division among the three counties on state aid work. In order to participate in state aid all three counties have issued bonds. In 1917 Sussex County authorized the issuance of $1,000,000 in bonds, in 1919 Newcastle the issuance of $700,000, and last year Kent authorized a $1,000,000 bond issue.

The geographical character of Delaware makes its trunk line highway system one of north and south routes. Tapping the agricultural districts of the state and making easily available market centers has been the chief business of the State Highway Department. Believing a concrete road to be the best type of modern construction and believing that a better slab may be secured through study and investigation, Delaware's "family" of state highway engineers bid fair not only to popularize the motor truck on the farm but to add much in research upon concrete highway construction.

Garbage Quality Reflects Thrift Tendency

Observations made to determine the tonnage and nature of the refuse collected and delivered to the garbage destructor in San Francisco, according to a report by M. M. O'Shaughnessy, city engineer, show that the city's garbage has decreased from 540 tons a day in 1915 to 380 to 400 tons per day at the present time. This decrease is ascribed to two causes, the increased value of paper, rags, etc., and the consequent activity of junk men, and to the increasing practice of economy in the household. Analyses made of the garbage at various times show the following contents: combustible, 20 to 25 per cent; moisture, 45 to 50 per cent; ashes and incombustible, 25 to 36 per cent; all percentages being by weight.

The Cement Manufacturers Before the Lockwood Committee

As PREVIOUSLY recorded in this journal, a New York legislative committee has for some months been investigating the building industry of New York City. At the end of December it quizzed a number of eastern cement manufacturers in the endeavor to show that they control closely the distribution of cement and use that control as an element in fixing prices. The questioning was so conducted as to convey the impression that there was a strong case against the manufacturers. In fact, *Engineering News-Record*, in its issue of Jan. 6, p. 46, conveyed the same impression, the report there printed being prepared from a summary of the proceedings. The testimony now being available in full, a conclusion as to what was shown can be drawn.

Such examination leads to the conviction that, so far as this testimony goes, the case must be adjudged, "not proven."

It will be well to understand, first, the character of the proceedings. The investigation consisted solely in the questioning of subpœnaed witnesses by the counsel of the committee. That was all. Testimony was not taken under court rules of evidence. Witnesses were not allowed counsel; consequently there was no cross-examination to clarify the testimony or to show that it meant something different than was disclosed under the direct questioning. Counsel for the committee, Samuel Untermyer, a very sharp inquisitor, in trying to make a case against the witnesses asked only such questions and permitted such statements as would help to build up his case.

"Specific Job" Deliveries

His chief point of attack, in endeavoring to prove control and price fixing, was on the practice on "specific job contracts." These are contracts by which the manufacturer guarantees to supply a dealer at a definite price all the cement required for a specific job which will require shipments beyond a 15-day period. Mr. Untermyer endeavored to show that under these contracts if a dealer received and paid for cement in excess of the job's requirements, he would have to return the excess cement. It was clearly proved, however, that this could not be the case, first, because under the cement manufacturers' practice excess cement is not shipped to jobs, and, second, because on these contracts cement is not paid for when ordered but only upon shipment.

The purpose of the "specific job contract" is to allow a contractor to bid on a job with assurance that the cost of his cement will not increase, even if the job last one or two years. The benefit accrues also to the engineer and the owner, for without the "specific job contract" the former could not estimate with certainty cement costs on jobs, nor could the owner know in advance his probable investment. If under such a contract a dealer could get more cement than was required for the job covered, he would, in case the price went up, be able to get cement for general sale below the market price, thus taking advantage of the practice established for the purpose of stabilizing construction. On the other hand, if the market price should drop and the demand be slack the dealer would refuse to take the excess cement and possibly leave the manufacturer with a large stock which he had been reserving for this and for similarly cancelled options.

To prevent such over-ordering nineteen eastern manu-

facturers are operating the Cement Manufacturers' Protective Association, which distributes to its members a record of all "specific job contracts" that have been closed, and which, on demand of members, sends inspectors to these jobs to determine and report on the quantity of cement needed. In this way, only the amount of cement needed is shipped, the contract allowing cancellation of excess amounts.

Mr. Untermyer tried also to show close control by questions designed to indicate that for general sale, called "warehousing" in the cement trade, a dealer could contract only for the amount of cement that a manufacturer could ship him in 15 days, even though the dealer would pay for all the cement he could get. The testimony of the only manufacturer quizzed on this point did indicate such to be the practice. In fact, though, a dealer can, from some companies at least, contract for cement for warehousing over a period longer than 15 days, *but* the companies will guarantee the price for only 15 days. Moreover, depending on the usual manufacturers' precaution of seeing that all his customers are supplied and of not allowing one or two men to "hog" his output, the dealer can secure as much cement as he wishes. The testimony brought out that information is not exchanged regarding cement sold for warehousing, so that a dealer can buy large supplies simultaneously from several companies.

Statistics exchanged by the companies regarding stocks of clinker and cement on hand and amount of cement shipped were attacked as a means of controlling production. This was admitted by a manufacturer who said that they "assisted in preventing overproduction," but he maintained that the information was necessary for the intelligent direction of his business.

Prices

On the matter of prices, there was sharp questioning in an endeavor to prove collusive price fixing, but this line of examination failed to produce any supporting evidence. It was admitted by manufacturers that prices quoted by competing companies were never apart except for a few days at a time, but this, it was maintained, was normal in the marketing of a standardized product.

Also, there was endeavor to create the impression that the large size of some of the companies enabled them to control the market and that the profits have been large. One of the big companies declared last year a 50-per cent stock dividend on its common stock, and another—a 25 per cent stock dividend, but, against the wishes of the committee's counsel, the president of the first company slipped in the statement that his common stock had not paid a dividend for ten years.

Costs of cement, in relation to the manufacturer's selling price, received some consideration, but the resulting testimony was so confused as to allow no intelligible conclusion to be drawn.

The practice of charging, on direct sales to contractors, 10c. per barrel more than to dealers, to which contractors have so often objected, was barely touched upon, and nothing informative brought out.

The inquiry as a whole may be summarized as follows:

It was unfair in its methods and failed to substantiate what the counsel for the committee endeavored to show—unfair control and price fixing. It did, however, give general publicity to the system of marketing cement, but the newspaper summaries conveyed to the public not what the testimony showed but what the counsel for the committee hoped that it would show.

Precast Slabs vs. Monolithic Concrete for Repairing Paved Roads

MINOR repairs to concrete pavements on the state highway system in California are now made by two methods, one or the other being chosen according to conditions. These are (1) casting new concrete in place, or (2) using one or more precast slabs, 1½ x 3 ft. in size and 6 in. thick. This standardization of practice came after experiment with various methods, including use of the cement gun, making and keeping in stock slabs of various sizes, and divers means of securing a compact foundation beneath the point of repair and of making joint between slab and pavement.

The chief disadvantage of casting a patch in place is that, after repair, traffic must be kept off it for ten days. With the precast slabs, on the other hand, the fundamental disadvantage is the difficulty of getting them set so they will maintain the continuity of the pavement surface under heavy traffic. For small patches, particularly where inconvenience results from diverting traffic around the repair, the precast slabs are preferred. On less traveled roads, and where the area to be patched is of considerable extent, a small mixer is usually taken to the job and the concrete poured in place. Where the latter method can be used, less time is required for preparing the foundation and the edges, highway officials point out. The shape of the patch is purposely left more or less irregular to give a better bond. On the whole, the monolithic patch is often easier to put in, and highway officials consider it cheaper and less likely to give trouble.

The use of precast slabs was begun several years ago; at first an attempt was made to stock sizes from 1 ft. to about 6 ft. long and of various widths. The large slabs were discontinued because of the difficulty of placing them. Getting them into place was slow work and, because of their weight, it was most impossible to bed them in mortar or sand satisfactorily. The larger the slab, highway officials point out, the less the likelihood of an even distribution of stress over its entire base and hence the greater the danger of breaking under traffic.

No limit has been set on the maximum area that can be effectively patched with the smaller slabs. A score or more of the 1½ x 3 ft. slabs are sometimes set with their edges in contact. Either asphalt or grout is used to fill the joints between slab and pavement. With the grout a better bond could be made, but it takes time to set. The danger with the asphalt is that it may heat and, if the foundation becomes uneven, permit the slab to tilt under heavy traffic. The slabs are made with a 1:2:4: mix; heavy wires are imbedded with loops protruding for convenience in handling.

South Carolina's Highway Program

More than $6,500,000 worth of highways are now under construction in South Carolina, according to figures compiled by Charles H. Moorefield, state highway engineer. This work embraces 39 projects, all under way with about one-third of the work completed. In addition to the highways now being constructed approximately $200,000 worth of roads are now being advertised, and bids will be received on these during the next month or two. All but 15 of the 305 miles under construction are top-soil, gravel and clay roads.

Interstate Water Conflicts and Possible Solution

Complete Utilization by Large Projects for Irrigation and Power Depends on Engineering and Legal Co-operation of States Involved—Possibility of Interstate Compacts

By R. I. Meeker
Irrigation Engineer, Denver, Col.

LEGAL and engineering co-operative study of the physical conditions, potential water needs and relation of the various parts of a river basin, recognition of the general low efficiency under which water is applied for irrigation, more thorough investigation of the relation and magnitude of return flow water from irrigation, and appropriate legislative action by agreements or compacts among the states involved are some of the principal factors entering into the effective settlement of interstate water conflicts or determination of water utilization.

Fundamentally two forces have been contending in the development of water supply in large river basins of the semi-arid West; physical conditions and divided authority. States are made up of arbitrary political divisions of river basins, and, since each state controls and administers its water supply, utilization of water for irrigation and power has progressed independently in each state on long river systems. Through co-operative efforts there are a few exceptions.

Physical conditions of river flow and relation of irrigable areas to storage sites are antagonistic to divided authority when complete utilization is attempted. The final control of western rivers requires efficient storage capacity. Reservoir sites for such control must be developed according to physical location or opportunity, which may be in other states hundreds of miles away from the point of water utilization. Conversely, large reservoir sites constructed in a lower state depend largely on the run-off of upper states.

A period in the western United States has been reached where future irrigation and power development must depend largely on water equalization and regulation through the construction of reservoirs. Since river flow is now administered under divided authority, some legal adjustment of state water laws and apportionment of state waters must be reached as a sound basis for future construction and use.

The pressing water needs of the future and the spectre of interstate litigation are commencing to awaken thinkers among engineers, attorneys and state and federal officials to the necessity of studying river basins regardless of state lines, and evolving some economic, legal and equitable interstate plan of development and administration that will permit of the widest use in each state, and yet assure and leave undisturbed the existing vested rights. On several western streams plans are now crystallizing for large storage, irrigation and power projects whose effect upon a river system is so great as to compel study of their relation, both physical and legal, for hundreds of miles. Consequently, complete utilization may rest on interstate study and co-operation.

Especial reference is made to the proposed constructive and comprehensive plan of development of the Colorado River and its tributaries by the League of the Southwest. Roughly, this plan contemplates the pooling of water supply by the seven interested states—Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada and California—through engineering investigation and study and the formation of a program that will provide flood control for the lower river and the widest use for irrigation and power in both the upper and lower portions of the Colorado Basin. Sixteen million acre-feet of water annually and more than 5,000,000 acres of land, of which 2,000,000 acres are now irrigated, are included in the plan. Storage reservoir sites of as much as 25,000,000 acre-ft. capacity are being investigated, and hydro-electric possibilities of 2,000,000 hp. are being discussed. The State of Washington has expended $100,000 in studying the irrigation possibilities of the Columbia River Basin, dependent upon water supplies from Montana, Idaho and Washington, for a project of 1,750,000 acres at an estimated cost of $300,000,000. Contrast these projects with those originating earlier than 1910.

Prior to the passage of the Reclamation Act in 1902, irrigation projects were small and were generally confined within a single state. Today even when private and Federal Reclamation projects do not cross state lines they are nevertheless interstate in character because of the heavy water demand they impose, and the far-reaching effect that demand may have for hundreds of miles up or down a river. Projects of the future involve extensive control by reservoirs, the position and relation of which on a stream will be thoroughly interstate in character.

By reason of its high and extensive mountain system Colorado is the radiating source of four major river systems: the Platte, Arkansas, Rio Grande and Colorado. Wyoming and New Mexico occupy similar positions with reference to interstate waters, being the source of four river basins each.

Colorado's strategic position in water supply, however, has its obligations (as witnessed by interstate water suits), since the four above-mentioned rivers traverse nine states, and one of them impinges on the Republic of Mexico, in all of which irrigation is practiced. Some Colorado interstate problems will, therefore, be touched upon as typical of conditions in the West generally and illustrative of the need of a better solution of interstate water conflicts than litigation.

A review of interstate water litigation discloses that during the past 26 years six interstate suits have been brought against Colorado, or Colorado ditches, on four river systems. Arranged in order of occurrence they are:

COLORADO INTERSTATE WATER SUITS

Stream and State	Date of Suit	Court	Remarks
Arkansas River . . . [illegible]	1901	U. S. Supreme	Insufficient injury shown by Kansas dismissed without prejudice 1907
Laramie River. . . . [illegible]	1910	U. S. Supreme	No decree to date, reargued at request of U. S. Reclamation Service
[illegible]	1914	U. S. District	Decided adversely to Colorado
[illegible]	1915	U. S. Circuit	Decided adversely to Colorado
	1917	U. S. Supreme	Appealed; no decision to date
[illegible]	1913	U. S. District	Settled by compromise in 1916.
[illegible]	1916	U. S. District	No decision to date
[illegible]	1917	U. S. District	No decision to date

Other conflicts loom on the horizon, of which one is on the La Plata River (a small tributary of the San Juan), between Colorado and New Mexico. Latent conflicts exist on the Rio Grande and North Platte River, and potential or prospective problems on the Colorado and its principal tributaries. Litigation of 18 years' standing has not resulted in a solution of these vexing problems.

Important questions of water conflict have arisen and will continue to arise in the future in other states. Unless legal co-operation between various states is had on interstate rivers, the 17 states where irrigation is essential to successful agriculture will witness much litigation in the future. Continued development of interstate streams is inevitable. A possible solution, or a step in that direction, is one of mutual compacts or treaties between the states involved, based upon a thorough engineering investigation of the physical facts of water and land relationship and economic use supported by legal advice and legislative assistance. Thorough examination and analysis of the underlying physical facts which largely control the use of water in river basins, if properly disseminated among water users, will go a long way toward wiping out popular fallacies, local antagonisms and misunderstandings which surround water rights.

Interstate Water Problems

A brief reference is here made to some specific interstate water problems observed by the writer in his professional practice.

State-Line Ditches — Administrative problems on state-line ditches (canals crossing state lines) are serious because such canals are virtually outlaw canals. A concrete example is that of the Mitchell Canal from the North Platte River which diverts water one-half mile west of the Nebraska-Wyoming line and furnishes water for the irrigation of land in Nebraska. The State of Wyoming has no particular interest in the control of this canal because the water is utilized in Nebraska, and the headgate lies below all headgates in Wyoming. Water officials of Nebraska cannot regulate the headgate because it lies in an adjacent state; hence, this canal diverts water at its own pleasure regardless of prior rights in Nebraska. Many state lines have one or more of these canals. The Republican River interstate water suit was caused by a state line ditch. Two such ditches divert water from the La Plata River in Colorado for use in New Mexico. The two main canals of the North Platte project are of the interstate type.

Interstate Reservoirs—Large reservoirs have been constructed in an upper state to supply lands in a lower state, involving the use of a river channel as a conduit for hundreds of miles. An example of a reservoir in an upper state largely operated for the benefit of lands in the lower state is the Pathfinder reservoir (1,170,000 acre-ft. capacity) on the North Platte River, Wyoming, the water of which is used chiefly in Nebraska, on the North Platte Project, extending as far east as Kearney, a distance of 500 miles. The Jackson Lake reservoir in western Wyoming supplies Idaho lands along the Snake River with stored water.

The utilization of large reservoirs in lower states demanding a satisfactory water supply from an upper state is interstate in character. Such a reservoir in the lower state operating to the detriment of an upper state is the 2,600,000-acre-ft. capacity Elephant Butte reservoir of the Rio Grande Project in New Mexico. In this case canals and reservoirs of any magnitude undertaken later than the initiation of the Rio Grande Project have been denied a right-of-way over government land for the reason that the water supply of the Rio Grande was believed to be insufficient for development of any lands other than those within the Federal Reclamation project. The Pathfinder reservoir also falls in this class for the reason that development above Pathfinder reservoir on the North Platte River in Colorado and Wyoming has also been restricted through denials of rights of way; but co-operative study between the State of Wyoming and the U. S. Reclamation Service will probably adjust this difficulty.

Trans-Mountain Diversions — Withdrawing water from the original drainage basin to an adjacent one, but within the confines of a single state, may have an interstate relation. A concrete example of an intrastate trans-mountain diversion on an interstate stream is the two-mile Laramie-Poudre Tunnel which proposes the diversion of water from the headwaters of the Laramie River in Colorado to the Cache la Poudre River in Colorado. The Laramie River lies in both Colorado and Wyoming, the water originating chiefly in Colorado, and the irrigable lands of the basin lying mostly in Wyoming. It is proposed to take annually 56,000 acre-ft. of the headwater flow away from its own drainage basin to an adjacent one in Colorado. The Laramie-Poudre tunnel project is the origin of the Wyoming-Colorado interstate water suit. The 3-mile Strawberry tunnel diversion of U. S. Reclamation Service in Utah is another example of a trans-mountain diversion taking water from Green River watershed to Great Basin.

Excess Decrees or Filings—Many cases exist of excess decrees or filings in both lower and upper states not now using all water alleged to be appropriated. Such water rights should be officially reduced to meet the physical facts of beneficial use. In some states this will require the adoption of a modern irrigation code.

International Phases—Interstate problems on rivers whose drainage basin lies within two or more states may have an international as well as an interstate angle. Examples are the Rio Grande, the Colorado and Milk Rivers. At present treaty agreements cover these cases.

Origin of Interstate Water Conflict

The origin of interstate water conflicts is traceable chiefly to the following causes:

Physical Conditions—Political boundaries of most western states cross watersheds, seldom coinciding with boundaries of major river basins. Hence, topographic and hydrographic features of river basins seldom correspond with state lines.

State Ownership and Administration—By constitutional provision the waters of some of the states are declared to be *public property* held in trust for appropriation. The administration of the use of the public waters lies in separate states, and since the principal rivers traverse two or more states, river basins have become artificially divided into sections through independent utilization and administration in each state.

Reduced Flow—A reduced direct-flow water supply in the lower state of a river basin, due to increased diversion for additional areas in the upper state, or states, compels indifferent irrigation or abandonment of areas once cultivated, or else imposes the cost of a new or supplemental water supply.

A popular fallacy has grown up among many water users, and some attorneys and engineers, that water priorities on the same stream should be enforced between the states regardless of state lines because of the prevailing common doctrine of priority within the states. This doctrine is plausible on first thought, but is erroneous because enforcement of the supply of any interstate stream according to priorities regardless of the state lines would deprive water users of vested rights (long used and assured by state laws) by changing the relation of every water right, and consequently, the amount of water divertible by each ditch. In some instances inferior water rights would be enriched and in others dependable direct flow rights depleted to flood rights or even worse, and every gradation between would occur. In fact, in many cases such administration would be practically confiscatory of vested rights.

The application of interstate administration according to priority dates of old rights to streams and their tributaries traversing two or more state and affecting several hundred to a thousand ditches scattered through a distance of one hundred to one thousand miles, would disturb the entire use of water in the river basin.

Physical conditions of our main interstate streams are also opposed to the literal enforcement of priorities of state lines. In the arid west practically all of the main interstate streams originate in high mountainous territory, pass through plain or plateau areas, and in the lower third of the basin the channel becomes wide, sandy stretches, wasteful of large volumes of water during the hot summer months by evaporation and lateral percolation. A few old water rights usually exist along the wide, sandy stretches at the lower ends of rivers, such as the Arkansas, South Platte, North Platte and Rio Grande. Operation of main interstate streams, according to priority regardless of state lines is uneconomic of water, because during the hot summer months large volumes of water are lost by evaporation. In order to deliver comparatively small volumes of direct-flow water for irrigation on the lower end of such rivers to relatively small areas, large volumes of water are, and would be, required to satisfy channel losses. Supplemental reservoir equalization on the lower river and for the lower river appears to be essential in such cases, for in the future it would not be economy to permit large volumes of water to go to waste on the lower river to satisfy a very small area when land values in the upper areas invite utilization. Interstate enforcement of old water rights would place the burden of reservoir development almost entirely on the upper state through a demand of heavy volumes of direct-flow for the lower area. Complete utilization of a river requires extensive reservoir equalization on the lower river as well as on the headwaters area. F. H. Newell has advanced a doctrine of economic use to supplement the older doctrine of beneficial use in irrigation.

Replacement Storage

On most interstate streams where conflicts have arisen there are still unused flood- or winter-flow waters available for storage, and suitable storage sites occur. A constructive step, then, in an interstate settlement would be for the state involved to construct reservoirs jointly with which to minimize the conflict, leave undisturbed the vested rights in the upper and lower states, and apportion any surplus water according to the needs of the various lands within the drainage basin. This would give stability to future development. If interstate enforcement of old priorities is not practicable, then what method of administration will least disturb the present vested rights, permit of additional development and wipe out conflicts extant or likely to arise?

A rational plan of development would be for the various states involved on any particular stream system to organize a joint engineering commission to study the relation of irrigated and irrigable lands, water supply, reservoir equalization, consumption of water, return flow, interstate conflicts and related matters, the findings to be a comprehensive plan for utilization to fit physical facts, and to form the basis of legal interstate water compacts or agreements, as previously indicated. Such a plan has practically been outlined in the League of the Southwest for the development of the Colorado River in seven southwestern states. Joint investigations and studies of water supply, land and water rights, have already been made by the State of Wyoming and the Reclamation Service on the Green River in Wyoming, and the North Platte River in Wyoming and Nebraska. Similar co-operative administration is being practiced on Snake River in Wyoming and Idaho. These joint efforts have resulted in much good and are clarifying the issues, though no binding agreements have been made.

Return Flow and Re-use

A review of irrigation history discloses profound changes in stream-flow, one of which is "seepage" or return water from irrigation. It is well established that canal and lateral losses are heavy on most irrigation projects, ranging from 15 to 50 per cent of the headgate diversion. Additional heavy losses on the irrigated fields occur from evaporation and deep percolation, so that the plant may receive, and actually consume, only from one-fourth to one-third of the water originally diverted. A large percentage of the total losses above cited returns eventually to the stream channel in the form of seepage water, and is re-diverted and re-applied in some instances many times.

The magnitude of return flow or seepage waters is not generally known for three reasons: (1) Several years are usually required to build up the water table, or underground soil reservoir, to equilibrium. This consumes large volumes of water from deep percolation since 1 cu.ft. of soil can absorb one-fourth to one-third of its volume of water. (2) Return waters from irrigation are largely non-visible and where they do appear as small surface streams they become commingled with ditch or river water, and their identity lost. (3) Re-diversion and re-use on tributaries or along the main stream prevent cumulative effect. Special hydrographic studies are required to segregate such water from surface run-off.

In the South Platte Basin in Colorado the annual mountain run-off averages 1,500,000 acre-ft. (15 years' record). Storage development approximates 1,000,000 acre-ft. total capacity. The area irrigated is, in round figures, 1,000,000 acres. The mean annual outflow of the South Platte River at the lower end of the basin is approximately 275,000 acre-ft. (15 years). In round figures the total consumptive use of original water from the mountainous area is 1,000,000 acre-ft. annually, or about 1.0 acre-ft. per acre per year. The explanation is the large volume of return flow and consequent re-use taken in conjunction with the large amount of storage

water available for application on demand at critical times.

Measured seepage returns in a 150-mile stretch on the lower South Platte River in Colorado approximate 750,000 acre-ft. (1918) annually, a heavy increase over ten years ago. Annual measured return flow along a 150-mile section of the Arkansas River in Colorado approximates 350,000 acre-ft. Along the North Platte River in Nebraska between the Nebraska line and Bridgeport, a distance of 100 miles, the 1918 returns approximated 400,000 acre-ft. From the North Platte Project (Interstate unit) alone the visible return flow measured in drainage ditches in 1918 amounted to 1.5 acre-ft. Heavy return flow waters occur also in the 100,000 acres.

Heavy return flow in the Rio Grande area in Colorado has not developed because of lack of natural drainage. Instead, 50,000 acres of land have been more or less waterlogged and alkalied. Artificial drainage is rapidly remedying this feature, and in 1920 the measured drainage water in the San Luis Valley approximated 70,000 acre-ft. Hervy return flow waters occur also in the Sevier River in Utah.

The above facts are cited to show that return waters from irrigation constitute a large factor in water supply, and in the future must be considered in water supply analyses of river basins. They also show that the widest use of water in a river basin will occur if large areas are irrigated in the upper or middle third, thus permitting the re-use of seepage water both along tributaries and the main stream of the lower areas. In other words, irrigation on the upper areas of a river basin is developing storage regulation without cost for the lower areas by storing in the sub-soil water which is discharged slowly back to the stream channels and improves the late summer and winter flow.

Returning to the subject of possible settlement of interstate water conflicts by state compacts, provision exists in the Constitution of the United States for settlement of difficulties between sovereign states so that the legal foundation, upon which to rear a rational procedure for interstate determination of water rights and possible apportionment of unused waters, is available.

Summarizing

Topographic and hydrographic features, controlling physical factors in water utilization, conflict with control by separate states acting independently because political boundaries do not coincide with drainage basins.

Unless constructive legal measures are adopted to fit physical conditions in utilization of water or major river basins, interstate litigation will ensue or development be retarded.

Replacement storage of flood waters or winter flow now unused can be a means of wiping out some of the present interstate water conflict.

Effective solution of interstate conflicts rests upon a thorough co-operative engineering study of a river basin and its land areas and water supply, and a comprehensive plan of utilization that should be the basis of a legal compact or agreement between the states involved. In addition, some provision should be made for the administration of such agreements.

Any plan for settlement of interstate water problems should not disturb the position and relation of vested rights perfected in the various states under state laws and virtually guaranteed by the respective states.

Return flow waters from irrigation furnish a large part of the water supply in the lower irrigated valleys.

Interstate enforcement of old water priorities does not appear practicable in large river basins. Adjustment of interstate utilization by agreements or compacts is offered as a possible solution. Provision for such treaties exists in the Constitution of the United States.

Local Road Materials Report

FIELD parties investigating deposits of road building materials available for projected improvements in Pennsylvania make their reports on a letter sheet size form as follows:

..... Pa., ... 19...

Engineer of Tests:

My investigation of a deposit of.....
Stone-Sand-Gravel
for use on Route ..... Sec. ..... Appl. ..... Auth. .....
County ..... has been completed and the following data obtained: Owners Name ..... Address ..... Location of Supply ..... Dead haul is ..... Mi.
Borough-Twp-County
to Sta. ..... over ..... with an .....
Improved-dirt-farm road, etc. uphill-
..... grade not exceeding ..... Supply was sampled on....
downhill per cent date
and sample shipped..... Percentage of deposit represented by
date
sample is ..... Workable area of deposit is .....
with average thickness of ..... feet. Stripping would be
..... ft. of ..... Strata vary from .....
sand-clay-shale-etc.
inches to ..... inches in thickness and are.....
Horizontal-Inclined-Etc.
From inspection give exten of variation in quality of strata
.....
..... If deposit consists of boulders or field stone give (1) Stone Sizes ..... (2) Uniformity ..... (3). Ap-
Structure-Kind
proximate quantity ..... (4) How found .....
Walls-piles-or-
..... Water supply is.....Mi. from deposit. Distance scattered
to nearest R.R. Shipping point is ..... Mi. Is material available? ..... If not, state reasons why .....
.....

Show by sketch of plan and section, or otherwise, (1) the part of deposit where sample was taken, (2) Location and depth of test pits, (3) How stripping increases or decreases (4) Location of nearby buildings or other obstructions, (5) any other important details, (Use additional sheet if necessary).

If material requires (1) chuting down hillside, (2) mining, (3) construction of incline, (4) new roadway, (5) improving old roadway, (6) or industrial railroad, give all details. (Use additional sheet if necessary).

Approved.....Signed .....
Title .....Title .....

These reports form the original records of the testing laboratory and are the basis of a brief schedule of locations of acceptable local materials which is furnished the contractor when bids are asked.

Slippage in Small Water Meters

Ordinary ⅝-in. water meters on residence services will average a slippage of unrecorded water amounting to 40 or 45 gal. per day, according to tests made on the Spring Valley Water Co.'s system by George W. Pracy, and reported at the recent annual convention of the California Section, American Waterworks Association. The tests were made by using accurately calibrated meters on mains found by tests to be water tight, and supplying groups of the ⅝-in. services. It was possible to pass through both new and used meters, for ⅝-in. services, as much as 200 gal. per day with little or no registration by very small steady flows such as leaks would cause. In other words, the actual loss equals that which would result from one meter in every four slipping its maximum amount.

Engineering Studies of Reclamation Service Resumed

HYDRAULIC investigations connected with the operation of the irrigation works of the U. S. Reclamation Service, interrupted during the war, have now been resumed. The object of the inquiries is the experimental determination of certain factors and elements regarding which little is known, thus permitting more economical design of future works. Much valuable work along this line has been accomplished in the past and an allotment of $3,000 for 1921 has been provided to continue it. J. L. Savage, designing engineer in the Denver office, has prepared a program of data most urgently needed and of what can be done this year.

The investigations completed so far have been printed in the *Reclamation Record* and these are summarized under 36 titles. On nine of these subjects further study was deemed advisable. The subjects are as follows:

EXPERIMENTS TO BE CONTINUED

Seepage losses from canals.
Value of Kutter's n for concrete channels.
Transition losses in open canals.
Flow in chutes and disturbances in stilling basins.
Discharge coefficient for siphon spillways.
Friction coefficient for gate leaves and bronze seats.
Coefficient of discharge for overflow d[illegible]
Discharge coefficient through headgates.
Effect of alkali on concrete.

In addition to the above, 21 other subjects are considered more or less urgent. A summary follows of these questions on which experimental data ultimately should be obtained.

EXPERIMENTAL DATA NEEDED

1. Value of Kutter's n in concrete pipes
   (*a*) Monolithic pipe.
   (*b*) Precast pipe.
2. Curve losses in pipes
   (*a*) Wood-stave pipe.
   (*b*) Monolithic concrete pipe.
   (*c*) Precast concrete pipe.
   (*d*) Steel pipe.
3. Losses and recoveries
   (*a*) Flume inlet and outlet structures.
   (*b*) Siphon inlet and outlet structures.
4. Value of Kutter's n in concrete flume
   (*a*) Monolithic jointed flume.
   (*b*) Monolithic continuous flume.
   (*c*) Semi-precast flume.
   (*d*) Gunite flume (sides shot against forms, bottom gun finish).
   (*e*) Combination gunite and concrete flume.
   (*f*) Gunite canal lining (all gun finish).
   (*g*) Concrete canal lining, trowel finish.
   (*h*) Concrete canal lining, finished with wood float or other similar finish.
5. Control section weirs
   (*a*) Establish rating curve.
   (*b*) Determine necessary loss through structure.
6. Head gates
   (*a*) Coefficient of discharge for [illegible]
   (*b*) Coefficient of recovery behind [illegible]
7. Pipe turnouts
   (*a*) Coefficient of discharge (gate wide open).
8. Curve losses and disturbances in open channels
   (*a*) Semicircular flume.
   (*b*) Rectangular flume.
   (*c*) Trapezoidal channel.
9. Losses due to piers, bents, distortions and other deflections
   (*a*) Bridge piers and bents.
   (*b*) Check bents and [illegible]
   (*d*) Headworks, piers and [illegible]
10. Measuring gate (adjustable Henny Venturi flume)
    (*a*) Establish rating [illegible]
    (*b*) Determine [illegible]
11. Flow over dams
    (*a*) Shape of surface [illegible]
    (*b*) Discharge over various shapes [illegible] under different heads.
    (*c*) Shape of nappe [illegible]
    (*d*) Effect of [illegible]
12. Flow in spillway channels parallel to crest
    (*a*) Water surface [illegible]
    (*b*) Air content [illegible]
    (*c*) Necessary [illegible]
13. Chutes
    (*a*) Value of Kutter's n.
    (*b*) Air content.
    (*c*) Effect of [illegible]
    (*d*) Angle of entrance to basin.
    (*e*) Effective [illegible]
    (*f*) Effect of [illegible]
14. Hydraulic jump
    (*a*) Velocity [illegible]
    (*b*) Height of [illegible]
    (*c*) Cross [illegible]
    (*d*) Profile of [illegible] and [illegible] chute.
    (*e*) Length of [illegible]
15. Siphon spillways
    (*a*) Losses segregated as far as possible.
    (*b*) Overall coefficient of discharge.
    (*c*) Depth of crest and interval of time to prime.
    (*d*) Position of water surface when seal breaks.
    (*e*) Surface curve at approach of siphon.
    (*f*) Elevation above sea level and barometric pressure at time of experiment (for high siphons).
16. Percolation factors and uplift
    (*a*) Salmon Lake Dam.
    (*b*) Percha Dam.
    (*c*) Grand Valley Dam.
    (*d*) Canal structures.
    (*e*) New dams.
17. Saturation slopes
    (*a*) Salmon Lake Dam.
    (*b*) Deer Flat embankments and other earth dams.
18. Beaching slopes
    (*a*) Gravel embankment.
    (*b*) Earth embankment.
19. Wave heights
    (*a*) Effect of fetch.
    (*b*) Height of splash on different slopes.
20. Outlet works
    (*a*) Losses, segregated as far as possible (gates wide open).
    (*b*) Overall coefficient of discharge.
    (*c*) Capacity curves.
    (*d*) Path of issuing jet from Arrowrock type outlets.
    (*e*) Water cushion.
21. Coefficient of friction
    (*a*) Handwheel and crank pulls for gate hoists under different load conditions.
    (*b*) Gate leaf against sliding surfaces.
    (*c*) Stem in guide.
    (*d*) Radial gate seals.
    (*e*) Concrete flume on earth.

Only a small portion of the above can be done in 1921 because of the limited funds. The choice of subjects for immediate study depended on urgency of the need for the data and project facilities.

EXPERIMENTAL WORK FOR 1920

GRAND VALLEY PROJECT

1. Grand River Dam
   (*a*) Continue recording well readings to determine the hydraulic gradient under dam.
   (*b*) Experiments to determine coefficient of discharge over crest of dam.

HUNTLEY PROJECT

1. Henny Venturi measuring gate
   (*a*) Determine coefficients of discharge.
2. Control section weir
   (*a*) Determine coefficients of discharge and establish rating curve.

KING HILL PROJECT

1. Siphon Spillway, Malade Flume (Gooseneck type)
   (*a*) Determine losses segregated as far as possible.
2. Combination Gunite and Concrete Flume
   (*a*) Determine value of Kutter's n.
3. Semiprecast Flume
   (*a*) Determine value of Kutter's n.
4. Monolithic Jointed Flume
   (*a*) Determine value of Kutter's n.
5. Gunite Flume (sides shot against forms, bottom gun finish)
   (*a*) Determine value of Kutter's n.
6. Wasteway from Four-Mile Flume (basin type)
   (*a*) Determine capacity without check.
7. Big Pilgrim Siphon (wood-stave pipe)
   (*a*) Determine inlet, outlet, and curve losses.
8. Little Pilgrim Siphon (monolithic concrete pipe)
   (*a*) Determine inlet, outlet, and curve losses.
9. Flume transitions (modern design)
   (*a*) Determine transition losses.
10. Deer Gulch Siphon (part monolithic concrete pipe and part wood-stave pipe)
    (*a*) Determine inlet, outlet, and curve losses.

RIO GRANDE PROJECT

1. Radial gate hoists (worm-gear type)
   (*a*) Determine pull on handwheel and efficiency.
2. Leasburg Dam
   (*a*) Determine coefficient of discharge over crest.
3. Percha Dam
   (*a*) Determine upward pressure under foundation (hydraulic gradient).
   (*b*) Determine coefficient of discharge over crest.
   (*c*) Investigate standing wave below dam.
   (*d*) Investigate water surface curve above dam.

[illegible]

1. Metal flume on curve (No. 144 on curve of 63.6-ft. radius)
   (*a*) Investigate curve losses.

[illegible]

1. Siphon spillway (gooseneck type)
   (*a*) Determine [illegible] coefficient and sensitiveness [illegible]

To Take City Engineers Out of Civil Service

The law committee of the league of Cities of the Third Class in Pennsylvania has decided to try to secure the repeal of state legislation placing city engineers under civil service. An attempt will also be made to secure an act authorizing cities of the third class to establish and regulate building zones.

An Investigation of Perforated-Pipe Filter Underdrains

Limits Determined of Head Required To Obtain Uniformity of Discharge Along Laterals, of Size and Spacing of Laterals and Perforations

By Harry N. Jenks
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A STUDY of the information available on the design of rapid sand filter underdrains discloses the fact that present-day practice is based largely upon precedent rather than upon experiments made to demonstrate the relative importance of the factors involved. Not only is the underdrain system one of the most expensive structural features of the complete filter unit, but on the correct arrangement and proportioning of the elements comprising it depends the efficiency of application of the wash water used in periodically cleaning the filter. Similarly, the construction of the gravel bed immediately above the underdrains proper has an equally important influence upon the character of the wash. From an examination of the details of design of existing plants in relation to the foregoing considerations, it was noted that wide divergences occur among the values assigned to such factors as the size of perforation, the ratio of area of perforations to filter area, the arrangement of piping, the use of strainer plates and the sizes and depth of gravel. Because of the importance of the subject and the lack of uniformity of practice with regard to the solution of the problems it presents, it was decided by the Filtration Division of Sacramento, Cal., in preparing plans for the eight 4,000,000-gal. daily rapid sand filter units for that city, to determine experimentally the conditions governing the design of a less expensive and at the same time more efficient underdrain system than the commonly accepted types.

On account of its evident advantage in low cost of installation and maintenance, the type of underdrain chosen for these experiments was a modification of the one first developed at Harrisburg, the distinctive feature of which is the use of perforated-pipe laterals spaced at equal intervals along the filter bottom and dividing the filter box into two equal parts. In contrast to former installations of this type, the gravel-bed depth was increased to 18 in., and for the purpose of studying the behavior of the water wash it is to be considered an integral part of the underdrain system itself. The course of the wash water was followed from a point immediately outside the filter box, at the entrance to the lateral, until the water reached the dividing plane between the gravel bed and the bottom layer of sand. The scope of the observations embraced a determination of two principal controlling conditions: (1) The conditions resulting in the optimum hydraulic characteristics in relation to (a) total head required, and (b) uniformity of discharge along the lateral. (2) The conditions governing the uniformity diffusion of the wash water up to the top of an 18-in. bed of graded gravel, the variable factors being (a) the size and spacing of laterals and of the perforations in the laterals, and (b) the rate of wash.

Hydraulic Experiments—The general layout of the apparatus used in making the tests is shown in outline by Fig. 1. The pressure head in the supply pipe varied from 30 to 40 lb. per sq.in.; at the latter pressure it was possible to pass 32 cu.ft. per minute through the meter. From the meter the water continued through a 2-in. pipe into a 16-in. riveted-steel header pipe, 7.5 ft. long, into which ten standard 4-in. wrought-iron pipe sockets had been welded in such positions as to permit laterals to be screwed into the header pipe at spacings of 6, 8, 9 and 12 in., the maximum number of laterals to be used in each case being four. For the purpose

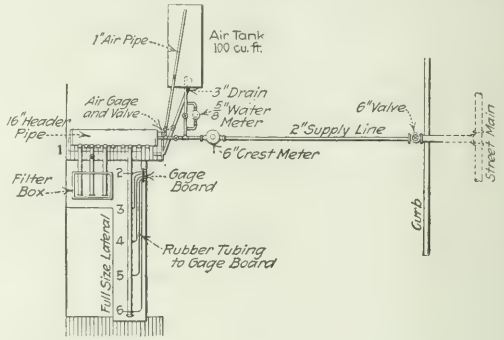


FIG. 1. SACRAMENTO UNDERDRAIN TEST APPARATUS

of obtaining a supply of air under pressure, use was made of an air-tight steel sprinkler-wagon tank, the capacity of which was 100 cu.ft. Suitable connections were made with the water supply, and the air displaced by the incoming water was carried from the tank to the header pipe through an air line.

Measurements of pressure head were made by water columns. A gage board 11 ft. high, suitably painted and graduated in feet and tenths, was erected in a convenient position with reference to the control valves. Six gage glasses extending the length of the board were fixed in place in the following order, from the left:

Gage 1. Head of water in main header pipe. (The table is based upon readings of this gage.)
Gage 2. Head of water at beginning of perforations.
Gage 3. Head of water at 1/4 point along lateral.
Gage 4. Head of water at 1/2 point along lateral.
Gage 5. Head of water at 3/4 point along lateral.
Gage 6. Head of water at end of lateral.

For heads higher than 11 ft. a mercury manometer was used. With this arrangement of gages it was possible to study in detail the hydraulic characteristics of the perforated-pipe lateral as affected by the diameter of lateral, diameter of perforation, spacing of perforations and rate of wash.

The laterals tested were straight, new lengths of standard wrought-iron black pipe. Each pipe had an effective length of 12 ft., and the distance between the first and last perforations was 11 ft. 6 in. Such a lateral is designed to serve a strip of filter bed 12 ft. long (the inside width of a half filter unit) and of a width equal to the spacing of the laterals. Fig. 2 indicates clearly the position of the lateral when under test.

The perforations in the laterals were drilled in a

FIG. 2. EQUIPMENT USED FOR TESTING AN UNDER DRAIN LATERAL.
Horizontal pipe at left is lateral with jets pointing downward. Vertical gage board in center.

power drill press and all noticeable burrs were subsequently knocked off by scraping the inside of the pipe with an iron bar, and by filing lightly around the inner edge of the holes. Experiments showed that no great degree of refinement is necessary or warranted in drilling the holes to exact dimensions.

The laterals were tested with the perforations pointing vertically downward and discharging freely into the air. In determining the variation in discharge along the lateral, the discharge at the beginning, at the quarter-points, and at the end was caught and measured.

Diffusion Experiments—Having determined from preceding experiments the relationship of diameter of lateral and the diameter and spacing of perforations giving the best hydraulic efficiency, tests were continued to ascertain the diffusion, or effectiveness of distribution, of the wash water throughout the filter bed when applied through the wash-water lateral selected on the basis of hydraulic efficiency alone.

The small filter box containing the gravel bed was made of 2-in. redwood stock, 3 x 2 ft. in plan and 2 ft. deep, all inside measurements. The depth permitted 18 in. of graded gravel to be placed inside, leaving 6 in. of freeboard. The position of the laterals in the filter and the manner in which the gravel bed was built up are indicated in Fig. 3.

In the tests the bed was modified slightly by substituting sand for the top 1½ in. of gravel, in order that, by its movements, the behavior of the wash might be distinctly observed. No different grading or depths of gravel were experimented upon because of the fact that entirely satisfactory results were obtained with the use of the sizes and depth selected.

By placing the 3-in. gravel along the laterals on the filter bottom, an unrestricted waterway was formed directly underneath each pipe, approximately 1 x 2 in. in cross-section and extending the entire length of the lateral. It is believed that the existence of these channels, by equalizing the pressure of the wash water in the plane of the piping system, is an important factor in causing an even distribution of the rising prism of water.

The bottom 8-in. layer, including the 3 in. of gravel, was composed of hand-picked cobbles as nearly round as it was possible to select them from the gravel bank. The other layers comprised the ordinary bank run, screened to the required sizes. Thorough studies were made of the distribution of the wash through the gravel bed under varying conditions of rate of wash, number and spacing of laterals, and size and spacing of perforations, using both air and water. The complete data are too extensive for presentation here; accordingly one experiment only will be described briefly, in which were employed the proportions selected for the final design of the 4,000,000-gal. daily filter units. The design factors were as follows:

	Inches
Diameter of lateral	3
Spacing of laterals	12
Diameter of perforations	¼
Spacing of perforations	6
Depth of gravel	18

Using both air and water washes, careful observations were made of the behavior of the gravel and thin surface layer of sand under the influence of the rising currents. In the case of the water wash, the diffusion could be very satisfactorily studied by the sand "craters" that appeared wherever the stream lines passed through the sand. Around each crater the sand was kept in constant motion similar to that which takes place on the bottom of a pool fed by springs beneath.

With as low a wash as 6-in. vertical rise per minute, these centers of ebullition of the sand occurred in all parts of the filter; but due to the natural lack of uniformity in resistance to flow at such low velocities, the craters were not altogether evenly distributed. It was quite apparent, however, that this was due to the fact that all the water was able to pass upward through these craters and so was not forced to break through over the entire area. That this was the case could easily be shown by making a slight depression

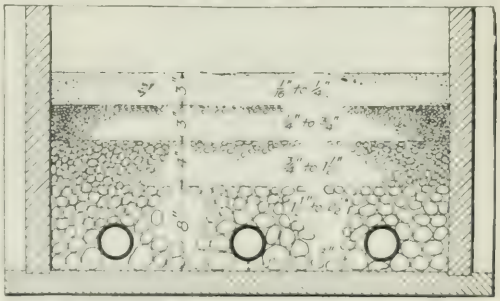


FIG. 3. FILTER BOX SHOWING LATERALS AND GRAVEL.

in the sand layer; the resistance at this point being thereby decreased, the water commenced to boil upward at this point, forming a new crater. This was considered sufficient proof that even at low rates of wash the distribution of the wash with the type of underdrain and gravel bed under investigation, is satisfactory. In this connection, also, it is to be expected that the presence of a considerable body of sand and head of water above the gravel bed will tend still further to steady and make more nearly uniform the discharge of the wash water throughout the filter area.

As the rate of wash was increased, the evidences of uniform distribution became more and more marked. At a 24-in. vertical rise per minute and over, the entire filter surface presented a mottled appearance, caused by the formation of craters over every square inch of the surface. These observations on the movement of the sand were supplemented by means of a dye (Uranine A), which was injected into the header pipe

TOTAL HEAD REQUIRED FOR VARIOUS SIZED HOLES AND SPACINGS IN 3-IN. AND 2½-IN. LATERALS FOR FILTER UNDERDRAINS

3-INCH LATERAL

RATE OF WASH Vertical Rise, In. per Min. for Lateral Spacing of				DIAMETER OF PERFORATIONS, INCH			DIAMETER OF PERFORATIONS, INCH					DIAMETER OF PERFORATIONS, INCH				DIAMETER OF PERFORATIONS, INCH		
				For 2-In. Hole Spacing			For 4-In. Hole Spacing					For 6-In. Hole Spacing				For 8-In. Hole Spacing		
8 In.	9 In.	10 In.	12 In.	¼	⅜	½	¼	5/16	⅜	7/16	½	5/16	⅜	7/16	½	⅜	7/16	½
3	2.7	2.4	2	0.2	0.1	.	0.5	0.3	0.1		.	0.4	0.2	0.1	.	....	0.2	0.1
6	5.3	4.8	4	0.3	0.2	0.1	1.0	0.5	0.3	0.2	0.1	0.8	0.5	0.3	0.1	....	0.6	0.4
9	8.0	7.2	6	0.6	0.4	0.2	2.4	0.8	0.5	0.4	0.3	1.9	1.0	0.6	0.3	....	1.0	0.7
12	10.7	9.6	8	1.2	0.6	0.3	4.4	1.7	0.8	0.6	0.5	3.6	1.8	1.0	0.6	....	1.8	1.1
15	13.3	12.0	10	2.0	0.9	0.5	6.8	2.8	1.2	0.8	0.7	5.8	2.8	1.6	0.9	....	2.8	1.7
18	16.0	14.5	12	3.0	1.3	0.7	10.0	3.9	1.9	1.1	0.9	8.4	4.1	2.3	1.4	....	4.0	2.5
21	18.7	17.0	14	4.2	1.7	1.0	14.0	5.3	2.8	1.5	1.1	11.5	5.7	3.2	2.0	....	5.5	3.5
24	21.3	19.0	16	5.6	2.2	1.4	18.0	7.1	3.7	2.1	1.4	15.0	7.6	4.3	2.8	....	7.0	4.7
27	[illegible]	21.5	18	7.2	3.0	1.9	22.5	9.0	4.8	2.8	2.0	19.0	9.8	5.6	3.7	....	9.0	6.1
30	26.7	[illegible]	20	8.8	3.7	2.5	27.5	11.3	6.1	3.7	2.7	23.0	12.3	7.8	4.7	....	11.5	7.7
33	29.3	26.5	22	10.6	4.5	3.1	32.5	13.9	7.5	4.6	3.4	28.0	15.1	8.5	5.8	....	14.0	9.5
36	32.0	29.0	24	12.7	5.3	3.7	38.0	16.8	9.0	5.6	4.1	33.5	18.2	10.1	6.9	....	17.0	11.5
39	34.7	31.0	26	14.9	6.2	4.3	....	20.0	10.6	6.6	4.9	....	21.3	11.9	8.1	....	20.0	13.6
42	37.3	33.5	28	17.2	7.2	5.0	....	23.4	12.4	7.7	5.7	....	24.7	13.8	9.4	....	23.0	15.8
45	40.0	36.0	30	19.5	8.4	5.8	....	26.8	14.4	8.8	6.5	....	28.5	15.9	10.8	....	26.2	18.1
ΣVQ	....	....	..	47	58	151	21	36	65	...	81	45	38	16	55	....	11	25
VQ max	....	....	..	14	23	39	6	14	19	...	26	13	13	5	17	....	4	11

2½-INCH LATERAL

3	2.7	2.4	[illegible]	....	....	....	0.2	0.1	....	...	...	....	0.2	0.2	0.1	0.3	0.2	0.1
6	5.3	4.8	4	....	....	....	1.0	0.4	....	...	...	....	0.5	0.4	0.3	0.8	0.5	0.3
9	8.0	7.2	6	....	....	....	2.4	1.0	....	...	...	....	1.0	0.7	0.4	1.8	1.0	0.6
12	10.7	9.6	8	....	....	....	4.3	2.0	....	...	...	....	1.9	1.3	0.6	3.2	1.9	1.1
15	13.3	12.0	10	....	....	....	7.1	3.2	....	...	...	....	3.1	2.1	1.1	5.1	3.1	1.9
18	16.0	14.5	12	....	....	....	10.5	4.6	..	...	...	....	4.5	3.0	1.9	7.3	4.6	2.9
21	18.7	17.0	14	....	....	....	14.7	6.2		...	...	....	6.1	4.1	2.8	9.9	6.3	4.2
24	21.3	19.0	16	....	....	....	19.0	8.1		...	...	....	7.9	5.4	3.8	12.9	8.2	5.4
27	[illegible]	21.5	18	....	....	....	24.0	10.4	. .	...	...	....	10.0	6.9	4.9	17.3	10.6	7.0
30	26.7	[illegible]	20	....	....	....	30.5	13.2	. .	...	...	....	12.0	8.6	6.1	22.0	13.3	8.8
33	29.3	26.5	22	....	....	....	....	16.5	. .	...	...	....	14.1	10.5	7.4	27.5	16.3	10.8
36	32.0	29.0	24	....	....	....	. .	19.9	. .	...	...	....	16.4	12.6	8.7	33.8	19.7	13.0
ΣQV	....	....	..	....	....	....	....	.	.	...	...	....	....	....	. .	....	....	....
VQ max	....	....	..	....	....	....	....	....	....	...	...	....	....	....	..	21	38	....
																7	13	....

and subsequently appeared, evenly distributed above the filter bed.

During the course of the experiments observations were made on the bearing of lateral spacing upon effective distribution. At the outset it was believed that, in deference to current practice, the laterals should be so spaced as to provide, for the particular size and spacing of holes selected, from 0.4 to 0.6 sq.in. of hole area per square foot of filter area (0.28 to 0.41 per cent). The studies clearly demonstrated, however, that a lateral spacing larger than the 6 to 9 in. necessary to meet the above requirement is entirely permissible. The excellent distribution obtained in the experiment under consideration occurred with a lateral spacing of 12 in., providing a ratio of total area of perforations to area of filter equal to 0.0021, or 0.3 sq.in. per square foot.

A convincing proof of the propriety of using a lateral spacing of at least 12 in. was obtained by closing a valve on the middle lateral and using the two outside laterals to serve the entire 6 sq.ft. of filter. The wash water continued to come up as before over the area that should have been supplied by the central lateral.

As it was photographically difficult to record the appearance of the surface of the sand during the progress of a water wash, air was turned on in sufficient amount to cause the surface of the water to be agitated to a degree that should indicate the evenness of distribution of the sand craters in the water wash. Fig. 4 is a photograph of the apparatus operating under these conditions, and shows the completeness with which the wash is broken up and diffused by the deep gravel bed.

The rate of air wash at this time was 48 in. vertical rise per minute, or 4 cu.ft. per square foot of filter area per minute. Extensive tests of the behavior of the air wash were not carried out because of the fact that with the type of wash-water lateral and gravel bed adopted it is expected that the water wash alone will be sufficient to clean the filter sand thoroughly at all times. Should it be necessary at certain times to employ air as an auxiliary wash, it was found that a rate as high as the one mentioned, namely, 48 in., will not disturb the gravel. At this high rate a very even distribution is obtained. Although the size of holes used in this type of lateral is much greater than that ordinarily chosen for use in the air system, it is believed that the stabilizing influence of the resistance offered by the sand layer and the depth of water on the filter in the full-size units, will tend to cause a much more even dispersal of the air at normal rates of wash than it was possible to effect by diffusion through the gravel alone.

Design Data and Conclusions—It is believed that the experiments summarized in the foregoing paragraphs were carried out in sufficient detail and comprehensiveness to justify the acceptance of the results as a reliable guide in judging of the adaptability of the perforated-pipe lateral to the requirements of a satisfactory underdrain system for rapid sand filters. As an integral part of this system, the use of the deep gravel bed, similar to that described, is presupposed.

The table gives the total head required, in feet of water, for various rates of wash, diameters and spacings of perforations and spacings of laterals for 3- and 2½-in. laterals. This is the head necessary to produce the given discharge through the laterals. It is measured from the center line of the pipe and includes the loss of head at entrance (in the case of the laterals tested $h_e = 0.5\ (Vo/2g)$, where Vo is the initial velocity in the lateral), losses in the pipe and head of discharge through the perforations. In calculating the height at which the wash-water storage tank must be placed, to the above head must be added the loss of head through the gravel and sand, the static head on the filter below the top edge of the wash-water troughs and the wash-water pipe line losses between the tank and the entrance to the lateral.

It will be observed that the head required is a direct function of the rate of wash, the spacing of the laterals and the spacing of the perforations; and that it de-

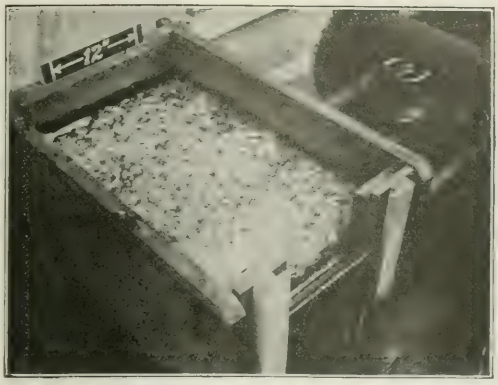


FIG. 4. APPEARANCE OF TEST FILTER UNDERDRAIN WITH 4 FT. VERTICAL RISE AIR WASH

creases with increased diameter of holes. Comparing the values for the different-sized laterals in the table it is seen that under the same conditions, the head decreases with increased size of lateral.

The entries of ΣVQ and VQ Max. have been made to show the superiority in respect to uniformity of discharge of certain combinations of size and spacing of holes. ΣVQ, an abbreviation with no mathematical significance, denotes the arithmetical total variation in discharge of the five sections of the lateral, from the mean discharge; while the maximum single variation is designated by VQ Max. Both of these quantities are expressed in percentages. When $\Sigma VQ + VQ$ Max. $= 35$ or less, the results are satisfactory.

For washes up to 30-in. vertical rise per minute, the head required is well within economical limits in combination with the values which the other variables assume in practical design.

The hydraulic tests were made in detail on 3-in. and on 2½-in. laterals. The latter size is believed to be the smallest that should be employed for lengths above 10 ft., as it was found that with a decrease in diameter of lateral the conditions favoring a uniform discharge were more difficult to obtain; moreover, the total head required increases with a decrease in diameter of lateral. A 3-in. lateral possesses as satisfactory hydraulic characteristics, for the length tested, as a 3½-in. or 4-in. lateral; and because it may be spaced at a greater distance apart than the 2½-in. lateral for the same loss of head, its use is not materially more expensive in first cost.

In the design of laterals of the perforated-pipe type elsewhere it has been considered that their length should not exceed 6 to 8 ft. if conditions governing uniform discharge were to be realized. Accordingly it was thought that if the width of the filter box exceeded this distance materially, the use of the perforated-pipe lateral would be precluded. The present experiments demonstrated, however, that, other conditions being equal, the uniformity of discharge is dependent upon the correct ratio of the length of lateral to its diameter. In the case of the laterals tested, this ratio is $L/D =$ 34 to 56, where $L =$ effective length of lateral between first and last perforations in inches, and $D =$ actual internal diameter of lateral in inches.

Above the upper limit of L/D noted the discharge tends to become irregular. The ratio for the lateral to be adopted for use at Sacramento equals 45. If a lateral of 4-in. size were used, its length might properly be increased to 16 ft.

Considerable latitude is permissible in the selection of the sizes and spacings of perforations. At proper spacings, uniform discharge is obtainable through holes of from ¼ to ½ in. in size. The spacings corresponding to this range vary from 3 in. to 8 in., so as to give a ratio of total hole area in a lateral *(a)* to the cross-sectional area of the lateral *(A)* of from 0.25 for the smallest holes to 0.50 for the largest holes. The head required varies inversely as this ratio and practically the same for equal ratios. Hence for economy in head requirements, the larger sizes of holes at the greater spacings are preferable. The ratio a/A adopted in the Sacramento design is 0.49, being made up of 7/16-in. holes at 6-in. spacing. If the size and spacing of the holes are properly proportioned, the uniformity of discharge is practically unaffected by changes in the rate of wash.

The discharge from the laterals, or the rate of wash (R_w), may be varied from 6 in. to 36 in. vertical rise per minute with the assurance of uniform distribution and freedom from disturbance of the gravel.

The spacing of laterals is dependent upon the minimum allowable ratio of total hole area in the underdrain system (Σa) to filter area and upon the maximum head available. Using 18 in. of graded gravel, the above ratio may be made as low as 0.0021, corresponding to approximately 0.3 sq.in. per sq.ft. of filter.

FIG. 5. DETAIL OF FIG. 4 TAKEN WITH SHORT TIME EXPOSURE

This allows a lateral spacing of 12 in. for 7/16-in. holes 6 in. apart. A lateral spacing greater than 12 in. would usually be inadvisable or impossible because of the increased head demanded.

The perforated-pipe lateral is designed primarily to insure a satisfactory water wash, although an air wash may be applied through the same system with effective results in respect to distribution, provided the rate be not materially less than 4 cu.ft. per sq.ft. of filter per minute. Such high rates have already been attained in practice, and in the present experiments no disturbance of the gravel bed was noted below the top layer of 1/8 to ¼-in. size.

Based upon the results of the foregoing experiments, values for the most important design factors for this type of rapid sand filter underdrain system may now be tabulated as follows:

L/D should not exceed 60.

d, diameter of perforations, should be selected between ¼ and ½ in.

S_h spacing of perforations, varies from 3 in. for d = ¼ in. to 8 in. for d = ½ in.

a/A should not exceed 0.50 for d = ½ in., and should decrease to 0.25 for d = ¼ in.

a/filter area may be as low as 0.002 or 0.3 sq.in. per sq.ft. of filter.

S_L spacing of laterals, may be as great as 12 in. for satisfactory diffusion, but is limited by the total head available.

A gravel bed depth of 18 in., composed of graded sizes, insures excellent diffusion of wash-water.

R^W may be varied from 6 to 36-in. vertical rise per minute with satisfactory results in regard to distribution of wash, provided the foregoing factors are employed in the design.

The present investigation was made by the writer, assisted by C. L. Knight, field engineer, and under the direction of Prof. Charles Gilman Hyde, chief consulting engineer, C. G. Gillespie, resident engineer, and H. B. Foster, assistant hydraulic and filtration engineer, Filtration Division, Sacramento.

Street Cleaning and Related Work in Philadelphia

City Has Taken Over Street Cleaning, Garbage, Ashes and Refuse Collection in Two Districts and Garbage Reduction Works

By James W. Follin

Engineer, Bureau Municipal Research, Philadelphia, Pa.

BEGINNING Jan. 1, 1921, street cleaning and the collection of ashes, rubbish and garbage were undertaken in Philadelphia by municipal forces in two of the thirteen new street cleaning districts. The remaining districts are under one-year contract. This is the first time that municipal forces have been employed on this kind of work in Philadelphia for over forty years. An act of the Pennsylvania assembly of the year 1874 required that all work to be done for the city should be performed by competitive contract. The new charter requires that both street repair and city cleansing work must be done by the city itself unless contract work is approved by both the council and the mayor.

The two districts in which municipal work has been undertaken are in the center of the city and include the most frequented section, the retail business section. However, the city-cleaned districts include sections having greatly varying conditions and the results of the work will furnish an excellent index to what the city can accomplish in the districts still under contract. The total street mileage in the city-cleaned districts is about 15 per cent of the total mileage of paved streets in the city, but the amount of street cleaning work done somewhat exceeds this percentage because the frequency of cleaning is greater than in the contract districts.

The city has practically outfitted anew in mechanical equipment. No change has been made in the types of equipment which have been used for a number of years. The chief dependence in street cleaning is still upon horse-drawn machine brooms and motor flushers. However, the quantity of equipment has been considerably increased over that formerly used by the contractors in the same area. The number of block men has been increased about 10 per cent but the use of block men is still less than that of some other cities.

The bulk of the collection equipment for ashes and rubbish in the municipal districts was purchased from the former contractor. However, 35 new wagons were bought from the Troy Wagon Co. Ten new five-ton trucks with 6-yd. steel bodies were also purchased—five Mack with square bodies and five White with bodies having a fan-tail end similar to the New York type.

In the collection of garbage old equipment is being used throughout. Previously to this year the garbage had been collected and disposed of under a one-year contract. The company gave out the collection to subcontractors. Negotiations are almost completed for the purchase by the city of the garbage reduction plant, collection wagons, and other facilities owned by the Penn Reduction Co. These facilities are under lease by the city for the month of January, and their purchase at a price of $500,000 is being considered by the City Council. While opposition was at first expressed to the price named, it is expected that the purchase will be approved at that price. Garbage is being collected by municipal forces in the two city-cleaned districts and by one-year contract in the remaining eleven districts. These contracts are distinct from those for the joint work of street cleaning and ash and rubbish collection. The city furnishes the collection wagons to the garbage contractors. Private collectors are not permitted except as agents of the contractors. A certain section in the center of the city has been designated a closed area, and private collectors are permitted in this section only under permit of the Board of Health for the collection of garbage from hotels and restaurants. The city also contracts for the transfer by barges of the garbage from a collecting wharf to the reduction plant.

No changes have been made in the methods of disposal of ashes and rubbish. These materials are placed on dumps leased by the contractors. It is stated in the contracts that the collected materials are the property of the city, and the contractor may be called upon to haul them to salvage plants if the average haul shall not exceed that to the dumps specified by the contractors in their bids. It is expected that some action will be taken by the Bureau of Highways later in the year in the direction of refuse reclamation.

The contracts for street cleaning and ash and rubbish collection in eleven districts for 1921 total $3,895,424. Adding to this the estimated cost of the work by municipal forces in the two city districts of $1,280,000, gives $5,175,424. This total exceeds the 1920 cost by $829,020. The estimated cost of the work in the two city districts is $200,000 less than the bids for these same districts. The total cost of collection and disposal of garbage in 1920 was $750,000. It is expected that this cost will be reduced in 1921.

The past year has been a busy one in Philadelphia in developing plans to meet the requirements of the new charter. An appropriation was made by council of $25,000 to carry on an investigation. A special force was organized to collect and assemble the necessary material and a trip of investigation was made to a number of the larger American cities by a committee of engineers. (See *Engineering News-Record*, July 29 and Aug. 19, 1920, pp. 236 and 357.)

The city cleansing work is performed by the Bureau of Highways of the Department of Public Works. Fred C. Dunlap is chief of this bureau, while John H. Neeson is deputy chief in charge of street cleaning. E. D. Very, formerly of the Department of Street Cleaning, New York City, is engineer on street cleaning work.

Long-Span Concrete Roof Arches for Chicago Garage

Arch Ribs Built as Polygons Save Expense in Forms—Cost Little More than for Wood Truss—Cold Weather Concreting

THE largest concrete roof arches ever built are believed to be those of a Chicago garage, the arch ribs of which have a span of 103 ft. 7½ in. over the outer faces of the supporting piers. The building is a motor truck garage and distributing station at 4820 Cottage Grove Ave. for the dry-goods firm of Mandel Brothers. It is 103 ft. 7½ in. x 161 ft. 4 in. in plan and it was desirable to obtain an unobstructed floor area and ample exterior light at reasonable expense. There are eight concrete arches of the span noted, supported on pilasters in the brick walls; at one end is a 65-ft. arch on concrete columns, in order to allow of an upper floor across this end of the building. All arches have a rise of 17 ft. and are spaced 16 ft. c. to c. Fig. 1 shows the construction and Fig. 2 an interior view of the completed structure.

Each main arch is a concrete rib 11½ x 24 in. in section with a short vertical stem at each end seated on a concrete cap on the 17-in. brick pilaster. It is reinforced by three ⅞-in. rods in top and bottom, with stirrups spaced 3 ft. apart, the longitudinal rods being hooked into a spiral at each end of the arch and having their ends hooked at the lap splices. The intrados has nominally a radius of 90 ft. but actually the arch is polygonal, with 10-ft. sides, this arrangement avoiding the expense of curved form work. In the 65-ft. arch the radius is 42 ft. A single 2½-in. tie rod with turnbuckles forms the lower chord. At each end of the tie rod is a nut and bearing plate, the plate at one end taking a bearing against the steel spiral and being embedded in the concrete, while at the other end the plate bears against the outer face of the rib. This rod is 14 ft. above the floor, and to prevent sagging it is supported by five ⅜-in. hooked hangers whose upper ends are fitted with washers and embedded in the arch rib. Turnbuckles provide for adjustment of the hangars. Details of the ribs and forms are given in Fig. 3

On each side of the crown are two lines of longitudinal concrete beams or struts, 8 x 6 in. section, formed between the ribs and extending to the end walls. Upon these rest the wood framing of continuous skylights or monitors 12 ft. wide. This arrangement gives a good distribution of light over the entire floor area, as the roof design eliminates all interior obstructions. Pivoted sash in the sides of the monitors provides for ventilation.

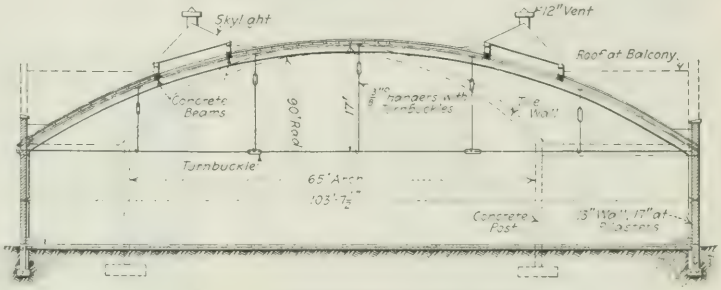


FIG. 1. CROSS-SECTION OF ARCH ROOF

Wood rafters were planned originally to be carried by timber strips bolted to the sides of the arch ribs,

FIG. 2. CONCRETE ARCHES OF 103 FT. SPAN CARRY ROOF OF GARAGE

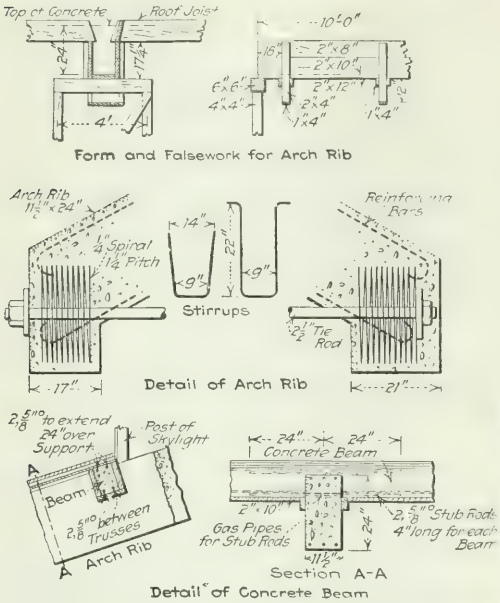


FIG. 3. DETAILS OF ARCH RIB AND FORMS

but a simpler construction was adopted by seating the ends of the rafters in the ribs. For this purpose the rafters were supported by the forms and the concrete was poured around them. They are 2 x 10 in., spaced 2 ft. c. to c. The roof sheathing consists of two layers of $\frac{7}{8}$-in. matched and dressed boards placed transversely and separated by 2 x 2-in. strips extending across the arch, the air space thus formed serving for heat insulation and preventing the condensation of moisture on the inner side. A layer of building paper is laid upon the inner sheathing, and over the outer sheathing is placed a felt and pitch roofing. Across one end of the building is a balcony carried by wood joists seated in the end wall and in stirrups on hanger rods whose upper ends are embedded in the 65-ft. arch rib.

For each rib the form was supported on a timber frame or falsework, having bents spaced 10 ft. c. to c. The roof joists or rafters were seated in notches in the sides of the form (see Fig. 3), and at the middle of the span the first layer of roof sheathing was laid on the joists to serve as a platform for the concreting wheelbarrows. Planed 2-in. lumber was used for the forms, which were made watertight. This falsework construction was adopted partly because the work was done during the winter, as it permitted the entire area to be covered before concreting was commenced.

A rich and rather dry concrete mix of 1:1:2 was used, with $\frac{3}{4}$-in. stone as the coarse aggregate. This was partly for strength and partly in view of the cold weather. No salt was used, but the water and materials were heated and salamanders were kept burning on the floor. Two of the ribs were poured on a cold day and zero temperature was reached the same night, but the concrete was not affected. Forms were left in place for 60 days. A mixer at one end of the building discharged the concrete into wheelbarrows which were hoisted to the roof platform and dumped into the forms, filling the ends first and then working toward the crown. The concrete was well rodded to ensure density and close contact with the reinforcing steel.

A snow load of 25 lb. per square foot was the live load element in the design. Compression in the concrete is taken at 750 lb. per square inch. Owing to the high cost of lumber the cost of the nine arches was only about $800 more than that of wood lattice trusses such as are used frequently in buildings of this kind, but the trusses would have formed considerable obstruction to proper distribution of light.

The arch ribs were figured first for the full dead load and for the live load over the entire span, which condition of loading determined the greatest horizontal thrust. The greatest bending moment in the arch was assumed to occur when the live load is acting on one-half of the arch. This moment is positive in the loaded quarter point and negative in the unloaded quarter

FIG. 4. TESTING CONCRETE ROOF ARCHES

point. Combining this bending moment with the thrust from the total dead load and the live load on one-half of the span determined the critical or most dangerous section of the arch.

One of these arches was tested at the demand of the Chicago Building Department, being subjected to a test load of 12,000 lb. concentrated at one quarter point of the span. This test was made with a platform 8 x 10 ft. hung from the arch by three sets of $\frac{5}{8}$-in. cables and loaded with 125 bags of cement, as shown in Fig. 4. Assuming the arch to act as hinged at the two abutments the greatest deflection occurs at the loaded point. According to the elastic theory the quarter point of the unloaded side should have a rise equal to the downward deflection of the loaded point, while the crown of the arch should not show any vertical deflection. Assuming a modulus of elasticity of 3,000,000 the formula gives a deflection of $\frac{5}{8}$-in.

In the test, the deflection immediately after the load was applied amounted to $\frac{1}{4}$-in. at the loaded point and

zero at the crown, with $\frac{3}{16}$-in. rise at the quarter point of the unloaded side. These values increased to $\frac{3}{8}$-in. and $\frac{1}{4}$-in. at the quarter points after 24 hours, the crown still showing no deflection. Immediately after removing the loads the nonelastic deflection was $\frac{1}{8}$-in. and $\frac{1}{16}$-in. at the loaded and unloaded points, respectively.

The architect and superintendent for this building was I. S. Stern, Chicago. The concrete arches were designed and constructed by L. J. Mensch, Chicago.

Effect of Worn Runners on Dredge Pump Efficiency

Comparative Tests of New and Worn Runners Show Economic Necessity of Providing for Prompt Replacement

By Ivan E. Houk
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

PROMPT replacement of worn pump runners has been made a rule in pumping hydraulic fill at the flood protection dams of the Miami Conservancy District. Tests of the dredge pump at the Taylorsville dam made on several different dates in the early stages of the work and under several different conditions indicate the reason for this practice. The observed and calculated data of these tests are given in Tables I, II and III. Table I gives the data obtained while using a 39-in. cast-iron runner; Table II gives that obtained using a 37-in. cast-iron runner, made by cutting off the ends of the vanes of a 39-in. runner, with an acetylene torch; and Table III gives that obtained using a 34-in. manganese-steel runner with diameter increased to 36 in. by shoes. A cross-section of the pump is shown by the drawing. The motor is a 350-hp. three-phase 60-cycle induction motor having a full load speed of 505 r.p.m.

Making proper correction for elevations of gages the total head on the pump and the friction head in the pipe line were determined by readings of carefully calibrated suction and pressure gages. Velocities for the measured friction head per 100 ft. were taken from the tests described in *Engineering News-Record*, Jan. 6, 1921, p. 18, using the test for which the conditions were most similar. The power input to the motor was obtained by counting the revolutions of the disk of an integrating watt-hour meter. Speeds were measured by an ordinary speed indicator held on the end of the motor shaft. Motor efficiencies for different speeds were furnished by the manufacturers. Observations at a given speed were taken simultaneously and were repeated in all cases.

In working up the data for a given test the different determinations of friction head, total head, and power input were plotted against the speed, and the points balanced by smooth curves. The quantities given in the tables were taken from these curves. In this way some of the small observational discrepancies were eliminated. It might be stated, however, that in no instance were these discrepancies of appreciable magnitude. The work was carefully done throughout. Although the

TABLE I. TESTS OF 15-IN. DREDGE PUMP WITH 39-IN., 4-VANE CAST IRON RUNNER

Test of March 29, 1919; length of line, 2010 ft.; runner, new; static lift, 6 ft.; average pump efficiency, 56.8 per cent

Speed in R.P.M.	Friction Head in Disch. Pipe, in Ft.	Total Head on Pump, in Ft.	Velocity in Feet per Sec.	Discharge in Sec. Ft.	Hp. Output	Hp. Input	Plant Efficiency in per Cent	Motor Efficiency in per Cent	Pump Efficiency in per Cent
267	29.7	36.7	7.62	9.37	39.0	129	30.2	46.7	64.7
288	38.9	46.4	8.71	10.7	56.3	185	30.4	52.4	58.0
322	48.2	56.6	9.69	11.9	76.4	226	33.8	59.0	57.3
346	52.9	62.1	10.2	12.5	88.2	258	34.2	63.6	53.7
364	59.8	69.9	10.8	13.3	106	290	36.5	66.9	54.5
390	71.3	82.8	11.8	14.5	136	338	40.2	71.9	55.9
423	82.9	96.1	12.7	15.6	170	386	44.0	77.9	56.5
454	96.6	110.9	13.7	16.9	213	450	47.3	83.4	56.7
504	112.6	129.2	14.8	18.2	267	543	49.1	91.7	53.5

Test of April 1, 1919; length of line, 2140 ft.; 2700 cu.yd. pumped by runner; static lift, 7 ft.; average pump efficiency, 50.4 per cent

262	25.5	33.6	6.83	8.40	32.1	140	22.9	46.3	49.5
292	33.6	41.5	7.84	9.64	45.5	193	23.6	53.2	44.4
320	41.6	50.1	8.72	10.7	60.9	203	30.0	58.4	51.4
343	48.6	57.9	9.43	11.6	76.3	232	32.9	63.0	52.1
360	53.2	63.0	9.88	12.1	86.6	258	33.6	66.2	50.8
388	61.2	72.7	10.6	13.0	107	301	35.6	71.4	49.0
421	76.2	88.3	11.8	14.5	145	354	41.0	77.6	52.8
454	91.2	105.0	12.9	15.9	190	430	44.2	83.4	53.0
490	102.8	118.9	13.7	16.8	227	515	44.1	89.4	49.3

Test of April 29, 1919; length of line, 1750 ft.; 2700 cu.yd. pumped by runner; 17,000 cu.yd. pumped by [illegible] runner since April 1; static lift, 8 ft.; average pump efficiency, 53.9 per cent

270	27.8	37.2	7.89	9.70	41.0	148	27.7	48.0	57.7
309	34.8	45.6	8.83	10.9	56.5	184	30.7	54.5	56.3
330	42.6	54.8	9.75	12.0	74.8	225	33.2	60.3	54.9
350	48.2	61.1	10.4	12.8	88.9	254	35.0	64.3	54.4
370	54.1	68.1	11.0	13.5	104	285	36.6	68.1	53.7
395	62.2	77.3	11.8	14.5	127	326	39.0	72.8	53.[illegible]
428	73.5	90.1	12.8	15.7	161	388	41.5	78.[illegible]	52.[illegible]
460	85.1	103.1	13.8	17.0	199	455	43.7	83.4	51.[illegible]
492	97.2	117.1	14.7	18.1	[illegible] 41	537	44.9	89.7	50.1

Test of May 25, 1919; length of [illegible] 1340 ft.; [illegible] 22,000 cu.yd. pumped [illegible] 13.0 [illegible] efficiency, 44.8 per cent

287	14.1	30.8	7.50	9.23	[illegible]	[illegible]	20.8	50.8	[illegible]
318	21.7	38.2	8.82	10.8	47.1	[illegible]	24.6	[illegible]	42.[illegible]
350	29.2	46.2	10.2	12.5	65.6	[illegible]	[illegible]	[illegible]	44.8
368	33.4	51.0	10.9	13.4	77.6	[illegible]	[illegible]	[illegible]	44.[illegible]
385	37.7	55.6	11.6	14.3	90.4	[illegible]	[illegible]	70.[illegible]	45.[illegible]
408	43.0	62.0	12.5	[illegible]	[illegible]	321	33.8	74.[illegible]	43.[illegible]
438	50.2	71.0	13.8	17.0	13.7	371	[illegible]	[illegible]	[illegible]
475	59.2	82.2	15.4	[illegible]	[illegible]	438	40.3	[illegible]	[illegible]
508	67.0	92.8	16.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE II. TESTS OF 15-IN. DREDGE PUMP WITH 37-IN., 4-VANE CAST IRON RUNNER

Test of April 2, 1919; length of line, 2170 ft.; runner, new; static lift, 6 ft.; average pump efficiency, 50 per cent

Speed in R.P.M.	Friction Head in Disch. Pipe, in Ft.	Total Head on Pump, in Ft.	Velocity in Feet per Sec.	Discharge in Sec. Ft.	Hp. Output	Hp. Input	Plant Efficiency in per Cent	Motor Efficiency in per Cent	Pump Efficiency in per Cent
262	24.7	32.6	6.68	8.21	30.4	129	23.6	45.9	51.4
313	32.8	41.0	7.63	9.46	44.1	158	27.9	56.0	49.8
343	40.9	49.7	8.58	10.6	59.8	190	31.5	62.4	50.5
365	45.5	54.9	9.06	11.1	69.3	213	32.5	66.7	48.7
381	51.3	61.2	9.61	11.8	82.1	236	34.8	69.9	49.8
406	57.0	68.1	10.1	12.4	96.0	278	34.5	74.8	46.1
435	69.7	82.5	11.2	13.8	129	322	40.1	80.2	50.0
465	82.4	96.9	12.2	15.0	165	374	44.1	85.6	51.5
503	96.2	111.6	13.2	16.2	206	427	48.2	92.5	52.1

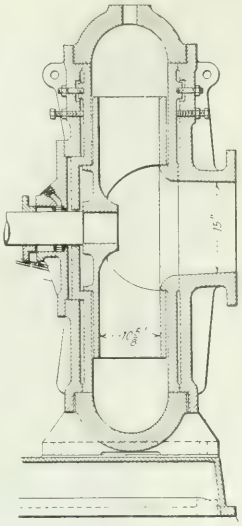
Test of April 2, 1919; length of line, 1220 ft.; 700 cu.yd. pumped by runner; static lift, 5 ft.; average pump efficiency, 53.8 per cent

266	20.5	27.2	9.12	11.2	34.8	136	25.6	46.8	54.7
300	27.4	35.3	10.5	12.9	51.8	174	29.8	54.3	54.9
328	33.2	42.5	11.6	14.3	69.1	213	32.4	60.0	54.0
349	37.8	47.9	12.4	15.2	82.7	241	34.3	64.2	53.4
368	42.4	53.1	13.1	16.1	97.8	274	35.7	67.8	52.6
397	49.3	61.1	14.2	17.4	121	311	38.9	73.1	53.2
433	55.1	69.2	15.0	18.5	145	380	38.1	79.8	47.8
461	68.8	84.5	16.7	20.6	198	435	45.5	84.6	53.8
497	86.2	104.3	18.7	23.0	273	500	54.5	90.9	59.9

Test of April 22, 1919; length of line, 1750 ft.; runner worn out, 17,000 cu.yd. pumped; static lift, 8 ft.; average pump efficiency, 43.8 per cent

229	22.8	33.4	7.24	8.90	33.8	135	25.0	52.5	47.6
327	29.7	40.5	8.04	9.89	44.3	162	27.3	58.7	46.5
358	34.8	45.9	8.87	10.9	57.3	197	29.1	65.3	44.5
376	38.9	50.6	9.34	11.5	66.3	219	30.3	68.9	44.0
391	42.9	55.1	9.80	12.1	75.2	240	31.3	71.7	43.6
420	48.9	61.7	10.6	13.0	92.5	280	33.0	77.4	42.9
448	56.9	70.8	11.3	13.9	111	319	34.8	81.9	42.5
472	65.5	80.6	12.0	14.8	133	368	36.1	86.9	41.[illegible]
501	72.4	88.3	12.9	15.9	162	423	38.3	92.1	41.6

results are not as accurate as would be expected in performance tests of high-grade centrifugal water pumps, the writer believes that they are much more accurate than most dredging data.



CROSS-SECTION OF 15-IN. DREDGE PUMP FOR HYDRAULIC FILL AT TAYLORSVILLE DAM

Reference to Table I shows that the average efficiency of the pump with the 39-in. runner was reduced from about 57 per cent when the runner was new, to about 45 per cent when the runner was worn out. During this time the pump handled about 40,000 cu.yd. and the runner, about 22,000 cu.yd. The pump had handled about 36,000 cu.yd. when the 39-in. runner was installed. On April 1 1919, after the runner had handled about 2,700 cu.yd. the propelling area of each vane was found to have been reduced by wear about 22 sq.in. When the runner was discarded this wear amounted to about 81 sq.in. The wearing was confined entirely to the inner ends of the vanes and was probably due to the impact of the rocks in getting into the runner. The material handled was clay, sand, and gravel with a preponderance of clay. A mechanical analysis of a typical sample showed that about 10 per cent by weight was retained on a ¼-in. screen and that about 50 per cent of the remainder passed through a 200-mesh sieve.

Table II shows that the average efficiency of the pump with the 37-in. runner was reduced from about 50 per cent to about 44 per cent, by the wearing down of the runner vanes, the latter figure being practically the same as for the worn-out 39-in. runner. However, the efficiency when the 37-in. runner was first installed was somewhat lower than in the case of the new 39-in. runner, due possibly to the larger flow space between the outer ends of the vanes and the pump shell as well as to the rather rough manner in which the vanes had been cut off. About 105 sq.in. had been worn off of each vane of the 37-in. runner when it was discarded.

TABLE III. TEST OF 15-IN. DREDGE PUMP WITH 36-IN., 4-VANE MANGANESE STEEL RUNNER

Test of May 28, 1919; Length of line, 1414 ft.; runner new; Static lift, = 12 ft., average pump efficiency, 62.3%

Speed in R.P.M.	Friction Head in Disch. Pipe, in Ft.	Total Head on Pump, in Ft.	Velocity in Feet per Sec.	Discharge in Sec. Ft.	Hp. Output	Hp. Input	Plant Efficiency in per Cent	Motor Efficiency in per Cent	Pump Efficiency in per Cent
293	24.5	40.0	9.10	11.2	50.9	141	35.1	51.2	70.5
316	28.6	45.4	9.79	12.0	61.9	174	35.6	55.4	63.1
342	34.3	52.6	10.7	13.2	79.0	211	37.4	61.8	60.5
363	39.4	58.9	11.6	14.2	95.0	242	39.2	66.1	59.3
384	44.7	65.6	12.5	15.3	114	274	41.6	70.2	59.3
400	48.9	71.0	13.2	16.2	131	300	43.7	73.3	59.6
435	59.0	83.0	14.8	18.2	172	357	48.2	79.7	60.5
470	70.0	96.0	16.7	20.5	224	413	54.1	85.8	63.0
497	78.6	106.2	18.1	22.2	268	457	58.6	90.7	64.6

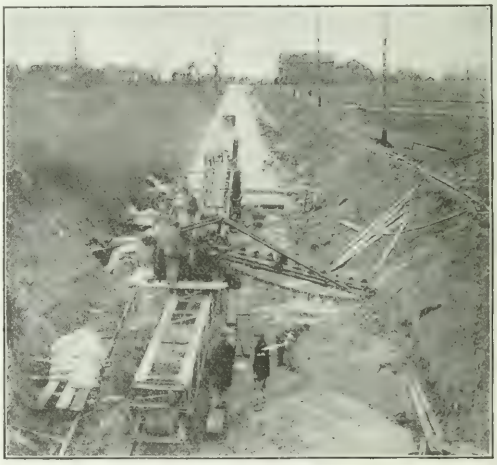
The data in Tables I and II seem to indicate that the efficiency was higher when pumping through the shorter pipe lines, which seems reasonable, since for such conditions the discharges were greater and the heads smaller. Unfortunately it was not feasible to vary the head and discharge through a certain pipe line without varying the speed.

Both of the runners mentioned above were cast-iron runners which were furnished with the first pumps obtained. This accounts for the comparatively short life. Manganese-steel runners with detachable shoes were later adopted because of their much longer life. They are now being used at all locations. The average efficiency of the Taylorsville pump with a new manganese-steel runner was about 62 per cent, as shown in Table III, or about 5 per cent higher than with the new 39-in. cast-iron runner. However, the test recorded in Table III was made with a pipe line 1,414 ft. long whereas the test with the new 39-in. cast-iron runner was made with a line 2,010 ft. long. The efficiencies would probably have been about the same if the tests had been made with the same length of line.

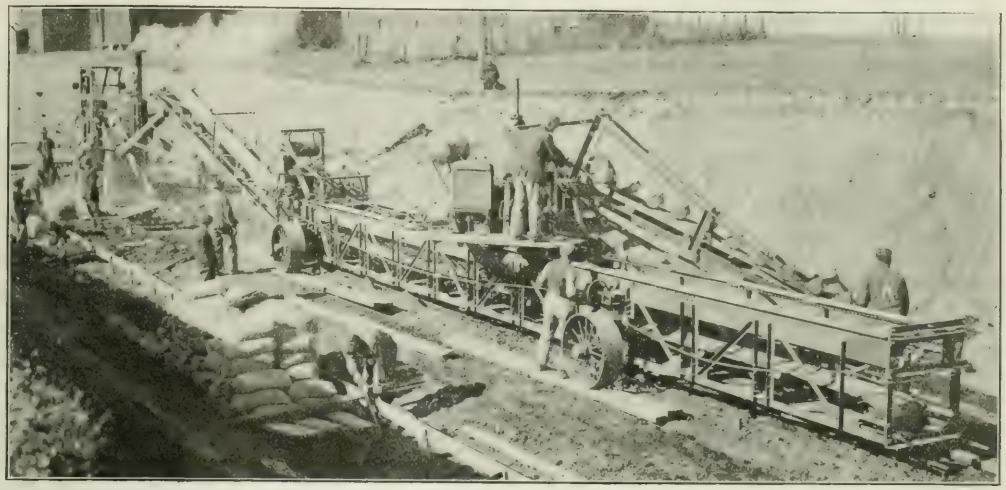
The tests described were made with the co-operation of the division engineers, O. N. Floyd and H. S. R. McCurdy, at the Taylorsville and Englewood dams respectfully, at times when the work would interfere least with the construction progress. Arthur E. Morgan is chief engineer of the Miami Conservancy District, Charles H. Paul, is the assistant chief engineer and C. H. Locher is the construction manager.

Mechanical Mixer Loader Facilitates Paving Operation

A MECHANICAL loader, which picks up the aggregate from ground piles, measures it to correct proportions and conveys it to the mixer, was a notable element this season in a paving operation near Carrollville, Wis., for which the Jacobus & Winding Construction Co. of Milwaukee was the contractor. By the use of this machine the crew was reduced to 13 men. Due to the absence of shoveling and wheeling, soft



(1) END VIEW OF LOADER AND MIXER, STOCK PILES ON ONE SIDE



(2) END INCLINE LEAVES CLEAR SPACE FOR TRIMMING SUBGRADE

sub-grade caused little trouble. Only falling rain stopped the work, if the materials were on the ground. Construction in cuts, with rain every few days, gave ample opportunity for these facts to be determined and verified.

Two views of the outfit are given from which a fairly clear idea of its appearance and general arrangement is had. The loader consists of a long framework, mounted on self-propelled trucks, which carries a rubber belt conveyor which discharges the material through a chute into the mixer skip. On the top of this framework a bucket elevator is mounted so as to move back and forth along the frame to adjust it into working relation to the piles of sand and stone on the subgrade. Underneath this elevator and above the belt conveyor, a hopper is mounted, which is divided into a number of compartments and is movable along the frame so that anyone of these compartments may be placed in position for the elevator to discharge into it.

In operation the elevator first fills a series of sand hoppers sufficient for eight batches and then moves into position to elevate stone, for which two hoppers are provided. When the elevator fills a stone hopper it is discharged, together with a sand hopper, onto the belt and carried to the mixer. When the last sand hopper is discharged, the elevator is moved to the sand pile and refills the eight sand compartments. During this time the two compartments of stone are ready for delivery to the mixer so that no delay results in changing the elevator from one pile to the other.

The material is spouted into the mixer skip by means of a swivel chute pivoted at the end of the framework. The purpose of this chute is to enable the material to be spouted well toward the inside of the skip and also to allow considerable variation between the mixer and loader so that exact alignment is unnecessary. This saves time in moving. It is to be noted, also, that the inclined section of the conveyor extends to a height of about 12 ft. and permits a length of about 30 ft. between the skip of the mixer and the wheels of the loader for finish grading, with sufficient head-room for men to work without danger. Although the subgrade was in exceptionally bad condition and needed considerable trimming, still this 30 ft. of working space was all that was ever required.

Trucks delivered the material in piles at one side of the road, four piles in fifty feet—sand and stone alternately. The range of the elevator being a little over 50 ft. enabled it to work on any one of four piles with one setting of the machine. Considerable additional range is provided by the swivel chute which can be extended either forward or backward to discharge the material into the mixer skip. In this way a total variation of 70 ft. is possible in the piles. This is approximately 20 per cent of a day's run. It was found that materials never varied more and it was hardly ever necessary to work at the extreme points.

By placing material on one side of the road, the other side was left open for bringing up additional material and cement. On this job sufficient room was left between the loader and the forms to bring up cement in wagon loads and pile it within 20 ft. of the mixer. The piles of sand and stone were approximately 12 ft. wide, two to three truck loads being dumped on each pile. These were almost completely picked up by the elevator, only one man being required for cleaning up.

The crew consisted of 13 men, placed as follows: One finisher; two men spreading mixed concrete and laying reinforcing; one mixer engineer; one fireman (helped on loader chute); two cement men; two men for preparing the grade; one loader engineer; one man operating hoppers on the loader; one man cleaning up material piles; and one form setter. This crew required considerably less supervision than the ordinary mixer crew, chiefly because only half as many men were required and most of these were skilled workmen who in turn set the pace for the laborers.

Weather conditions and other delays beyond the control of the contractor, and, later freezing weather, interrupted progress of the job to such an extent that output figures mean very little. The average progress of the work was approximately on the basis of 30 ft. per hour which was the capacity of the mixer. At this rate the loader was idle 30 per cent of the time waiting for the mixer.

Large Railroad Ash-Handling Plants of Two Types

Underground Removal for Through Trains—Overhead Removal at Terminal—Remote Control of Electric Operation—Costs and Comparisons of Service

RADICALLY different methods used under different operating conditions for handling ashes dropped from locomotives when cleaning fires are illustrated in the two new and large ash-handling plants on the Pittsburgh & Lake Erie R.R. At Brightwood, Pa., the ashes from engines of through trains are dropped into hoppers having bottom gates for delivering the ashes to a car traveling in a transverse tunnel and in turn discharging into the skip of an ash hoist. At Haselton, Ohio, the locomotives at an engine terminal drop the ashes into cars in a shallow pit, the car bodies being hoisted out by a trolley on an inclined runway extending across the tracks to the ash bin.

In each case the plant has capacity sufficient to handle the ashes from twelve engines per hour, or about 45 cu.yd. per hour. At Brightwood, with underground operation, the conditions are uniform and only one man per shift is needed in the tunnel for the ash handling plant. At Haselton, with outside or surface operation, from two to three men per shift are needed for equivalent service, the number varying with the weather conditions. At this point, however, the extra capital cost for two long tunnels and the necessary machinery for underground operation would not be warranted.

Underground Ash Handling System

For delivery of coal, water and sand to the engines of through trains, a large plant serving six tracks has been built at Brightwood, Pa., and on four of these tracks the engines can have their fires cleaned at the same time that they are taking water from the standpipes placed between the tracks. The fires are cleaned by the ashpit attendants, the enginemen and firemen remaining in charge of their engines. The layout of this plant was shown in *Engineering News-Record* of July 15, 1920, p. 107.

Ashpits Over Tunnel.—Long pits between the rails would be objectionable in running tracks and the transfer of ashes across and above such tracks would be equally objectionable. To meet local conditions a hopper-bottom ashpit of 225 cu.ft. capacity is placed in each of the four freight tracks, the pit having a length of only 14 ft. and a depth of 8 ft. from the rail to the cut-off gate in the bottom. These pits are of concrete, with firebrick lining. Beneath the ashpits is a transverse concrete tunnel 114 ft. long, 13 ft. wide and 8 ft. high, one end of which opens into the shaft of an ash hoist. The general construction is shown in Figs. 1 and 2. At the river end of the tunnel is the pump house which supplies the water station. The entire concrete structure was built in open-cut and is reinforced for both the earth loads on the roof and side walls and also for external water pressure, as this work is below high-water level in the Ohio River, which parallels the railroad. The concrete is made waterproof, as explained in the article noted above. Inclined hatchways or ladder shafts give access to the tunnel, which has also a recess for a heating stove and a large hatchway for handling machinery.

Heavy reinforced-concrete girders, integral with the roof and walls of the tunnel, carry the running tracks across the tunnel and also form the side walls of the ashpits (see Fig. 2). Upon these girders are placed cast-iron rail chairs of I-section, with anchor bolts in

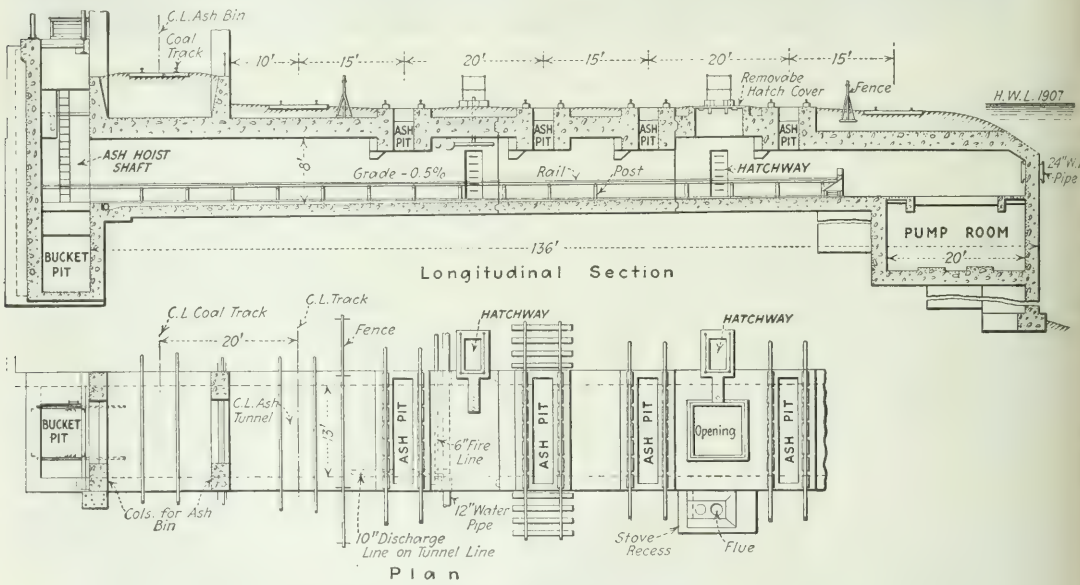


FIG. 1. ASHPITS AND TUNNEL AT BRIGHTWOOD; P. & L. E. R.R.

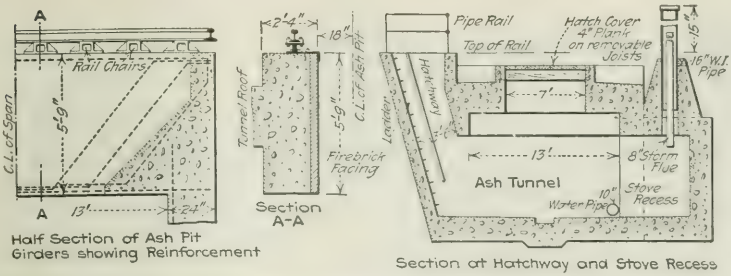


FIG. 2 TUNNEL SECTION AND GIRDER DETAILS

the bottom flanges and clip bolts for the rails in the top flanges. These chairs are placed 29 in. c. to c. and have a bearing 4 in. long for the rails, and 26 in. long on the concrete. The rail clips do not grip the top surface of the rail flange, but allow ¼-in. vertical play, thus preventing the deflection or wave motion in the rail from causing any motion of the rail chair on the concrete. This track construction is shown in Fig. 3.

Ash Car in Tunnel.—A steel, hopper-bottom, motor-driven ash car of 75 cu.ft. capacity travels in the tunnel and is operated by a rider who also loads the car by means of the undercut gates in the bottoms of the four ashpits. Details of the gate apparatus are given in Fig. 4. A track of 7-ft. gage with a grade of 0.5 per cent descending toward the shaft has its 90-lb. rails supported on steel posts spaced 6½ ft. c. to c., the top rail being about 24 in. above the tunnel floor, in order to accommodate the hopper bottom of the car, which lies between and below the rails. Each post is a 4-in. I-beam, 39 in. long, with the lower end grouted into the tunnel floor. At the top are two angles with a cap plate to carry the rails, which are secured by clip bolts passing through the plate and angles, as shown in Fig. 3.

Water is used freely in cleaning the ash-pans of the engines and for cooling the ashes in the pits so that they are not dry or hot when delivered to the car. Water is available also in the tunnel for cooling any unusually hot ashes and for washing the floor and the car, the floor having a gutter and being sloped to carry off all wash water as well as the drainage from the pits. Electric power wires and contact rails are carried along the roof of the tunnel on the side opposite to that on which the operator does all his work, the rails engaging with contact plates supported by an arm on the side of the ash car.

Cast steel wheels with outside flanges carry this car, one axle being geared to a 5-hp. motor, which gives a maximum normal car speed of 250 ft. per minute. Spring buffers on the ends of the car sills engage bumper blocks at each end of the track. On one end of the motor shaft is keyed a wheel for a brake band operated by a treadle. The controller handle, brake treadle and dumping lever are placed convenient to the operator, who stands on a running board on one side of the car. The car and its brake equipment are shown in Fig. 5.

Ash Hoist.—When in its dumping position, the ash car stands in the hoisting shaft (Fig. 1), directly over the skip or elevator bucket. The track gage (7 ft.) is wide enough to allow the skip guides to be placed between the rails, these guides being cut away to allow the front axle of the ash car to pass through. When the car is run back out of the shaft and the hoisting skip is raised, a counterweighted frame or gate automatically rises and barricades the end of the tunnel, so that the ash car cannot be run into the dumping position until the skip bucket has again returned to its loading position and thus carried down the barricading gate to clear the tunnel. The ash car and skip mechanism are interlocked both mechanically and electrically to secure proper operation and to prevent interference. When the car is in position over the skip bucket, the operator releases the gate forming the front end of the car; after the ashes have run out he closes this gate and latches and locks it in one operation.

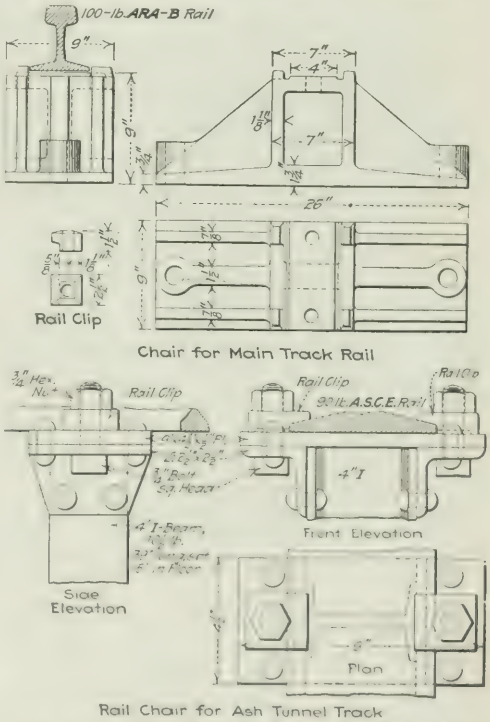


FIG. 3 RAIL SUPPORTS FOR MAIN AND ASH-CAR TRACKS

The hoisting skip has a capacity of 90 cu.ft. and is operated by a 22-hp. motor. At the top of its travel the skip automatically dumps the damp ashes into a hopper-bottom concrete storage bin of 3,500 cu.ft. capacity. This bin, which is emptied daily, is placed above the coal car track of the coaling station, so that cars which have dumped their loads of coal can be loaded with ashes directly from the bin. Each round trip of the ash skip, starting at the bottom of the shaft,

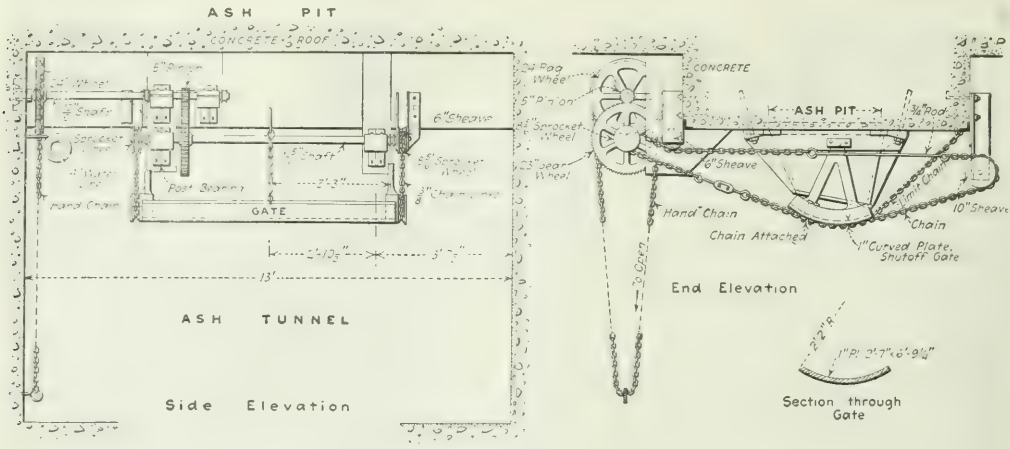


FIG. 4. ASHPIT GATE AND MECHANISM

is effected by the operator pressing a button located on the wall of the tunnel, the button being placed about 20 ft. back from the skip.

About 50 to 90 cu.ft. of ashes are dropped by each engine, the daily total in the fall of 1920 amounting to about 4,200 cu.ft. or 85 tons of dry ashes. By the introduction of the mechanical methods described, one man for each eight-hour shift can remove the ashes from the four pits, receiving ashes from twelve engines per hour, the assumed maximum service being six engines per hour in each direction, at ten-minute intervals. The operator's duty is to keep the pits empty and he has free communication with the men on the surface who are working on the engines.

Ash handling plants of other types serving through trains on this railroad require two or more men on each shift to perform this same duty. With the present wage scale capitalized, there is a capital or investment saving of $75,000 by eliminating three men per day.

As the ash handling plant at Haselton, Ohio, is part of the equipment of an engine terminal, main track conditions were not a factor, as at Brightwood. Low cost with economy and efficiency of operation were the main requirements. Concrete ashpits are located in four parallel tracks extending to the coaling station, sanding towers and water columns, as shown by the layout plan, Fig. 6. These pits are 125 to 152 ft. long, 4 ft. wide, and with a maximum depth of about 5 ft.; they are spaced 17 ft. c. to c. As the site is on filled ground the pit walls are carried below the floor to a single broad footing, which gives a maximum soil loading on clay of less than one ton per square foot. In each pit, the floor is sloped to four low points where sumps connected with four transverse 8-in. drains leading to a 12-in. longitudinal drain beyond the pits. Fig. 7 shows the pits and the ash handling equipment.

Steel cars with removable bodies of 2 cu.yd. capacity travel on a track of 37½-in. gage in the bottom of the ashpit, each pit having twelve cars. The cars are propelled by hand. Cast iron chairs or pedestals spaced about 4 ft. c. to c. are embedded in the concrete floor to carry the 71-lb. rails, the outer edge of the rail base fitting under a lug in the casting and the inner edge being held by a rail clip and bolt at each support. A clear space is provided behind and under these rails to facilitate cleaning out the small amounts of stray ashes that fall into the pit. The main track rails rest on cast-iron chairs spaced about 30 in. c. to c. and resting on the top of the ashpit walls.

Overhead Runways.—Two elevated runways, on a grade of 4½ in. per foot, extend across the pits and form a V, in plan, so that each pit is served by both runways, and the apex, at the high point, is over a concrete ash bin of 220 cu.yd. capacity. On each runway travels a trolley with hoisting cable, the cables being led to two separate hoisting plants, each having a 22-hp. motor. A locomotive standing at any part of the pit has its ashes dropped into a pit car, which is then run by hand under one or other of the runways, so that the bail on the fall line of the trolley can be hooked to trunnions on the ends of the car body. The body is then hoisted out of the pit car and hauled to the

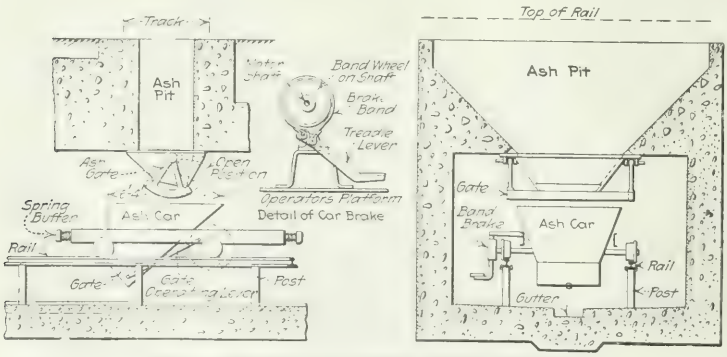


FIG. 5. ASH CAR IN TUNNEL UNDER ASH PIT

top of the runway, where it is inverted automatically by means of a trip and dumps its contents into the bin. The empty body is then run back and lowered upon the car frame in the pit.

Each runway is supported by two-post bents and a tower or four-post bent, the apex of the two runways being carried by a short six-post tower on top of the ash bin. Four lines of laced I-beams are used in each runway, the two inner beams having bolted to their top flanges the 20-lb. rails for the trolley carriage. At each end of the inclined track stops are placed to limit the travel of the trolley. The upper end of each runway is equipped with a slow-down switch, a stop switch and a limit safety switch.

Rectangular concrete piers with footings in the solid clay support the legs of the steel bents and the concrete columns carrying the elevated ash bin. This bin spans the sand track, so that cars which have delivered sand can be loaded with ashes for removal.

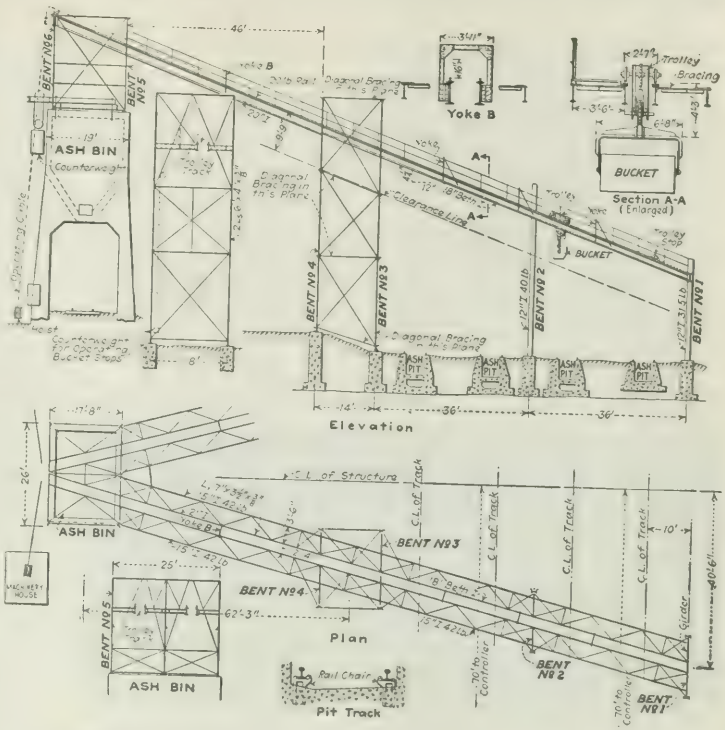


FIG. 7 ASH-HANDLING PLANT AT HASELTON, OHIO; P. & L. E. R.R.

From 100 to 150 engines are handled daily through this plant. Two or three men to handle the ash cars and to attach and detach the hoisting bails are required on each eight-hour shift, the number varying with the number of engines and with the weather conditions. The men operate the ash hoist by means of controllers placed just beyond the ends of the ashpits, from which position the operator can see the ash bucket for the full length of its travel. The men cool the ashes in the cars by means of water from a hose, there being eight separate hose outlets for this purpose.

Cost and Comparison.—These two ash handling plants of the Pittsburgh & Lake Erie R.R. were designed and installed under the direction of A. R. Raymer, chief engineer, and L. H. Turner, superintendent of motive power. The cost of the Brightwood plant was about $96,000, covering the ash hoppers, tunnel, tunnel car, hoist, bin and operating machinery. The cost of the Haselton plant was approximately $91,000, covering the ashpits, pit cars, runway, bin and operating machinery.

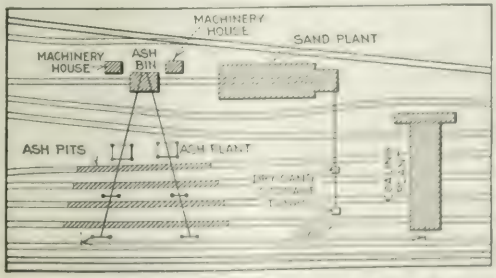


FIG. 6 COAL AND ASH-HANDLING PLANT AT HASELTON, OHIO

An overhead ash removal system for through train service was used at Groveton, Pa., for about fifteen years, but when the new plant was built at Brightwood the underground system was adopted as it could be operated without endangering or being endangered by the through trains. Underground systems in general, however, are considered undesirable on account of high cost and unpleasant working conditions. At Brightwood, the engines (of through trains) are operated by their crews, but at Haselton, the engines are operated by the hostlers, the road crews quitting on arrival at the terminal. Comparison of operating costs of the two systems cannot be made owing to the different operating conditions. At Brightwood it is essential that trains shall be delayed as little as possible, so that a much larger number of cleaners is required than at Haselton, which is a terminal point and where, in general, it is not necessary to do the work so quickly. Therefore cost per engine is greater at Brightwood.

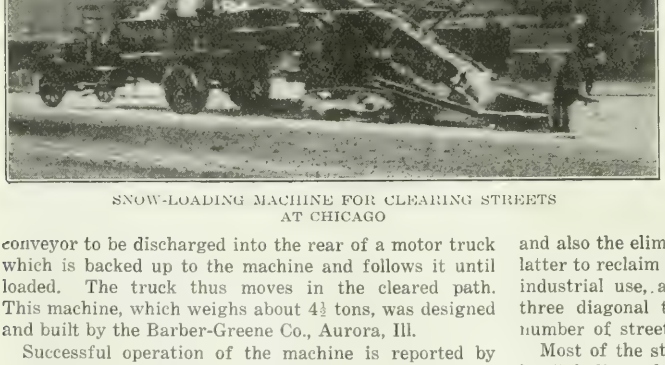
City-Owned Utility Bonds Outside Debt Limit

Besides making it possible for St. Louis and Kansas City, Mo., to increase their bond limit from 5 to 10 per cent the state constitutional amendment adopted last November provides that bonds issued for municipally owned utilities may be secured by mortgages on the utilities in which case the bonds will fall outside the debt limit.

Snow-Loading Machine for Clearing Chicago Streets

A NEW snow-loading machine for clearing streets, which has been purchased by the city of Chicago, is of the conveyor type, scooping up the snow and discharging it into motor trucks, as shown in the accompanying view. An inclined adjustable boom 20 ft. long fitted with high sides to form a trough, is mounted on a frame carried by a caterpillar. Upon the boom travels a 32-in. conveyor belt fitted with transverse cleats, the belt and caterpillar being driven by a 25-hp. gasoline engine. At the lower end of the boom is a plow with a bottom plate or apron 6 ft. wide and having high side wings to guide the snow to the belt. At the upper end is a chute for loading the trucks.

As the machine advances, the snow for a width of 6 ft. is gathered into the scoop and carried up by the conveyor to be discharged into the rear of a motor truck which is backed up to the machine and follows it until loaded. The truck thus moves in the cleared path. This machine, which weighs about 4½ tons, was designed and built by the Barber-Greene Co., Aurora, Ill.



SNOW-LOADING MACHINE FOR CLEARING STREETS AT CHICAGO

Successful operation of the machine is reported by W. J. Galligan, assistant superintedent of streets, who is in charge of street cleaning. On Dec. 26-27, the machine was in service for 32 hours, except at meal times and for one minor repair. It continued in intermittent operation during the next two days. Four men were required, an operator and helper and two laborers, the main work of these last being to clear and trim the snow as it feeds into the plow. Both slush and hard frozen snow were handled, the temperature ranging from — 5 to + 32 deg. F., but the machine appeared to operate equally well with snow of all kinds and on wood, granite, bitulithic and cobblestone paving.

A saving of $450 in labor per 8-hr. shift is reported, as compared with shoveling piled snow into trucks. The plan is to plow the snow into a windrow along the curb, the machine then loading from this windrow into the trucks, thus avoiding the necessity of shoveling the snow into piles for loading by hand. Further, the machine can be operated night and day, thus eliminating the difficulties of organizing shovel gangs for night work in bad weather. The machine will load an 8-yd. truck in 2½ minutes, but a gang of six shovelers will take twenty minutes for the same work. The cost of operating the machine is given by Mr. Galligan as less than $30 per 8-hr. shift, exclusive of interest and depreciation. It consumes about a gallon of gasoline per hour and a quart of lubricating oil per shift.

City Planning Recommendations for Lake Charles, La.

A GENERAL program for improvements to the city plan of Lake Charles, La., has been submitted to J. A. Trotti, mayor, and other city commissioners of Lake Charles, and to a special advisory committee of the Lake Charles Association of Commerce, by Bartlett & Rammey, engineers of San Antonio, Tex. Some features of the plan have been approved by the advisory council for immediate execution and the entire scheme is recommended for careful consideration. The advisory council also endorses the engineers' recommendation for a city plan commission.

The engineers advise enlarging the city by annexation so as to give it control of developments in outlying territory and also throw "more of the burden of the improvement of the community on the close-in lands, which will enjoy a greater percentage of enhancement in values than property within the present city." Enlarged wharfage facilities, with adequate railway service, are considered of prime importance to Lake Charles in view of its expected dedevelopment "as a port for seagoing vessels."

Besides the creation of a port zone the engineers recommend the establishment of certain areas of the city as wholesale, industrial and unrestricted residence districts. The site for a union passenger terminal, elimination of certain grade crossings and also the elimination of certain railway trackage, the latter to reclaim lake front and other areas from further industrial use, are suggested. The engineers propose three diagonal thoroughfares and the widening of a number of streets.

Most of the street widening, the report states, would be "of direct benefit and value to the abutting and adjacent property owners far in excess of the worth of the narrow strips given up." The engineers go on to say: "Even where the street line is established as much as 25 ft. back upon the present private property, this loss of depth cannot be considered on the basis of front values and reduces the value no more than if taken from the backs of the lots. Offsetting the loss in lot depth is the great enhancement in frontage value from the improved street width."

Other recommendations deal with parks, boulevards, a civic center, sewerage and garbage disposal. A special report on sanitary and storm sewers, with cost estimates, has been made. As to garbage disposal, the report says: "In view of the large areas of adjacent marsh land where garbage can be disposed of without nuisance and with resulting beneficial grade raising, our recommendation is against the installation of an expensive modern garbage incinerator." Light automobile trucks with trailers are recommended for garbage collection.

Trade with Germany During 1920

The *Foreign Trade Record*, published by the National City Bank of New York, recently stated that trade with Germany by the United States during 1920 aggregated $400,000,000, as against $533,000,000, the biggest year preceding the war.

Engineer Board Recommends Plans for Jersey City

New Developments Comprise Port Terminals on Hudson and Hackensack and Motor Road Approaches for Highway Tunnel

NINE months ago the City Commission of Jersey City, N. J., appointed a Board of Engineers to study and report on various engineering problems of the city. This board has been working on a number of different problems, including a new street system, sewage disposal, garbage and ash removal, parks and playgrounds, housing and zoning, passenger transportation, etc., and its first report is about to be published. It has paid particular attention to the water-front development of the city in relation to the whole problem of handling freight in the port of New York, and in this connection has made some recommendations that are being taken up by the city authorities actively. These comprise the development of a new industrial port terminal district on Newark Bay and the Hackensack River, the prospective construction of a belt line railway connecting the various trunk lines entering the city, and the laying out of highways which are intended to take care of the increased motor and other traffic from the new highway tunnels now under construction under the Hudson River. The details of the plans given below are taken from the report by Philip Guise, secretary of the board.

The report calls attention to the congestion in the port of New York today and refers to some of the proposed recommendations for improvement of conditions. It concludes that the logical first step in the solution of the problem of expanding New York harbor is in the development of Newark Bay and its adjacent industrial area. As a part of this it commends the exterior belt line railroad which has been proposed to intercept all the western trunk lines somewhere near the outer limits of the New Jersey portion of the metropolitan district, but it says that the realization of this plan will necessarily involve a long period of time and the expenditure of very large sums of money. The board therefore recommends that a quick and effective result can be obtained by unification and expansion of the existing break-up and classification yards facilities in the Hackensack Meadows, amplifying these existing facilities by connecting them together with short belt or marginal railways and extending these facilities at some future time by way of a Hudson bridge and tunnels with a New York City marginal railway which will tie up all of the Manhattan and Brooklyn piers. This part of the report reads as follows:

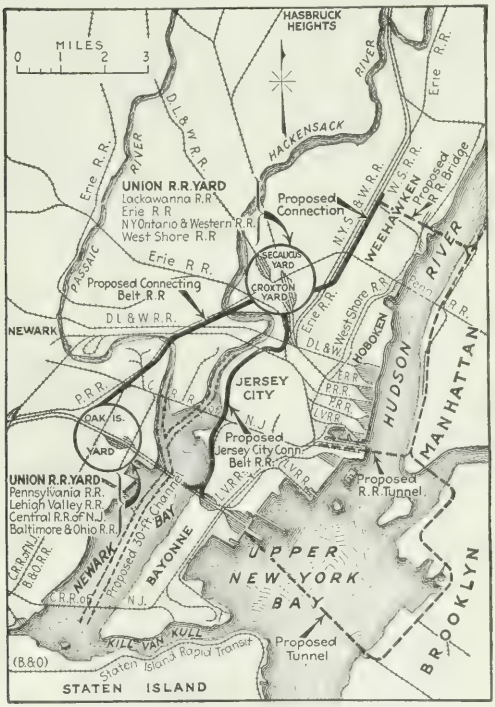
PROPOSED IMPROVEMENTS OF HARBOR AND MAIN LINE HIGHWAYS, JERSEY CITY

By connecting the existing Croxton yard of the Erie R.R. with the existing Secaucus yard of the D., L. & W.

R.R. and connecting thereto the lines of the New York, Ontario & Western and West Shore Railroads, 50 per cent of the freight of the port can be handled at Croxton. A similar union yard established by consolidating the Pennsylvania, Lehigh Valley, and Oak Island yards, connecting thereto the Central Railroad of New Jersey and the B. & O., will accommodate the other 50 per cent of the business of the port.

Marginal railroads connecting these two yards forming a complete belt line would result. This in effect will accomplish the same result as the exterior belt line, at much lower cost, a great saving of time and is reasonably within the possibility of realization by joint action of the railroads and a state or bi-state body. The existing yards can be readily connected and the Jersey City belt line forming a part of such a connection is already under way.

This proposed belt line railway utilizes the existing New Jersey Junction R.R., which extends along the western shore of the Hudson from Bergen Point to Weehawken, connecting with various roads. It would also use the Lehigh Valley's connection (known as National Docks Ry.), which extends to the Pennsylvania



LAYOUT OF NEW CLASSIFICATION YARDS AND CONNECTING RAILWAYS

R.R. and the New Jersey Junction R.R. There remains then to be built only one side of a four-sided belt, that is a section extending from the Lehigh Valley-Pennsylvania R.R. bridge over Newark Bay, near the Bayonne city line, along Newark Bay and the Hackensack River, crossing the Lincoln Highway by an overhead bridge, and extending across West Side Park on an elevated structure, again coming to grade near the Pennsylvania R.R., which will cross it by an overhead bridge. Connections would be made with Droyer's Point, where an extensive railroad yard is planned, and with the proposed Hackensack River development where yard facilities and provisions for sidings are made. Connections would also be made with all railroads entering the city and also between the yards.

It is the idea of the board that in the yards which would be tied to this line can be classified and separated the commodities whose ultimate and final destination is Manhattan or other parts of New York for transfer to union lighterage or steamship terminals located along the Hudson River shores, but a more important part of their conclusion is that freight for transatlantic or other ocean shipment is to be conveyed directly to and from railroad, warehouse, or steamship terminals located along Newark Bay, the Hackensack and the Passaic Rivers; that is, the board would transfer ocean freight terminals handling that portion of the freight which is not intended for New York City's use from New York to the Newark Bay district, thus eliminating the lighterage charges and congestion now existing.

To take care of the large amount of east-bound and west-bound freight going to and originating in Manhattan Island and Long Island the report indorses the well-known Lindenthal plan of a Hudson bridge and marginal railroads. The text of the report is as follows:

The effective means of accomplishing the transfer across the river is of the greatest importance in the development of the outlying boroughs of the City of New York. This means of transfer across the river should therefore be accomplished not by a temporary makeshift but by a method or means lending itself to full expansion to cover the needs of the constantly growing volume of manufacturers of the City of New York, including Brooklyn, Queens, the Bronx. Jamaica Bay looming up here as the future free port.

The logical accomplishment of this function of the railroad plan is by means of a Hudson River Bridge with marginal railroad extensions; first along the west waterfront of Manhattan, thence extended and carried to Brooklyn by a tunnel near the Battery running along the entire waterfront of the Borough of Brooklyn, extending southerly to the Pennsylvania Railroad yards at Bay Ridge and eventually connecting the Long Island Railroad, the New York Connecting Railroad and Jamaica Bay. This marginal elevated railroad to serve modern piers to be erected along the Hudson River shore of Manhattan by direct track connections to the upper deck of these piers whence the commodities can be loaded or unloaded to and from the ship by modern handling appliances, cranes, telfers, tractor-trailers, etc. The lower decks of the piers and the street surface reserved for motor truck and trailer operation.

The first step proposed by the Jersey City plan, the connecting up of the existing railroad yards at Croxton and Oak Island and their articulation by short belt lines to facilitate unified operation is also the necessary first step in bringing the trunk line railroad service across the proposed bridge. In these yards would be prepared the daily shipments on call to and from New York City, that freight not destined for Manhattan going or coming in via Newark Bay.

West Water-Front Improvements

The west water front of Jersey City is divided geographicaly into two parts—that portion extending from Bayonne to Newark, including Droyer's point, and the portion to the north of this extending along the Hackensack River from West Side Park to the Pennsylvania R.R. main line. All this is in the Newark Bay district where there is at present a 20-ft. channel and where the government has under consideration the deepening to 30 ft. Already on the north side of the bay the city of Newark is developing its Port Newark terminal where the Submarine Boat Co. has its shipyard. Opposite this Port Newark development Jersey City is developing the so-called Droyer's Point district. Here the plan is somewhat tentative, particularly as regards the lengths and widths of the piers. The general development consists essentially of the reclamation of land under water comprised between the bulkhead line, the Morris Canal, the Bayonne city line, and the Newark branch of the Central Railroad of New Jersey. The entire area included between these lines, aggregating about 350 acres, is to be reclaimed by hydraulic dredging and filling and a bulkhead built to provide wharfage for vessels of all types until such time as the necessity for pier space

develops. The present plan shows an ultimate development of sixteen piers, 150 to 250 ft. or more wide and from 500 to 1,000 ft. or more long. The city is now working on the dredging and filling here under an appropriation of $650,000. This district is on deep water which some time in the near future will be deep enough for all necessary purposes and is within 45 min. by motor truck from the Manhattan terminal of the Hudson tunnels.

The proposed Hackensack River improvement consists of the same type of development, which is visualized as a wharfage and warehouse district under the ownership or control of the city. A street system has been placed on the map for this district, but no work has been undertaken, though condemnation proceedings are under way. It would cost as outlined about $3,500,000.

The major part of the Hudson River waterfront of Jersey City being occupied by the railroad yards of the trunk lines, waterfront plans on the Hudson River are confined at this time to development of the Morris Canal Basin where a marine terminal is planned with two piers 1820 x 250 ft. with warehouse and adjacent terminal development. Just west of this in the South Cove a Barge Canal and terminal basin is planned with one 550-ft. double-deck pier. This is about to be begun by the city at an estimated cost of $700,000.

Proposed Highways

The highways which are proposed are two routes to take care of the expected traffic from the New Jersey end of the new highway tunnels under the Hudson. The first highway to be built will be called the Rotary Highway and will extend west from the tunnel portal, partly in widened old streets and partly in new right-of-way, up over the Palisades on a new viaduct and connecting with the Lincoln Highway to the west. The other recommendation is that the Morris Canal bed be utilized for the construction of a modern highway for the operation of motor trucks at high speed. By widening Henderson St., which parallels the Hudson River at the portal of the tunnel, a broad boulevard completely protected beyond the Henderson St. district could be had from the tunnel to Newark Bay, which would be crossed by the proposed inter-county vehicular railroad bridge. Besides the highway and the speedway several other routes as indicated on the map are proposed.

The final recommendation is that a barge canal be cut through the Bayonne peninsula between the Hudson and Newark Bay. This would add to the convenience of operating the Newark Bay district and place Newark Bay within the free lighterage limits.

The Board of Engineers which was appointed by the City Council of Jersey City is composed of engineers in different lines of work in the city, county and state, all of them, except the secretary, serving without pay. They are: Chairman, Martin Schreiber, who is engineer of the west water front committee of the Chamber of Commerce; Thomas J. Wasser, state highway engineer of New Jersey; Charles van Keuren, chief engineer, Department of Streets and Public Improvements of Jersey City; Joseph P. McLean, engineer, Hudson County Tax Board; Frederick Dunham, harbor engineer, Jersey City; Hugh A. Kelly, engineer, Department of Parks, Jersey City; Albert De Castro, engineer, Chamber of Commerce of Jersey City. Philip Guise is the secretary of the board and in charge of the engineering and other organization.

Future Water-Supply Needs of the Metropolitan District

Rates of Filtration Have Been Doubled Maintaining Efficient Bacterial Removal and Reducing Unit Costs

Conclusion of Discussion Before the New York Section of the American Society of Civil Engineers on Water Supply and Sanitation in the Metropolitan District.

HOW MUCH WATER the New York and New Jersey Metropolitan District will need twenty-five to fifty years hence, the available sources in New York, New Jersey, Pennsylvania, Connecticut and Massachusetts and the possibilities of joint action to meet those needs were some of the topics discussed on Jan. 13 before the New York Section of the American Society of Civil Engineers. The general subject for the meeting was Water Supply and Sanitation in the Metropolitan District. The portion of the discussion dealing with sewage and garbage disposal and snow removal, with particular reference to New York City, was abstracted at length in *Engineering News-Record*, Jan. 20, p. 104. Various phases of the water-supply question were presented at the meeting by W. W. Brush, deputy chief engineer, Department of Gas, Water Supply and Electricity, New York City; J. Waldo Smith, chief engineer, Board of Water Supply of New York City; Morris Sherrerd, chief engineer, Department of Streets and Public Improvements, Newark, N. J.; and William H. Burr and Allen Hazen, consulting engineers, New York City. The consensus of opinion was that water in plenty can be found to meet the future needs of the many millions in the metropolitan district twenty-five to fifty years hence, yet there should be no time lost in beginning to make studies and plans for future enlargement of the supply of the various portions of the district since already consumption is pressing close upon supply, including what will become available by works now under construction for New York City and for Newark. Most of the speakers believe that it would be necessary to go so far afield for water as to give rise to interstate complications unless joint action to prevent them were taken. An abstract of the discussion on water supply follows.—Editor.

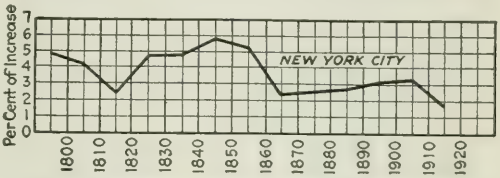


FIG. 1. PERCENTAGE OF ANNUAL POPULATION INCREASE, NEW YORK CITY

The points in the curve at the middle year of each decade indicate the annual compound percentage of increase during the decade.

Data to show the present available supply, present consumption and probable future needs of New York City were presented by Mr. Brush. Taking into account all sources of supply owned by the city, and including the Schoharie watershed addition to the Catskill supply, the safe yield with minimum rainfall totals 1,109 m.g.d., while the amount available with normal rainfall would be 1,280 m.g.d. The amount actually used during 1920 was 690 m.g.d. Besides the amount just stated private companies in Brooklyn and Queens Boroughs supplied 44 m.g.d in

1920, making a total of 734 m.g.d. supplied by the city and by private companies. The Schoharie supply now under development to be added to the Catskill will yield 300 million gallons daily.

Since the Catskill aqueduct was put in use the draft from the Croton drainage area has been materially reduced and the utilization of the supplies on Long Island and on Staten Island has almost ceased in order to do away with pumping so far as possible and take advantage of the gravity Catskill supply.

Speaking of the recurrent newspaper discussions about the large volumes of water wasted over the Croton dam of late, Mr. Brush pointed out that this is due to drawing upon the Catskill, as already noted, and will be greatly reduced when the Croton is utilized to its full capacity. He also pointed out the possibility of using the Croton dam overflow for hydro-electric power, the fall here at full reservoir being 150 ft. At other Croton reservoirs there are differences in water level of 90 ft. that might be used to develop power. It has been estimated that electric power equivalent to at least 3,000 kw. could be advantageously developed in the Croton watershed and that if this power were sold at the cost of only the fuel used to develop electric power within New York City the net return would be about $100,000 a year, equal to about 35 per cent on the capital investment.

The population increase of New York City by decades is shown by Fig. 1, while Fig. 2 shows the yearly percentages of increase in total water consumption for the past twenty years, also for the entire city. The average yearly increase in consumption during the entire twenty years was 3.2 per cent.

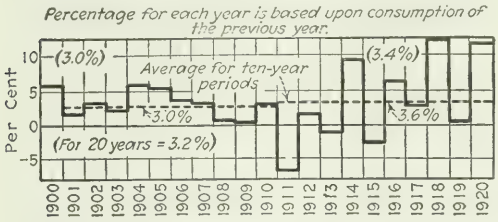


FIG. 2. YEARLY PERCENTAGE OF ANNUAL INCREASE IN WATER CONSUMPTION OF NEW YORK CITY

The percentage for each year is based upon the consumption of the previous year.

Fig. 3 shows the total water consumption and population in New York City from 1895 to 1920, and forecasts of population to 1945 and of consumption to the same date, the latter being based (1) on the assumption that the increase in consumption will be 3 per cent a year and (2) that it will be 4 per cent. The accompanying table shows the water consumption by boroughs for the entire city from 1900 to 1920. Waste prevention work from time to time has materially reduced the per capita consumption.

The entire safe supply of 1,109,000 gal. a day, Mr. Brush stated, might be required as early as 1932, or possibly not until 1941, while the average between the two extremes would be 1936. It is to be noted that a 3 per cent rate of increase in consumption after 1920 is based on the inspection at least once a year of all plumbing fixtures in unmetered premises.

Finally Mr. Brush said: "The engineers of the Bureau of Water Supply of the city believe that the time has now come for the initiation of the work of developing the supply which will be required about fifteen years hence."

In his discussion Mr. Smith said that on the completion of the Schoharie development of the Catskill area about 1925 New York City would have sources of water supply giving a safe yield of about 1,136 m.g.d. From this some 50 m.g.d. would soon have to be deducted on account of the unsatisfactory quality of the water, leaving about 1,086 m.g.d. available. Assuming that the normal increase in per capita consumption stopped at the present 131 gal. a day and that the growth of population is the least that

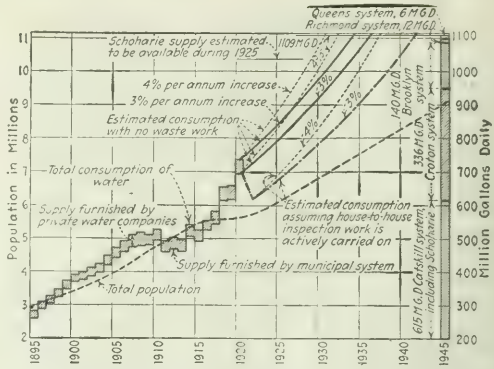


FIG. 3. POPULATION AND WATER CONSUMPTION IN NEW YORK CITY FROM 1895 TO 1920, WITH FORECASTS OF FUTURE POUPLATION AND CONSUMPTION

The forecasts of water consumption at the rates of increase indicated are designed to show when, at those rates, the present available supply completed or under development would be exhausted. To hold the yearly increase of water consumption to 3 per cent a year it would be necessary to inspect all plumbing fixtures in unmetered premises once each year.

can reasonably be expected the consumption would exceed the safe yield in 1958, whereas if the consumption continued to increase at the rate of the last five years it would exceed the safe yield in 1929. In the metropolitan area of northeastern New Jersey consumption already equals or exceeds the safe capacity of the present works, while Westchester County municipalities in New York State have reached the limit of their present water resources. The only important available source for an additional water supply in northeastern New Jersey is the further development of the Passaic watershed, but that with other local sources can probably be made to serve for fifteen to twenty years, although full development would require the construction of works across the state line in New York. It therefore appears that in fifteen years more or less "the entire metropolitan district in New York and New Jersey, with a probable population of 12,000,000 to 14,000,000, will have reached the limit of its water resources."

The conditions for developing more water from the Catskill area, beyond what is already under way, are not favorable. Possible sources of Dutchess and Columbia Counties, east of the Hudson, are barred to New York City by state legislation and if available would yield only about 250,000,000 gal. Another 250,000,000 gal. could be obtained from the deep sands of Suffolk County, on Long Island, but this source is also barred by the State Legislature. If made available by the legislature it would have to be pumped.

A gravity supply of 1,000 m.g.d. could be developed in the Adirondacks, but at a distance of 175 miles and at a cost that would be prohibitive except as a last resort on account of the great length of aqueduct and the water-power interests that would have to be taken care of by providing compensation water from additional storage reservoirs.

Some 750 to 800 m.g.d. could be brought a distance of only some 60 miles from the Ten Mile and Housatonic rivers, but this drainage area lies in the three states of New York, Massachusetts and Connecticut, and water-power rights would be involved.

A supply of 1,000 to 2,000 m.g.d. from the Delaware, only some 60 miles distant, could be developed, but local conditions are unfavorable to the construction of large storage reservoirs, and besides building many small reservoirs for water supply a storage would also have to be provided to compensate existing water supply, power and other interests.

Finally, Mr. Smith stated that since the available water supplies of all parts of the New York and New Jersey Metropolitan District would be exhausted at about the same date—i.e., what may be called local sources—it is apparent that water must be brought from great distances and at such costs as to make supply works prohibitive for the smaller communities acting alone. One supply for the whole metro-

politan district would therefore be logical. "Barring interstate complications," Mr. Smith said, "the Delaware lends itself particularly well to such a comprehensive treatment of this problem since, according to the method of development, an aqueduct to the City of New York will naturally either skirt or cross the north Jersey metropolitan area. With the City of New York amply supplied from the Delaware River Westchester County could be supplied by the existing Croton and Catskill works until such time as it will become possible and necessary to develop one of the sources to the north."

Mr. Sherrerd stated that the immediate present needs of the two million inhabitants in the New Jersey portion of the metropolitan district could be met by water available within the borders of New Jersey, especially if possibilities in south Jersey were utilized, although the latter would require pumping.

The population in the New Jersey territory is increasing at the rate of about 4 per cent a year and the water consumption is increasing somewhat faster than the population. Within the past twenty years water consumption in Newark has doubled, notwithstanding the fact that the supply of Newark is now 98 per cent metered. As an addition to its present supply of 50 m.g.d. from the Pequannock River there is now being developed for Newark an equal amount by the North Jersey District Water Supply Commisssion from the Wanaque River — which like the Pequannock River is a highland branch of the Passaic. An additional 40 m.g.d. of water could be developed from the Lower Passaic. The Hackensack River is good for some 50 m.g.d. total. Other supplies in the New Jersey metropolitan district, chiefly groundwater, yield some 20 to 25 m.g.d., bringing the total supply probably available within the next five to ten years up to 250 million gallons a day.

AVERAGE DAILY PER CAPITA CONSUMPTION OF WATER IN NEW YORK CITY FOR THE YEARS 1900 TO 1920

	Manhattan and Bronx	Brooklyn	Queens	Richmond	Total	
1900	131	85	115	100	114	1900
1901	129	84	116	100	113	1901
1902	129	84	110	100	112	1902
1903	127	85	115	99	112	1903
1904	129	90	121	100	115	1904
1905	132	93	120	100	118	1905
1906	132	97	120	98	119	1906
1907	130	100	124	102	119	1907
1908	125	101	121	99	116	1908
1909	120	95	112	106	111	1909
1910	119	97	106	104	110	1910
1911	105	92	105	109	100	1911
1912	104	91	109	114	100	1912
1913	105	79	101	127	96	1913
1914	113	82	105	125	102	1914
1915	109	76	92	121	97	1915
1916	114	78	102	129	101	1916
1917	114	78	115	125	102	1917
1918	123	90	117	162	112	1918
1919	121	87	108	163	110	1919
1920*	155	99	104	159	131	1920

* Based on 1920 Federal Census.

Within twenty-five years, Mr. Sherrerd estimates, 500 m.g.d. will be used for metropolitan New Jersey and in fifty years 1,000 m.g.d. The latter amount, Mr. Sherrerd said, "will scarcely be available within the confines of New Jersey, at least within reasonable distance of the centers of the population to be supplied."

All the foregoing statements being taken into consideration, and in view of the impracticability of the proposition to create a metropolitan state, Mr. Sherrerd was of the opinion that reciprocity between Pennsylvania, New Jersey, New York and Connecticut is inevitable if the water-supply problem of the metropolitan district is to be solved. A joint commission for that purpose was suggested, although Mr. Sherrerd added that "the experience of the New York and New Jersey Port and Harbor Development Commission does not argue well for united action."

Mr. Burr prefaced his remarks by the assertion that the preventable waste of water in New York City is small and that the average per capita water consumption is one of the lowest in the country. The gist of his further remarks was in favor of the ultimate adoption of the alternative plan of the New York Commission on Additional Water Supply, presented in 1903, which outlined the possibility of a filtered and pumped supply from the Hudson River at a point not far from Kingston, where brackish water would for the most part be avoided. The pumping cost would be partly offset by the relatively short aqueduct as compared with bringing in a far distant gravity supply, say from the Adirondacks. Water might be stored in the Adirondacks for the primary purpose of water power, and then be picked up at the proposed water-works intake on the Hudson near Kingston. This would require regulation or balancing so the water would be used for power when needed for the supply of New York City. Apparently this plan is for the rather distant future, since Mr. Burr stated that he was inclined to think that after present sources, and possibly the Delaware River, were exhausted, the Adirondacks would prove to be a valuable source of supply.

Allen Hazen took an optimistic view of the water-supply problem (as he did in his remarks on the sewage-disposal problem noted in our issue of Jan. 20, p. 104). Briefly, he said there is no cause to worry about the future water of the district since it has a rainfall twice what is needed for agricultural purposes, coming mostly in winter. If there were a market for it, Mr. Hazen said, there could be provided ten times the water that will actually be demanded in the territory from Boston to Washington. As to the Westchester County communities (north of New York City) Mr. Hazen said that if they could only get together a water-supply plan could be devised that would give them water cheaper than its cost to the metropolitan district.

Water and Sewerage Systems Not Fully Used

A recent sanitary survey of Hamilton, Ohio, disclosed the fact that one-seventh of the population did not use the public water supply, although the entire population had access to the city mains. The inquiry involved 757 representative households scattered throughout the city. In 85 per cent of the homes the public supply was used, in 12 per cent, private wells and in 3 per cent, cisterns. Thus the net value of the public supply from the health standpoint was reduced 15 per cent. The results of the inquiry concerning sewerage are even more startling. Of 775 households only 55 per cent had connections to the sewers and the remainder had outdoor privies. The city is well sewered on a separate plan, the sanitary sewers covering 88 per cent of the area of the city. Of the households having privies 75 per cent were accessible to sewers. W. H. Dittoe, chief engineer, Ohio State Board of Health, who conducted the survey, states that Hamilton may be an extreme case but he is of the opinion that is is representative of cities of its class. He recommends further surveys and greater activity in requiring the inhabitants to utilize their public water and sanitary facilities.

Wisconsin Begins Snow Survey

On selected main highways in Wisconsin records are being kept this winter of the character and extent of snow movement by the wind; of drift formation, location and magnitude, and all similar facts in connection with the accumulation of snow on these roads. Reports will be made on simple forms, which, in addition to the snow data, call for suggestions as to means of prevention of drifts by wind breaks, fences, hedges, etc. It is believed that with such records, plans may be formulated for barriers and other drift preventives which will materially reduce obstruction of highways. While the surveys are being conducted by country highway commissions, the routes surveyed are selected by the state highway commission, J. T. Donaghey, maintenance engineer.

Belt Line Plan to Make New York A Railhead Port

Joint Harbor Commission Also Projects "Automatic-Electric" Underground Loops for Manhattan Distribution

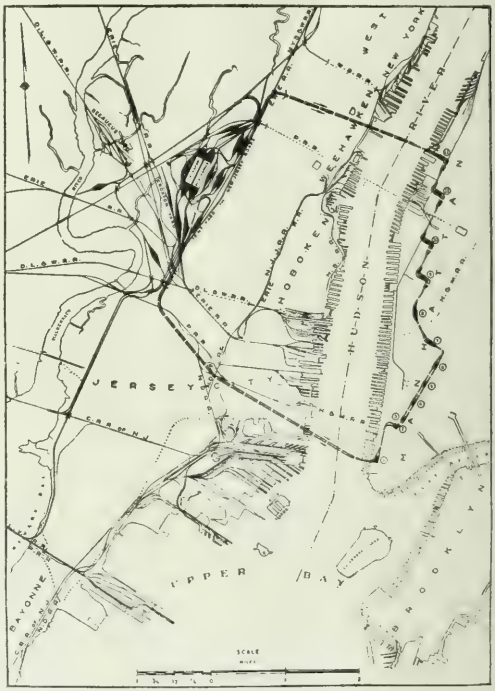
A SYSTEM of outer and inner belt lines to bring direct rail connections to the greater part of the water front of New York Harbor and a plan for building an underground "automatic-electric" freight subway loop system for distribution on Manhattan Island (at an estimated cost of $200,000,000) are the principal features of the physical plan for the solution of the New York port problem proposed in the report of the New York-New Jersey Port and Harbor Development Commission addressed to the governors of the two states, Dec. 16, 1920, and made public Jan. 24, 1921. While recommending the belt line system and the underground "automatic-electric" distributing system as the principal plans for ultimate relief, the commission makes reference to "measures for immediate relief" as "voluntary store-door delivery" by direct run of motor trucks with detachable bodies from rail heads to store doors in New York City and the unification and joint operation of marine equipment.

While the commission urges that these measures for immediate relief "be adopted at once," it does not at this time issue the two chapters of the detailed report on "Special Motor-Truck Service for Handling General Package Freight Between New Jersey and Manhattan" and on "Railroad Belt Lines and Consolidated Marine Service"—Nos. 12 and 16, respectively. The chapters of the report now issued, Nos. 9, 10, 11 and 14, deal with plans that the commission has rejected—the proposals for an elevated standard equipment railroad on the west side of Manhattan, an underground standard equipment railroad, and the marginal railroad with bridge connection—as well as the recommended automatic-electric system plan for Manhattan. As noted below, the commission finds that the cost per ton of handling freight by standard gage railroad—plans for which were rejected—would exceed *present* costs.

The commission holds the port to extend from Jamaica Bay to Newark and from Perth Amboy to Irvington-on-the-Hudson, and believes that a system of inner and outer belt line railroads connecting all trunk lines and having numerous spurs to the various water fronts, to be developed "in such sequence as further study would determine," would provide best for the future growth and economic development of the port.

While practically every part of the port, except Manhattan, would have direct rail connection with the water front, without breaking of bulk, the commission finds that a standard railroad in Manhattan is not feasible and therefore proposes an underground "automatic-electric system," an entirely new form of conveyor railroad, built below two subway levels, which, serving the nine New Jersey trunk lines as well as the New York roads, will carry freight on short trains with special cars, moving without locomotives or train operators, and running between twelve distributing terminal points in Manhattan and the joint yards in New Jersey and toward the upper end of Manhattan Island.

The first stage of the "automatic-electric" development in Manhattan is indicated in the accompanying cut. It provides for linking the New York Central R.R. with the New Jersey railroads through a loop from a joint yard in New Jersey and a spur to the New York Central's 60th St. yard, to "do away with the surface tracks in 10th and 11th Aves." and provide equal service for each of the ten railroads at twelve union terminals in lower Manhattan. The second stage, bringing the New Haven and Long Island Railroads into the system through a second joint yard near Wards and Randalls Islands, which the New York Central R.R. will also reach by additional tracks along the Harlem River, and providing additional lines and stations in upper Manhattan, "will solve the New York Central-Riverside Park problem by making possible the complete removal



FIRST STAGE OF "AUTOMATIC ELECTRIC" SYSTEM
Connection to N. Y. Central Lines Made Later

of the tracks from 60th St. yard to Spuyten Duyvil, and will give all parts of Manhattan universal rail service."

The accompanying cross-sectional drawing shows a typical "automatic-electric" distributing terminal in Manhattan, as proposed by the commission. The purpose of the plan is to release the present railroad pier stations for steamship service and the marginal way for supporting warehouses and to eliminate the present congestion of trucks on West St. and the marginal way, as well as to provide union terminals nearer to consignees and shippers, and reduce trucking haul and street congestion in Manhattan. The proposed facilities are expected materially to reduce car-float and railroad lighterage service, but much will still remain which the commission would consolidate into joint operation from a few new railroad terminals on the water front.

Coal for Manhattan would be handled by barge and lighter as at present. It was not found feasible to provide for handling coal by the automatic system.

The commission regards the proposed railroad-terminal system as the backbone of a rational port development, and it constitutes the physical plan which, together with a compact between the two states to make it effective, the commission urges for formal adoption. In furtherance of that rational development, though not as a part of the official plan, the commission recommends the following:

Construction of food receiving stations and inauguration of a system of inspection and certification at the railroad joint yards, which would make possible the creation of terminal markets around stations of the automatic-electric systems in Manhattan and the Bronx.

Reorganization with wider piers and slips and more warehouse facilities on the Manhattan and other congested water-fronts.

Dredging of channels to every part of the water-borne commerce seeking to use them, and removal or modification of bridges obstructing the channels.

Provision of suitable highway access to every part of the Port's waterfront.

Construction of additional terminals for the New York Barge Canal.

Wide installation of judiciously selected freight-handling machinery.

Creation of bunker facilities and fuel reserves for steamships.

Erection of grain elevators for joint use of New Jersey railroads and New York barge canal at a southern terminus of the outer belt line and at Piermont, and early completion of the barge canal elevator authorized at Gowanus Bay.

Provision of better facilities for handling building materials.

Zoning of steamship terminals by trade routes as far as practicable.

Establishment of free ports in the Port District.

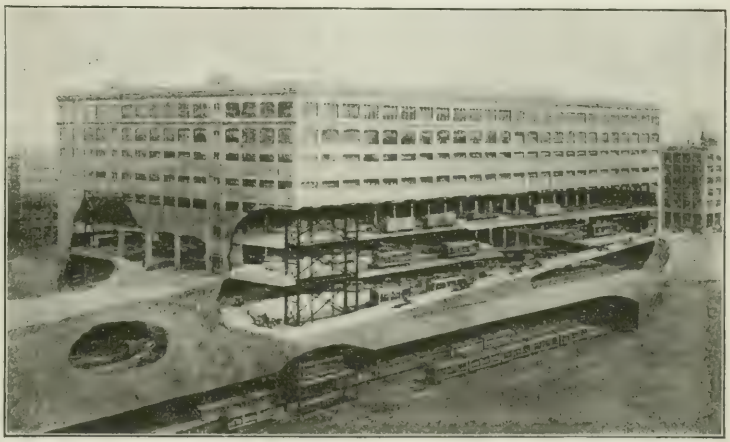
Obtaining of immediate partial relief from present oppressive terminal conditions through:

(a) Consolidation of marine equipment and service; (b) inauguration of voluntary store-door delivery by an organized motor-truck medium.

The "Summary of Joint Report With Comprehensive Plan and Recommendations," which the commission issues at this time (in addition to Chapters 9, 10, 11 and 14 of the joint report), describes the "automatic-electric" system as a joint railroad that taps all of the nine New Jersey railroads and leads to a joint yard on the Hackensack Meadows where incoming freight is transferred at extensive platforms to small trucks and hauled by tractors upon special cars. The cars, operated singly in the yard, would be made up into eight-car trains, dispatched on either of two parallel tracks passing under the Hudson to about 47th St., turning southward below two levels of subways and finally returning to the joint yard by another set of tunnels near the Battery. Twelve terminal distributing points, with manufacturing and warehouse floors above, would be distributed along the route in Manhattan, with approach sidings underground. When a dispatcher at the joint yard throws an electric switch the eight-car train would start automatically; speed up to 13 miles per hour and run to the desired terminal, on the approach siding of which it would automatically come to rest. Return trains would start from forwarding sidings at the terminal, when a switch is thrown, proceed to the joint yard and come to rest. The cars would then proceed singly to the transfer platforms, their trucks bearing outbound freight are removed and they receive new inbound loads and continue in the cycle. Elevators handle individual cars from the "main line level" to the outbound and inbound floors above, where loads are discharged and new loads received.

Surface Belt Lines

The recommended belt-line system includes joint marginal surface belt lines along a large portion of the navigable water fronts of the port, serving steamship terminals or industrial developments. The outer belt line would extend from Piermont above the Palisades to Bayonne, Staten Island and Perth Amboy, passing west of Paterson and the Orange Mountains. Connection between the New York and New Jersey systems is proposed first by car ferry across, and ultimately by tunnel under the Upper Bay. Brooklyn and the East River section of Queens would be served by the Long Island-New York Connection R.R. from Bay Ridge to Hell Gate, and by marginal lines, not necessarily continuous, but reached by float bridges or by spurs from the Bay Ridge-Hell Gate line, from which spurs are to be run to Jamaica Bay and Flushing Bay. Marginal lines would skirt the Harlem and East Rivers in the Bronx from Spuyten Duyvil to Throgs Neck and other lines are virtually to encircle Staten Island. Yonkers and the communities north are to be served by joint car-float stations reached from Piermont. Existing belt lines would be improved to serve the Hudson River and Upper Bay water fronts in New Jersey. New lines along both sides of Newark Bay and the Hackensack River, the west bank of the Arthur Kill and the north bank of the Raritan River are to serve Newark, Jersey City, Bayonne Elizabeth, Perth Amboy and other communities.



SECTIONAL VIEW OF TYPICAL "AUTOMATIC ELECTRIC" TERMINAL

The following figures are presented comparing the standard-equipment railroad with the "automatic-electric" system recommended: Capacity per year, standard equipment, 6,000,000 tons; automatic-electric system, 10,000,000 tons; cost of construction, standard-

equipment, $241,131,000, automatic-electric, $201,190,000; operating cost per ton, standard-equipment, $3.47 (compared with estimated present cost of $2.25 with existing facilities), automatic-electric, $1.82. It is stated that a relatively small expenditure for five additional automatic-electric terminals would bring the capacity of that system to 14,360,000 tons per year. It is estimated that the system will save some $14,000,000 yearly and reduce railroad costs, truck delays and trucking costs, if rentals for terminal storage space be included, besides effecting "many other important benefits not possible to estimate in money values."

Measures for Immediate Relief

Although Chapters 12 and 16, the titles of which are announced as "Special Motor-Truck Service for Handling General Package Freight Between New Jersey and Manhattan" and "Railroad Belt Lines and Consolidated Marine Service," are not issued at this time, the "Summary of Joint Report," now issued, contains the following paragraphs:

While the automatic-electric system, the belt-line system and the joint car-float stations and lighterage stations can all be built and put into operation without interfering with present operations, several years will be required to do this. Meanwhile two steps can be taken at once to bring about partial relief in the face of the growing congestion. One of these is the consolidation of marine equipment, the other is the inauguration of "voluntary store-door delivery."

Consolidation of marine equipment need not await consolidation of terminals at any point. The advantages of a single large fleet of tugs, car floats and lighters in place of a number of independent fleets can be realized immediately.

"Voluntary store-door delivery" offers a still better opportunity for relief. Investigation has shown that probably 30 per cent of the railroad business of Manhattan is in carload lots, and a considerable amount of that of the other sections of the port is in large consignments. The congestion at pier and other freight stations can be materially relieved by bypassing this freight and making pickups and deliveries direct between these large companies and the railroad yards. This will involve what might be termed a "partial or voluntary store-door delivery." A direct motor-truck service would be inaugurated between transfer platforms constructed at the railroad yards and large shippers in Manhattan and elsewhere in the port.

To avoid rehandling of the freight there should be a considerable number of detachable truck bodies with a comparatively small number of chassis, so that goods could be transferred from the car to the truck body at the transfer platform and delivered direct to the consignee. The service should be controlled by some suitable medium between merchant and railroad.

These measures for immediate relief involve no expenditures not utilized in the ultimate plan other than the construction of a few transfer platforms—for the motor-truck chassis, detachable bodies and voluntary store-door delivery should remain as auxiliaries to the automatic-electric stations—and the Commission urges that they be adopted at once.

In commenting upon a demountable-body-motor-truck system for universal freight distribution service, the commission makes the following statement in the summary:

In Cincinnati interchange of railroad freight in trap cars and local rail delivery and collection of freight at suburban stations have been to a considerable extent replaced by motor trucks with detachable bodies, operated on a schedule by a motor-truck company.

It was suggested that the system be applied at the Port of New York. Stations for the transfer of freight between cars and truck bodies, it was stated, could be built at the waterfront terminals of the several railroads, and trucks could operate between these stations and zone terminals at any desired point in Manhattan, or to and from the store doors of establishments large enough to receive and dispatch full truck bodies. It was pointed out also that while the motor truck could at the present time utilize the existing Hudson River ferries, special ferries for this service alone could be installed when the traffic warranted it.

This system has elements to commend it. The Commission is convinced, however, that its logical application at the Port of New York is to secondary rather than primary distribution. The Commission believes that it would be unwise to add this traffic to the existing vehicular traffic on the ferries, even though analysis shows that it might be accommodated; and that it would be unwise to impose this traffic on the streets along the Manhattan waterfront, inasmuch as one of the objectives in the solution of the Manhattan terminal problem is to reduce the truck congestion on the streets. Locating the transfer stations at the waterfront yards of the individual railroads would lessen the opportunity in the future of putting those yards wholly or in part to better uses, a fact which leads to the conclusion that the transfer point for such a system should be on the Hackensack Meadows at a joint yard.

The system shows upon analysis a greater cost per ton for handling freight than the one recommended by the Commission. The Commission cannot therefore recommend it as the best obtainable for the primary distribution of Manhattan freight to and from the New Jersey railroads.

Food Distribution—Pier Widths and Equipment

The Commission believes that the food-distribution problem can be effectively solved by creating food-receiving stations at the joint automatic-electric yards, including dry and cold-storage warehouses, sampling rooms and facilities for reconditioning and grading, and establishing at these stations a system of sampling and certification under public direction. Buyers will then find it necessary to see only the samples at the primary market, and their orders can be filled by direct shipment from the receiving stations, via the automatic-electric system or the belt-line railroads. This the Commission believes will greatly reduce the high cost of living within the port district.

Market structures far better adapted to the business than the old and small buildings of the present market can, and the Commission believes will, be built adjoining automatic-electric terminals; but the change will be by orderly voluntary action of the dealers, and not by forcing them into definitely established quarters.

Reorganization with wider piers and slips and waterfront warehouse facilities as recommended by the commission does not conflict with New York City's newly adopted plan for the lower west side of Manhattan, but extends the principle to frontage not yet covered by the city's plan, and to the opposite New Jersey shore. The Commission does not find the port so deficient in cargo-handling machinery as critics charge, nor does it look upon an abundance of machinery as a cure-all. It is useless, the commission thinks, to speed up one operation if the other operations cannot keep pace, hence tractors and trailers to move the goods on the pier are held to be as important as cranes to transfer them over the ship's side, and neither are of much value if warehouse space is not at hand to relieve the wharf shed of storage duty.

The Commission was created in 1917 by the legislatures of the two states to study the needs of the whole port and to formulate a comprehensive policy. The full report of the two-year investigation, which will be in two volumes and contain several hundred pages, will

be ready in a few weeks, but the Commission has prepared for immediate presentation its advance summary of sixty-five pages, together with four of the supporting chapters bearing on the Manhattan freight problem. The Commission consists of William R. Willcox, chairman; J. Spencer Smith, vice-chairman, and Eugenius H. Outerbridge, DeWitt Van Buskirk, Murray Hulbert and Frank R. Ford. Maj.-Gen. George W. Goethals is consulting engineer, B. F. Cresson, Jr., chief engineer, Julius Henry Cohen, counsel; William Leary, secretary, and C. A. Ruhlmann, assistant secretary.

The Commission urges the creation of a unified port district and a continuing port authority with broad powers and jurisdiction over the entire port district by means of a compact or agreement between the States of New York and New Jersey.

Letters to the Editor

It is the editors' desire to publish here all worthwhile letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Pile Bearing and Soil Pressure

Sir—In reference to the article by Lazarus White in *Engineering News-Record,* Dec. 30, 1920, p. 1268, and the letter from E. G. Haines in the issue of Jan. 13, 1921, p. 89, the writer desires to present some comments.

Considering earth or soil as an elastic solid may be reasonable in *most cases* where its bearing value alone is considered. Where pressure enters as a factor however, this assumption may be misleading except in the case of soils remaining solid under the operation as noted later.

To return to the foundation. The restriction "most cases," above, is made advisedly, because if a pile footing bears in soft clay the clay will flow wherever it ceases to be confined. The only danger to be apprehended is from excavating too close to the toe of a pile bearing in soft clay, in which case the clay will flow and the pile sink until it re-establishes its bulb of pressure in the confined clay further down. Experience in a large number of cases, many of which cover piles bearing in so-called quicksand, shows that excavation can be made within two feet of the footing without serious settlement, but that five or six feet should be established as the safe limit in soft ground.

Where piles are tested to 50 or 60 tons—assuming that as being at least 50 per cent above the bearing load—the bulb of pressure is not destroyed by the release of pressure, as assumed by Mr. White, nor is the soil, within the small area stressed, sufficiently elastic to show any appreciable rebound. There is, however, a measurable and in long piles a very appreciable rebound due to the elasticity of the pile body itself. Wherever possible this rebound should be prevented, as suggested, by wedging or by other means. There are many instances, however, where it is not practicable to hold the pile when tested—because of the absence of the permanent load or because of interference between the bottom of the load and the pile head where special construction prevents the maintenance of a strut in place. The inference should not be drawn however that the non-maintainance of a percentage of the test load will cause the pile to settle. This is not the case, as the excess test is the real prevention of settlement under the bearing load.

The possible danger of considering earth or soil as a solid in relation to the possible pressure exerted by it on trenches or tunnels is that too much reliance may be placed on cohesion, and weak bracing or even inadequate structures may result, as is sometimes the case in disintegrated rock or clay.

As a matter of fact all soil, whether solid rock, massive clay, or granular particles cohering (as in normally dry sand) does break or tend to break and exert pressure on confining structures wherever the operations are relatively large enough. That is, solid rock when cut by a trench sufficiently deep or a tunnel sufficiently wide will break to certain lines and the resulting pressure must be designed for as if the mass were noncohesive and granular. Nor does it matter whether these breaks occur in rock, clay, or sand; they are constant and similar under similar conditions, each obeying its own fixed law. Nor does it matter whether or not these lines or planes as they occur or tend to occur are called breaking lines or pressure lines or lines of rupture or lines of repose; they are well defined and capable of being measured under proper conditions. Within these lines or planes certain areas will cause pressure on a vertical face and other areas will cause pressure on a horizontal face.

While the writer measures these pressures in entirely different terms from those of the old masters, he still adheres to the good old terms: plane or angle of repose, dividing the breaking (or tending to break) from the unbroken; and plane or angle of rupture, dividing the areas causing horizontal and vertical pressures. The determination of the relations of these planes on a scale sufficiently large to be conclusive appears to the writer to be the big unsolved problem.

The writer wishes to emphasize again the fallacy of observations made on shallow trenches or small tunnels, frequently giving exaggerated ideas of the value of cohesion and suggesting that formulated results based on slope or pressure lines are erroneous. The writer has himself endeavored to formulate the pressures resulting from these breaks or tendencies to break, and has published elsewhere the results, which are too long to publish here.

To conclude then, it seems perfectly clear to the writer that normally dry earth or soil, including rock, should be treated as what it actually is or may become under operations on a small or large scale, that is, as either a monolithic or a granular mass. With this clearly before us, and the realization that pressure, whether from its own or from an extraneous body or bodies, is transmitted laterally by or through soil, we find that the reconciliation of fact and theory may be accomplished. And thus we come to a better understanding of many facts, such as that in normally dry ground (a) pressure is not accumulative vertically downward, (b) there is no tendency for the bottom of a tunnel to bulge up or for the earth at the bottom of a trench to exert any but nominal pressure, (c) the arching properties of granular materials are absolute as long as the material below the arch is prevented from disintegrating, (d) the base of a pile or foundation establishes and maintains under pressure a so-called bulb (or equivalent) of pressure, and (e) the reverse explains the picking up in driving of a shallow sand plug by a hollow pile, which may sometimes stop its progress until cleared out. Finally, the action of pressure in grain bins is more easily comprehended.

J. C. Meem,
Brooklyn, Jan. 18. Engineer for F. L. Cranford, Inc.

The Hydraulic Jump and Critical Depth

Sir—I read with much interest the novel and comprehensive article by Julian Hinds on the "Hydraulic Jump and Critical Depth" in your issue of Nov. 25, 1920, p. 1034. This original exposition explains a development of hydraulic theory which seems to have only recently been applied in practice, but which apparently is destined to have a wide field of usefulness when it is once well comprehended by hydraulic engineers. I am glad to know that the *Engineering News-Record* can still publish such articles

A consideration of critical depth and critical velocity seems to be applicable only to open channels and to flow at relatively high velocities. Perhaps this is why the subject has not been exploited before; because in natural channels

or in artificial channels in earth ordinarily all velocities are much below the critical velocity.

It is not apparent why in this study it is necessary to consider the so-called alternative stages. The critical depth and critical velocity seem to be most easily defined as the depth and velocity existing when the velocity head equals half the average depth in the cross-section. For a given quantity of water flowing, and a given channel cross-section of any of the ordinary shapes, the critical depth and velocity may be easily determined by trial by successive approximations.

Although the alternative stages are connected by a certain mathematical relation, this does not seem to correspond to any useful hydraulic relationship. A channel, uniform in cross-section and slope, carrying a given flow for any distance at one stage could not carry the same flow at the so-called alternative stage. If the channel is not uniform in cross-section and slope then, while it is conceivable that the flow could pass by means of the proper transitional channel from one to the other stage, it would during the transition have to pass through all the intervening stages, and it is not evident that the final stage would have any more practical connection with the original stage than would any of the intermediate stages.

Perhaps I do not fully comprehend the matter. But it appears to me that the essence of the problem is to determine for any given case of flow whether the velocity is greater or less than the critical velocity, and how much it differs from the critical velocity. These having been determined any desired modification of the flow can be considered. The so-called alternative stage seems only a matter of accidental mathematical relation.

It appears that there is an ample field here for further investigation. Additional practical applications of the principles relating to critical flow, the extention of the subject to covered channels, the consideration of channels having more than one critical depth, all offer inviting fields of study which it is hoped engineers will find time nad opportunity to develop more fully. S. M. WOODWARD,

Department of Mechanics and Hydraulics,
Iowa City, Jan. 6. State University of Iowa.

Post Offices Principal Work of Supervising Architect

Sir—In *Engineering News-Record*, Dec. 20, 1920, p. 1273, appeared an article on the proposed National Department of Public Works by Lieut. Col. C. O. Sherrill.

Col. Sherrill's principal argument against the bill is that the heads of departments should have entire charge of carrying out the functions of their respective branches of the government in whatever field they may extend; that they should employ their own engineers and technical men, if such are necessary, the technical work so performed being only incidental to the functioning of the department as a whole; that this is the present arrangement of governmental activities and should continue. Whereas, if the proposed bill became a law, the various department heads would have to apply to the Secretary of Public Works for services of this nature, thus subordinating a portion of their own department to his.

In the article in question, the following paragraph appears:

"The example most frequently given by the Department of Public Works advocates of the inconsistency of the present arrangement of governmental activities, is that of the Supervising Architect's Office in the Treasury Department. The real reason why this is under the Treasury, rather than any other department, is that this department is the largest governmental user of public buildings in our cities, for custom houses, sub-treasuries, Internal Revenue Offices, Federal Reserve Banks, etc. What is more appropriate than that the Secretary of the Treasury should direct the construction of the buildings he needs in his business?"

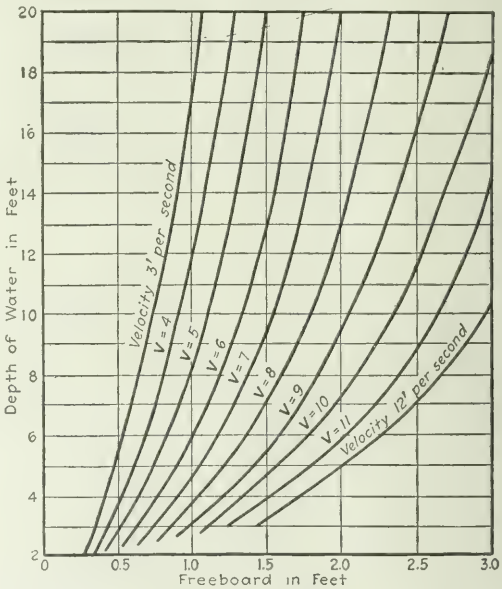
Somehow Col. Sherrill neglected to mention that over 95 per cent of the work of the Supervising Architect's Office is the construction of post offices throughout the country, not for the Treasury Department, but for the Post Office Department.

Therefore, under the existing conditions, which the opponents of the Public Works Bill argue should be maintained, when the Postmaster General wishes buildings constructed for the use of his own department, he does not engage his own engineers and architects, but, in the absence of a Department of Public Works, he does subordinate a portion of his own department, and a fairly important portion too, to the Secretary of the Treasury. J. A. CLIFF,

Structural Engineer, Office of the Supervising Architect.
Washington, D. C., Jan. 7.

Freeboard Allowance for Canal Linings

Sir—The attached chart, showing in terms of depth of water and velocity, the "freeboard," or height above normal water surface to which concrete irrigation canal lining should be carried, is based mainly on existing practice. There appears to be no standard practice with respect to this detail, existing canals under practically identical conditions bearing widely different allowances for freeboard. It is realized that factors other than the two mentioned



may influence a decision on the proper amount of freeboard to allow, but in nearly all cases the principal factors are depth of water and velocity, and it seems that it may be possible to work up a satisfactory empirical formula along the lines indicated by the chart.

The publication of this chart may bring comments from engineers with experience in this line of work which will be a valuable addition to the published data on the subject. The subject merits consideration, since the allowance for freeboard makes quite an appreciable percentage of the total cost of a canal.

Seattle, Dec. 19, 1920. CHARLES P. DUNN.

Railroad Rate Increases in England

As noted recently in *The Engineer*, London, railroad rates in England have advanced approximately 100 per cent above the 1913 level. Last July a further increase of 16⅔ per cent—making a total of 75 per cent over the pre-war rates—was made in passenger fares in addition to advances in the price of season and traders' tickets. More recently the Rates Advisory Committee report has been published, containing recommendations as to the raising of £53,500,000 additional necessary to operate the roads without loss.

NEWS OF THE WEEK

New York, January 27, 1921

Am. Soc. C. E. Directors Submit Annual Report

Total Membership on Jan. 1, 1921, Was 9,907—Curtailment of "Proceedings" Reduces Publication Costs

On account of limitations of space it was necessary to omit from last week's report of the annual meeting of the American Society of Civil Engineers a summary of the reports of the Board of Direction, the acting secretary and the treasurer. A digest of these reports is presented herewith:

The annual report of the Board of Direction for 1920 showed a total membership on Jan. 1, 1921, of 9,907, a net increase of 499 during the year. The total number of applications received in 1920 was 1,285 of which 960 were for admission and 325 for transfer.

The Engineering Societies Library received during 1920 a total of 2,337 volumes, 1,304 pamphlets and 244 maps and plans, making a total of 153,320 now in the permanent collection. Expenditures for the work of the library totaled $26,000. The total attendance for the year was 23,788, an average of 78 daily.

The Engineering Societies' Service Bureau was conducted jointly by the secretaries of the four founder societies. Its work has been administered at a total cost to the four societies of $12,431. The total number of men registered during the year was 2,171 and the number placed, including those not registered, was 1,579.

There exist four special committees as follows: Bearing value of soils for foundations; stresses in railroad track; highway engineering, and bridge design and construction. The board authorized a special committee on research, a committee on amendments to the constitution, and a committee on external relations of the society, its report to be reviewed by a committee of past-presidents.

Beginning with the August number of *Proceedings* changes were made in the type face and size of page and papers were published by abstract only in order to reduce expenses. This plan has saved the society $6,500 during the half year. The net expenditure for publications in 1920 was $45,309, this figure covering mechanical costs only.

For the year ending July, 1919, prizes were awarded as follows:

Norman Medal to William Barclay Parsons for paper, "The Cape Cod Canal"; J. James R. Croes Medal to D. B. Steinman for paper, "Stress Measurements on the Hell Gate Arch Bridge"; Thomas Fitch Roland Prize to

(Continued on p. 188)

Pier Failure Wrecks Two Spans of Concrete Arch Bridge

Two spans of the Third Street bridge across the Miami River at Dayton, O., failed shortly before 6 p.m. on Jan. 21, due to sudden subsidence of a section of the pier between. No lives were lost, although many persons were on the bridge at the time and three were thrown into the river, together with two automobiles. A street car had passed over just before the failure, and another was stopped just short of the collapsed part of the roadway.

The arches involved in the failure are the second and third from the east or Dayton bank. They span 90 ft. and 100 ft. respectively, and spring at a level of 14 ft. above original river bottom; the pier was founded on a compact gravel 9 ft. below original river bottom. At springing line the pier is about 10 ft. thick. Its footing is about 21 ft. by 80 ft.

Examination shortly after the collapse showed that the pier sheared off clean near the line of the outer rail of the near or westbound track. The end or north portion of the pier went down about 3 ft. No evidence of damage to the bridge outside of the two arches resting on the pier is reported.

An investigation of the failure has been initiated by the engineers of the Miami Conservancy District and the engineering department of the city of Dayton.

The bridge was built in 1904 and 1905, to designs of the Concrete-Steel Engineering Co., by the Hogland & Kline Construction Co. It is of the Melan type, and comprises seven spans 80 to 110 ft. long in the clear, with rise of 14 ft. 3 in. to 9 ft. 8 in. The clear width of bridge is 62 ft. A description was published in *The Engineering Record*, Mar. 24, 1906, p. 386.

Interstate Drainage Controversy in Supreme Court

A final hearing in the Dakota-Minnesota drainage case has been held before the U. S. Supreme Court, and the matter now awaits the court's decision. The essential part of the suit is an engineering question as to whether extensive construction of large ditches through level country not previously drained has increased the flood damage below; and if so, what are the rights of the riparian owners along the overburdened stream. This case comes before the Federal courts because the construction work was in Minnesota and the damage claims are in South Dakota and North Dakota, which states combined in a suit against Minnesota.

Iowa Engineers Organized for United Effort

Annual Convention Brings Out Record Attendance of 400—Three Sections Meet Separately

More than 400 engineers and their friends attended the meeting of the Iowa Engineering Society, Jan. 18, 19 and 20 at Des Moines, and more than 40 exhibitors were in evidence. It was the largest attended meeting of the kind Iowa has ever seen. The new constitution sectionalizing the work, districting the state and including local clubs, together with the licensing program put through by the society is accountable for the unity and solidarity of the profession in Iowa. Simultaneous sessions of the three sections, municipal, drainage and highway, filled the respective rooms to overflowing, although they would have been ample in size in previous years for the whole society.

Of actions taken the most important was the unanimous vote without discussion to become a charter member of the Federated American Engineering Societies. The State Legislature was memorialized to provide for a sanitary and water survey and to take care of the poorly equipped geological survey. Standard forms for engineering contracts, paving, sewers and waterworks were submitted by a committee of that name headed by M. G. Hall.

The most notable investigation undertaken during 1920 was that of the committee on compensation of which L. A. Canfield is chairman. The remuneration of men in other professions, doctors, lawyers and dentists, was compared with the income of engineers. Of the 1,500 inquiries sent out, 35 per cent were answered. The average curve of the engineers showed a steady increase, passing that of the dentists after twenty-two years of practice, the lawyers after twenty-five years and the doctors after twenty-seven years. Previous to these dates the engineers received a materially smaller income. A minimum schedule was suggested, based on the period of service for the various classes of engineering positions.

C. H. Young's report of the committee on legislation illustrated the functioning of the new type of organization. All legislative effort pertaining to engineering in the state is directed through the committee. A code revision of all laws of the state is under way and the committee acted as a clearing house for laws pertaining to engineers, passing these down to the various sections, clubs, districts or branches of national societies interested. When

commented upon, the laws, with suggestions as approved, were returned to the committee which acted in conjunction with a committee from the Des Moines Engineers' Club in presenting the information to the code revision committee. Assistance was rendered to the Department of Public Works movement; also for the Nolan bill increasing appropriations for U. S. Patent Office employees.

A new committee on publications was authorized to pass on papers and to ascertain if the number of exchanges with other organizations might not be cut down.

Of twelve organizations in the state, nine have decided to become district clubs of the society. They are as follows: Clubs of Ames, Davenport, Des Moines, Iowa City, Sioux City, Spencer and Webster City, Waterloo Technical Society and the Southwest Iowa Engineers' Club of Atlantic. Clubs at Cedar Rapids, Boone and Mason City still have the matter under consideration. These locals brought in 140 new members, raising the total membership to 515. The society raised $2,230 in 1920 and closed the year with $206 on hand, less by $350 than one year ago.

Although the convention was three days long, only two general sessions were held, one for the business of the society and one in which business problems of the profession were discussed. The drainage section held three technical sessions with six papers and eight topical discussions, the highway section heard two papers and the municipal section four. A new section for electrical and mechanical engineers was authorized following a petition from eighteen members.

The officers elected for the ensuing year are as follows: President, J. H. Dunlap; vice-president, Alvin Le Van; new director, J. D. Wardle. Of the municipal section, F. P. Wilson is chairman, P. K. DeVoe, vice-chairman and F. H. Austin, secretary; of the drainage section, C. E. Gross is chairman, J. L. Parsons, vice-chairman and R. G. Austin, secretary; of the highway section, H. W. Thompson is chairman, L. M. Martin is vice-chairman and C. W. Eby, secretary. The successor of Mr. Dunlap, who has served the society as secretary since 1914, will be chosen by the board of directors.

Am. Soc. C. E. Convention in Houston

The next annual convention of the American Society of Civil Engineers will be held in Houston, Texas, April 27. The decision was reached by the new Board of Direction at its meeting Jan. 19. It was indicated at the annual meeting in New York City last week that one of the most important matters to be considered at the Houston convention will be a new constitution for the Society on which a committee headed by Col. Peter Junkersfeld has been at work for some time past.

Transportation Problems Engage Federal Highway Council

The warning by S. M. Williams, chairman of the Federal Highway Council, against establishing highway transportation beyond highway development, is finding lodgment in traffic circles. Prominent traffic men co-operating with the council are now taking hold of the transportation problem with a determination to insure the construction of roads around industrial and commercial centers that will prevent a return to congested conditions.

They do not propose, according to C. W. Reid, manager of the transportation bureau of the council, to be caught unprepared when the traffic tide begins to rise again. "For this reason," said Mr. Reid, "many traffic managers throughout the country are going to give a closer study and more determined application to the motor truck terminal zones as a co-operating branch of the railway and express service." Now that the railway express merger has been approved by the Interstate Commerce Commission, it is the belief that the next great step forward will be to throw short haul tonnage to the motor truck as fast as the change can be brought about along practical lines.

Economic Service

The Federal Highway Council, according to Mr. Williams, is working upon the belief that the future development of any type of transportation will largely depend upon the economic service which that type may render the communities served.

"Admitting that the short haul freight is not a function of the railroads," Mr. Williams said, "and recognizing the necessity of relief to the railroads so that their equipment may be employed in the longer and more profitable haul, I do not feel that the public utilities commissions of the various states will be willing to relieve the railroads of that responsibility until the public is assured of a substitute that will give at least as satisfactory and dependable service. With the exception of a few instances the highways of our country are not in a position to assume the burden of the short haul now handled by the railroads, and therefore is it not time to begin the promotion of this subject from the bottom, rather than from the top?

Specific Traffic Needs

"I feel," Mr. Williams concluded, "that as a part of the important work of the council's transportation committee it will be necessary for its members first to analyze what intelligently constitutes the short haul. Second, they should ascertain, by intensive study, highway conditions in the various communities, with a view to encouraging the development of highways necessary to meet this specific traffic need. The entire work of the Federal Highway Council is based upon a policy that should support the transportation work.

Dinner for Leaders of Western Industry

To commemorate the thirty-fifth anniversary of the *Journal of Electricity*, the McGraw-Hill Co. of California has invited representative leaders in the development of western resources and their utilization in productive industry to be its guests at a dinner to be held Feb. 1 at the Palace Hotel, San Francisco.

Oregon Irrigation Congress

At the 10th annual session of the Oregon Irrigation Congress held in Portland Jan. 7 and 8, resolutions asking the state legislature to appropriate $10,000 for the sinking of an artesian well in the Fort Rock section of northern Lake County were passed. It is thought that a flow of water can be obtained at a depth of from 500 to 900 ft. to irrigate what would otherwise remain arid land.

A committee was appointed to confer with a like committee of the Oregon State Drainage Association looking toward the consolidation of the two bodies into one under the name of the Oregon Reclamation Association.

Fred N. Wallace of Tumalo, and J. Frank Spinning of Echo, were reelected as president and secretary, respectively. Four vice-presidents for the four districts were chosen as follows: Harry W. Gard of Madras, Fred A. Phillips of Baker, C. C. Clary of Arlington and James Chinnock of Grants Pass.

National Civic Federation to Discuss Labor Issues

International, European and American labor problems will furnish the main topics for discussion at the annual meeting of the National Civic Federation, Feb. 14, 15, 16 at the Hotel Astor, New York City.

Am. Soc. C. E. Directors' Report

(*Continued from p. 187*)

O. H. Ammann for paper, "The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City"; James Laurie Prize to F. W. Gardiner and S. Johannesson for paper, "Manhattan Elevated Railway Improvements"; Collingwood Prize for Juniors to Floyd A. Nagler for paper, "Obstruction of Bridge Piers to the Flow of Water."

There are at present 27 local sections and 8 student chapters.

Finances

The general balance sheet, as of Dec. 31, 1920, shows total assets of $1,241,081.22, total liabilities of $287,130.44, leaving in the reserve fund and surplus $953,950.78.

Receipts during the year, including balance of $27,920.65 on hand Jan. 1, 1920, amounted to $230,263.93; disbursements were $216,530.63, leaving a balance on hand Dec. 31, 1920, of $41,653.95.

New York Section, Am. Soc. C. E. February Meeting

In order to avoid a conflict with the annual meetings of the electrical and mining engineers the February meeting of the New York Section of the American Society of Civil Engineers will be held Feb. 9 instead of Feb. 16. Through an error, it was stated last week that the meeting date had been postponed from Feb. 16 to Feb. 23.

The subject of the meeting is "Light, Heat and Power," and the discussion will apply to the needs of the New York metropolitan district. The local sections of the mechanical, electrical and mining societies have accepted an invitation to attend the meeting and send delegates. The principal paper will be by Colonel William Barclay Parsons. It will be discussed by J. W. Lieb, vice-president, New York Edison Co., New York City; Frank Smith, vice-president, United Electric Light & Power Co., New York City; Farley Osgood, vice-president, Public Service Electric Co., Newark, N. J.; George Otis Smith, U. S. Geological Survey, Washington, D. C.; H. E. Skougor, consulting engineer, New York City; George Gibbs, consulting engineer, Gibbs & Hill, New York City; William Cullen Morris, engineer of construction, Consolidated Gas Co., New York City, and F. O. Blackwell, consulting engineer, Viele, Blackwell & Buck, New York City.

New Committees of Am. Soc. C. E. Are Named

The new Board of Direction of the American Society of Civil Engineers, at its first meeting Jan. 19, following the annual meeting of the society in New York, made the following committee appointments:

Publication Committee—A. M. Hunt, chairman; R. L. Humphrey, C. E. Grunsky, C. W. Hudson, C. C. Elwell.

Finance Committee — Clemens Herschel, chairman; John W. Alvord, Ira W. McConnell, Willard Beahan, J. S. Langthorn.

Library Committee — Francis Lee Stuart, chairman; R. A. Cummings, George G. Anderson, Carleton Greene.

Committee on Special Committees—A. P. Davis, chairman; Anson Marston, George H. Pegram.

Goethals Consulted on Ohio State Highway Work

The new governor of Ohio, Harry L. Davis, has been in consultation with Major-General George W. Goethals regarding a reorganization of the state highway department. During his campaign for office Governor Davis made the efficient administration of the state highway work one of his main issues.

Town Engineer Wanted

Applications for the position of town engineer are wanted by the Town Council, North Bay, Ontario, Canada.

Conditions Governing Wellington Transportation Prize

As announced in last week's issue the Board of Direction of the American Society of Civil Engineers has accepted *Engineering News-Record's* offer to establish an "Arthur M. Wellington Prize" to be awarded annually for a paper on any phase of the subject of "Transportation." The following letter addressed to the board under date of Dec. 15 explains the offer:

"For some time the staff of *Engineering News-Record* has contemplated the establishment of a memorial in honor of Arthur M. Wellington, former editor of *Engineering News* and author of the well-known book on railway location, entitled 'The Economic Theory of Railway Location.'

"After considering various proposals we have concluded that no memorial could be more fitting than the establishment, under the auspices of the American Society of Civil Engineers, of an 'Arthur M. Wellington Prize,' to be awarded annually for the best paper presented before the society on any phase of the science and art of transportation, whether by land, water or air.

"Accordingly, if it please the Board of Direction of the society, *Engineering News-Record* will be glad to establish a fund of $2,000, the annual income from which would constitute the material element of the prize referred to in the preceding paragraph.

"*Engineering News-Record* would make only two reservations regarding the award of the prize:

"1. That it be awarded only for papers on a transportation subject. Such a reservation, we believe, befits a memorial to a great transportation authority.

"2. That it be not restricted to members of the society. This reservation is made because the great advances in transportation in the future may be on water or in the air, specialties in which the members of the society do not normally engage.

"The usual discretion, of course, would be allowed the society's Committee on Prizes to withhold the awarding of the prizes in any year should they deem no paper offered worthy of the award. In that case the income should be added to the principal sum.

"Should the proposal herein contained meet with the approval of the Board of Direction check in the amount designated will be promptly forwarded."

Construction Division Men to Hold Reunion

The annual reunion of those who were identified with the Construction Division of the army during the war will be held at the Morrison Hotel, Chicago, Feb. 25 and 26. The afternoon of the first day and the morning and afternoon of the second day will be devoted to business sessions and the annual banquet will be held on the evening of Feb. 26.

Engineering Societies Hold Hydro-Electric Symposium at Philadelphia

Under the auspices of the Engineers' Club of Philadelphia the Philadelphia sections of the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Society of Mechanical Engineers there was held in Philadelphia on Jan. 21 a symposium on hydro-electric development and distribution. There were two sessions, one in the afternoon and one in the evening with a dinner in between. In the afternoon some of the recent developments in the hydraulic machinery field were discussed by Frank H. Rogers, hydraulic engineer, I. P. Morris Co., Philadelphia; Norman R. Gibson, hydraulic engineer, Niagara Falls Power Co.; R. D. Johnson, consulting engineer, New York City, and L. F. Moody, consulting engineer, I. P. Morris Co., Philadelphia. In the evening John L. Harper, chief engineer, Niagara Falls Power Co., showed a number of moving pictures of Niagara Falls and the construction of the recent extension to plant No. 3 of his company, at the same time defending a further diversion of water at Niagara for power purposes. D. B. Rushmore, of the General Electric Co., completed the evening with a discussion of the electrical features of hydro-electric power.

The symposium was one of a number which are intended to be held in Philadelphia under the joint auspices of the various engineering societies there, most of them to be devoted particularly to engineering features of interest to Philadelphians in order to bring before the people of the city the engineering problems of the city and at the same time to lead to a better understanding among the branches of the profession of the problems of the other branches. While the present meeting was devoted entirely to hydro-electric practice the predominance of local talent, particularly of local manufacturers, in the program, emphasized Philadelphia's relation to the industry rather than the industry itself.

Mr. Rogers' paper, entitled "The Modern Hydraulic Turbine," is a review of the present status of turbine design. It states that the important requirements today are (1) high power units, (2) high speed, (3) high efficiency, (4) reliability and (5) durability. He pointed out particularly the necessity for reliability and long life, because of the high first cost of the installation. A turbine might run successfully and efficiently for two years, say, and at that time have such a breakdown as to shut down the plant for a long time and thereby cause not only the cost of replacement but the loss of delivery of current. The paper refers, too, to the detailed design of intakes, canals, forebays, penstocks, valves, etc., and describes the testing plant for wheels at the plant of the I. P. Morris Co. in Philadelphia. The

paper notes, too, the importance of specific speeds. For low head high specific speeds has to be used, which results in high velocity of the runner discharge, thus making the draft-tube design of greatest importance. For high head low specific speeds are used, which would result in a relatively larger runner diameter, but gives greater trouble with water leakage at the runner seals and friction of the runners.

Mr. Gibson's paper was a description of his new method of water measurement and its application in the tests of the large turbines of the Niagara Falls Power Co. His method depends upon a record of the change of the pressure occurring in a pipe under head, this change being necessarily a measure of the change in velocity, so that in a given section the pressure changes indicate the volume discharge change.

Tests were carried out at the hydraulic laboratory of Cornell University which demonstrated the accuracy of the method to within very close figures and it was then adopted to test the flow in the Niagara Falls turbines and has been accepted by the government as the measure of the use of the water of the Niagara River. Mr. Johnson devoted practically all of his time to a description of his well-known surge tanks. Mr. Moody pointed out a number of the newer advances in hydraulic turbine design. These include the construction of the flow in the turbine as a continuous vortex which has led to the adoption of various draft-tube arrangements whereby the tube is kept in an axial relation to the turbine and the velocity of the discharge water reduced in circumferential lines. The leading types of such devices are Mr. Moody's type and one called the hydraucone, developed by Mr. White, of the Allis-Chalmers Co. The same whirling condition in the water in passing through the turbines has been utilized, too, in Mr. Moody's studies in the development of a propeller type of turbine, small models of which have been tested for some time in the I. P. Morris laboratory. A more radical innovation was proposed by Mr. Moody for low-head plants where high specific speed is required and where the consequent long draft tube is sometimes difficult to place. For such a condition he suggests the reversal of the turbine that is turning it upside down, making an upward flow wheel, in which case the draft tube could go below low water with a rising draft tube which would be dammed from the clear water by a siphon-like bell designed for such a layout. It is not stated that any such construction is contemplated.

The meeting was very well attended, there being some 700 to 800 men present at the two sessions and nearly that number at the dinner. It was presided over by Guilliaem Aertsen, president of the Engineers' Club of Philadelphia.

New Design for Belle Isle Bridge To Be Prepared

(From Engineering News-Record's Correspondent)

A resolution has been adopted by the Detroit City Council, providing for the preparation of plans for a reinforced-concrete arch bridge in lieu of the steel cantilever bridge faced with concrete for which detailed plans have been prepared and the construction of which has twice been advertised for bids. Plans for the reinforced-concrete bridge are to be prepared by D. B. Luten, of Indianapolis.

In introducing the resolution Councilman Bradley pointed out that bids on the original design accepted by the city show conclusively that the cost of such a bridge will greatly exceed the sum of $3,000,000 made available by vote of the people on April 7, 1919. It has been suggested that the question of providing additional funds through a bond issue be submitted to the people at a future election, but this would involve further delay, and it is considered desirable, in view of the large amount of unemployment existing in the city that all necessary public work should be put under way as soon as possible.

A reinforced-concrete arch bridge of the same general design, appearance and capacity as the official plans provide has been proposed to be built within the amount remaining in the Belle Isle bridge fund. It is stated that the construction of such a bridge involves the immediate and ultimate employment of practically 50 per cent more labor than a steel bridge. The construction of such a bridge can be begun immediately, using materials which can all be obtained locally and it appears that the construction of a reinforced concrete arch bridge can be effected in approximately one year less time than required for a steel bridge.

The plans and an estimate of the cost of a bridge to be built according to these plans to be prepared by Daniel B. Luten are to be prepared and submitted without cost to the city and are to be submitted to the Common Council before they are referred to Esselstyn, Murphy & Hanford, the engineers now in charge of the design and construction of the Belle Isle bridge.

Calder Urges Establishment of Trade Schools

Senator William M. Calder, chairman, Senate Reconstruction Committee, has recently sent letters to the Governors of all the states, urging the establishment of Trade Schools in order to provide sufficient skilled workmen in the Building Trades to take care of future building. The survey recently made on housing conditions by the committee of which Senator Calder is chairman, has engendered a belief that something must be done quickly to interest young men in the building trade.

Public Works Construction Asked as Relief for Unemployed

In his report upon the unemployment situation in Canada, the executive of the Dominion Trades and Labor Council, urges all labor unions throughout the country to assist in a revival of construction. To avoid unemployment which promises to be serious unless something is done, the report urges upon labor organizations that they impress upon all employers the necessity of retaining as many workers as possible, if need be through reduction in hours, though make public the actions of employers who use the period of depression to lengthen the hours of work and decrease the wages accordingly. Other suggested means to defeat unemployment are active resumption of public works construction, increased road construction, clearing of brush land, construction of public buildings, etc.

St. Louis Building Trades Plan Price Inquiry

An inquiry into the high cost of building materials and the business practices of material dealers and manufacturers with a view to requesting a grand jury investigation, has been undertaken by the building trades council of St. Louis, through its board of business agents. The council is composed of fifty-two labor unions.

The business agents will report the undertaking to their local unions and enlist the services of all workmen in the building trades to help gather evidence, according to Maurice J. Cassidy, secretary of the council. The business agents will report the progress of the investigation from time to time at the regular meetings of the board. It is said the investigation was projected in the belief that material dealers and manufacturers are holding up a building program for St. Louis by restricting competition through trade associations.

Sixty of Alleged Plumbing Ring Indicted

A blanket indictment was handed down January 20, accusing approximately sixty master plumbers, who operate as individuals or firms, of conspiracy under the Donnely Anti-Trust Law. The charges were made on the basis of evidence revealed during the recent investigation of the building industry in New York City, by the Lockwood Joint Legislative Housing Committee. The names of the defendants were withheld.

Builder Opposes Wage Cut

At the recent annual convention of the Ohio State Association of Builders Exchanges, F. G. Webber, New York City, Secretary of the National Building Trades Employers Association, issued a plea that the employers not reduce wages at this time, and also intimated that best results could be secured from laborers through an attempt to get them to do a bigger days work.

Wage Adjustments Affect Many Industries

Revisions Relate to Rates of Pay and Hours of Work—Five-Day Week in Minneapolis

A wage reduction of 25 per cent, effective Jan. 17, was made recently by the Master Builders Trade Alliance of Danbury, Conn. The reduction affects steam fitters, painters and electricians. Carpenters and bricklayers will not be affected because of existing wage agreements.

Announcement was made recently by officials of the Minneapolis, St. Paul and Sault Ste. Marie R.R. that shop employees in Minneapolis have been placed on a five-day week. Approximately 1,400 men are affected. Since Sept. 1, 1920, 1,250 employees have been laid off by that company.

Officials of the Toledo & Ohio Central R.R. announced, Jan. 8, a reduction of approximately 35 per cent in locomotive repair forces and 45 per cent in car repair forces on the entire system.

The New York Air Brake Co., one of the largest industrial employers in Watertown, N. Y., has cut the wages of its employees 10 per cent. The new wage scale is effective from Jan. 10.

Approximately 4,000 employees of the Public Service Railway Co., of Newark, after being apprised of the financial condition of the company, accepted, Jan. 13, an agreement whereby the basic working day is increased from nine to ten hours. It is estimated that the company will save $200,000 annually by the new agreement.

The Kalamazoo Brick and Stone Masons Union has voluntarily lowered the wage scale of its members from $1.35 an hour to $1.25 an hour. Reasons for this voluntary reduction given are the decline in living costs and a hope that stimulation may be given building, resulting in decreased unemployment.

After being idle for a month, the Savage Arms plant in Utica, N. Y., resumed operations Jan. 10. No reduction is made in wages but the basis of pay is now nine hours instead of eight.

The New Jersey Zinc Co., Palmerton, Pa., made a 10 per cent cut in wages and eliminated an 8 per cent bonus system Jan. 15. The plant, however, will operate at full capacity, say recent press reports.

According to an announcement made Jan. 22 the Erie R.R. is making a further reduction in payrolls by working office, yards, stations and other forces five days a week, except where the safety of property is involved. The reduction is to be put into effect at once.

Chicago Builders and Labor Leaders Indicted

Violation of the Sherman Anti-Trust Law is charged in the indictment of forty-seven labor union chiefs, mill owners and carpenter contractors, which was returned January 21, by the Federal Grand Jury in Chicago. In a special report the Jury characterized building conditions in Chicago as deplorable, recommending a thorough investigation of the entire building trades industry. An agreement entered into by the mill men, carpenter contractor association and members of the building trades in 1918, providing that only union-made materials could be used on jobs done by union labor, was the basis for the Grand Jury action.

Sand and Gravel Men Fined

Fines totaling $40,000 were imposed upon four sand and gravel corporations and eleven individual sand and gravel dealers by Judge Learned Hand, of the United States District Court, after they had pleaded guilty to a violation of the Sherman Anti-Trust Law. The indictments against the sand and gravel producers were found on Dec. 29, upon evidence submitted by special federal prosecutors. Judge Hand signed a decree dissolving the sand and gravel dealers' Board of Trades, the organization through which prices were alleged to have been fixed and maintained. The names of the four defendant corporations were given in *Engineering News-Record*, Jan. 6, 1921, p. 46.

Fifteen Thousand Out in Boston Building Trade Strike

Failure to agree on a basic wage scale has caused a strike of approximately 15,000 men in the building trades in Boston. All construction work which is being done by members of the Building Trades Eemployers' Association was stopped Jan. 20 as a result of this strike. Union officials maintain that an offer was made by them to sign a wage agreement at the old basic rate of $1 an hour for journeymen, whereas the secretary of the employers' association asserts that such an offer was made to the unions who refused it, the employers thereupon announcing a wage reduction, becoming effective Jan. 20, to a basic scale of 90c. per hour for journeymen.

Chicago Building Tradesmen Vote Continuance of $1.25 Scale

The Chicago Building Trades Council, in a recently issued statement, set forth reasons why the thirty-two unions affiliated with the Council voted not to accept any reductions in their present wage scales within the next three years. The union business agents recently met and voted to insist on a continuation of the present $1.25 an hour wage for union building workers. The reasons given are that union labor has already suffered, inasmuch as wages have not kept pace with the rise in prices of food stuffs, clothing, etc.; and that the ranks of the building trades have been decreased approximately 35 per cent within the last few years, owing to a desertion to more remunerative employment. Along with this insistence upon the continuation of the present wage scale goes the demand by all union labor leaders, that skilled workmen give a full honest day's work, failure to do so carrying with it severe disciplining by the workmen's organization.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; seventh annual convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; New Orleans, Feb. 9-12.

The Engineering Society of Buffalo, at a recent meeting, was addressed by Howard Richards and William C. Wilson regarding a bill which has been proposed in Congress compelling the use of the metric system of weights and measures in all commercial transactions.

The Minnesota Surveyors' and Engineers' Society will hold its annual convention at the Hotel Commodore, St. Paul, Feb. 21, 22 and 23.

The Northwestern Section, Am. Soc. C. E., has inaugurated a series of three meetings to discuss the "Open Shop vs. the Closed Shop." The first meeting was held in St. Paul, Jan. 17, and was addressed by George W. Lawson. W. E. McEwin spoke on "Industrial Relations."

The Engineers' Society of St. Paul, Minn., at its annual meeting Jan. 10, elected the following officers: President, J. H. Mullen; vice-president, W. W. Walker; secretary, A. A. Sommerfeld; treasurer, W. N. Carey. The society now has 302 members.

The Memphis (Tenn.) Engineers' Club, at a dinner held Jan. 10, elected the following officers: President, Robert W. Gay; vice-president, J. H. Haylow; secretary-treasurer, A. S. Fry.

The American Water-Works Association, Canadian Section, will hold its first general meeting at Toronto, Ont., Feb. 4. At 10 a.m. will commence the

"get together" session with luncheon at 1 p.m. A paper "The Relation of the Water Supply to the Public Health" will be read by Dr. J. W. S. McCullough, followed by open discussion. Alexander Milne of St. Catharines, Ont., is chairman.

The Provincial Association of Contractors and Supply Dealers of Ontario will be held in Stratford, Ont., Feb. 15-17.

The Association of Professional Engineers of New Brunswick, Canada, at its annual meeting Jan. 14 at St. John, elected the following officers: President, C. C. Kirby; vice-president, W. H. Duff; councillor for St. John district, L. P. Vaughan; councillor for Moncton, H. S. Pickard.

Personal Notes

THOMAS F. LAWLOR, former president of the Board of Public Works, Poughkeepsie, N. Y., has been appointed superintendent of public works.

WILLIAM S. HENDERSON, for several years engineer of Washington County, Kan., has been appointed city engineer, Lawrence, and later, when the resignation of L. A. Quigley becomes effective, will become superintendent of the water plant.

CLARENCE McN. STEEVES of St. John, N. B., has been appointed assistant engineer, Department of Railways and Canals, Ottawa.

W. J. KELLY has resigned as highway engineer, Walker County, Texas, to take charge of all road building in Trinity County.

MAJOR L. E. LYON, Corps of Engineers, U. S. Army, formerly military assistant to the district engineer at Norfolk, Va., has been assigned to duty as engineer of the Philadelphia district.

L. A. DUFRESNE has been appointed highway engineer for Calhoun County, Miss., where 50 miles of Federal Aid project surveys are being made.

N. L. SOMERS, for four and one-half years assistant to the works engineer, Algema Steel Corp., Sault Ste. Marie, Ont., will incorporate a company to engage in sales engineering and contracting and will specialize in power development, hydro-electric and transmission lines. His office will be in Toronto.

L. S. JEFFORDS, since 1910 with the Atlantic Coast Line R.R. and recently assistant engineer maintenance-of-way, second division, has been appointed engineer maintenance-of-way, of the Charleston & Western Carolina Ry.

GUY C. DUNN, formerly engineer of construction at Winnipeg of the Grand Trunk Pacific Ry., has been appointed office engineer, chief engineer's office, Eastern Lines, Canadian Northern Ry. at Toronto, Ont.

LANE, DAVENPORT & PETERSON is a newly organized architectural and engineering firm with offices in the Dime Bank Building, Detroit, Mich. Horace H. Lane has supervised the design and erection of numerous industrial plants and power houses, among which are the steel car plant and power house for the American Car & Foundry Co., the Delray power plant of the Detroit-Edison Co., and the $2,000,000 plant of the Eastern Car Co. near Halifax, N. S. H. D. Davenport is an architect and has been practicing a number of years in Grand Rapids and Detroit. A. A. Peterson is a structural engineer with several years' experience in the design of steel and reinforced concrete buildings; he has been associated with Mr. Lane for nine years in the design and layout of manufacturing buildings.

G. A. RUSSELL, formerly engineer of Geary County, Kan., has been appointed engineer of Pottawatomie County, Kan.

F. S. WILSON, an engineer of Rosedale, Kan., has been appointed a member of the city planning commission of Kansas City, Kan.

ANDREW LENDERINK, for nine years city engineer, Kalamazoo, Mich., has entered private practice as a consulting engineer with office in the Kalamazoo National Bank Building, Kalamazoo, Mich. He will engage in the preparation or review of designs, plans, specifications, and contracts for municipal work, the inspection of building and road construction and consultation on construction matters.

W. BINTZ, formerly structural engineer of the Flint, Mich., engineering department, has accepted a similar position at Lansing, Mich.

ELBERT REYNOLDS, for several years highway engineer for Jefferson County, Ark., has been appointed an engineer for the State Highway Commission under Herbert R. Wilson, recently appointed highway commissioner. He will continue to direct the highway work of Jefferson County.

SWIGART & EHRMAN, civil and hydraulic engineers, announce the retirement of H. N. Legreid from the firm.

JERRY DONOHUE of Sheboygan, Wis., has been engaged as city engineer of Hartford, Wis.

E. W. GUNGEL has been appointed chief inspector for the newly created smoke inspection bureau of Harrisburg, Pa.

ARTHUR S. TUTTLE, deputy chief engineer of the Board of Estimate and Apportionment, New York City, has been appointed chief engineer to succeed Nelson P. Lewis who recently resigned.

ALFRED E. KORNFELD, formerly manager of *Engineering News*, will sail Feb. 3 for a seven-months' trip through Europe, Egypt and the Holy Land. In the latter country he is to make a survey of industrial, business and financial conditions with regard to future colonization.

HERBERT S. SISSON, state commissioner of excise since 1917, has been appointed New York State Highway Commissioner, succeeding Col. Frederick S. Greene, resigned.

Obituary

EDMUND M. BLAKE, production engineer for Charles R. McCormick & Co., and president of the National Association of Railway Tie Producers, died in San Francisco on Jan. 12 after an illness of only a few days. Mr. Blake, who was a Harvard graduate, went to the Pacific Coast four years ago, where he had a prominent part in wood preservation activities. He took a keen interest in the commercial development of the timber perforating process and was instrumental in getting the first machine for timber perforation installed on the Pacific Coast. Up to a few days before his death Mr. Blake had been very busy with plans for the annual convention of his association, which is to be held in San Francisco the fourth week in January and over which he was to have presided.

MAX EVERHART SMITH, president of the Continuous Transit Securities Co. and long the foremost advocate of moving platforms for passenger transit, died on Jan. 23 at the age of 72. His most successful work was the development of the escalator.

ELMER FOLSOM, senior member of the firm of Folsom & Taylor, civil engineers, Bloomington, Ill., died at Los Angeles, Cal., Jan. 9, 1921. He was 58 years old. Mr. Folsom was for 14 years city engineer of Bloomington, Ill., retiring from that position in 1915 to enter private practice. Recently he has been representing the firm as engineer for the Bloomington and Normal, Ill., Sanitary District for sewage disposal.

F. S. WARDWELL, engineer and contractor, died Jan. 16 at Stamford, Conn. He was born in 1860 at Bucksport, Me. Early in life he was engaged in railroad construction work and built the streeet railway in Duluth, Minn. He came to Stamford about 20 years ago to undertake the work of widening the east branch of the harbor and to construct docks. He then made a specialty of waterfront construction. His work in Stamford included the construction of docks for the Stollwerck Co., a bulkhead for the Petroleum Heat & Power Co., docks for the Yale & Towne Mfg. Co. and the Luders Marine Construction Co. He has been engaged in numerous contracts for dredging and construction, including the construction of foundations for various bridges.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

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Protecting the Hudson Channel

SECRETARY OF WAR BAKER has done well in refusing New York City's plea to make permanent its temporary extension of piers into the Hudson. The conclusion is unavoidable that the city has never been honest in its dealing with the Government in this matter of channel encroachment, but has consistently pursued a policy of getting the camel's nose under the tent. These gradual grabbings of a bit more of the Hudson River are merely an avoidance of a real port policy and intentionally disregard the rights of New Jersey in the river and port. Possibly now the city will consider more seriously the limitations of the lower Hudson front and begin to think of the port as a whole.

The Good Roads Congress

AS A forerunner to the Good Roads Congress which will open in Chicago next week under the auspices of the American Road Builders Association this number of *Engineering News-Record* has been made a "Road Building Issue." It contains a number of articles dealing with the work of design, construction and maintenance which engineers and contractors in various parts of the country are doing. This year promises to be an important one in the road-building field. Lower prices of materials and labor and the improbability of factors such as the car shortage which held up work last year offer substantial grounds for an optimistic outlook. It is important, therefore, that the road congress shall have a large and representative attendance. To engineer and contractor is offered the opportunity of keeping abreast of the best thought in highway subjects and of learning what the manufacturers are doing in supplying new or improved types of road-building equipment.

Hog Island Closes

IN THE depth of winter just three years ago, violent controversy broke out over a new enterprise of titanic magnitude, the building of a great shipyard on a marshy island in the Delaware River and the name of Hog Island became famous—or infamous—over night. Men had undertaken the impossible down there. Through ice and snow they struggled against hopeless odds to convert a bold conception into a reality. Railway, labor, and organization difficulties seemed insuperable. Yet only a few months later Hog Island was putting ships into the water, and had fairly started on its career as the greatest shipbuilding machine ever created. That career has now reached its end, for this week Hog Island closes its gates. Its work is done; the "Aisne," last of 122 ships, made her trial trip a week ago, and henceforth the name of the great yard will be only a memory of heroic achievement. It will be remembered particularly in connection with our profession, for it was civil engineers who created Hog Island. Leaving their accustomed activities they set themselves a new task and entered upon its execution with faith and courage. All about them was the cry that ships must be built in vast numbers, and they undertook to answer that cry. The greatest part of their task was performed through Hog Island. Much has been written of the dreams that were made real on that mile of marsh. The designing of ships for factory production, the building of hull sections by the hundred thousand tons in many scores of bridge shops scattered over a dozen states, the rapid and systematic assembling of these sections on fifty launching ways, the creation of great plants for fitting out and equipping ships, all have been made the theme of inspiring story. There is no need to rehearse the facts here. But in these closing days of the enterprise it is fitting to recall that in all of its stages the achievement at Hog Island is a monument which our own profession has erected to itself. The names of the field leaders of the work will always be remembered—the names of Robinson, of Goodenough, of Muhlfeld, Wood, Holbrook and Brush, men who vitalized the work with inspiration and guiding thought. But the names of a host of other engineers stand alongside these. The record is one of pride and honor to each member of the host.

Foundation Failures

BRIDGE history is thickly dotted with foundation failures, and the remarkable case of the Third St. bridge in Dayton is thus only an addition to the long account. Most failures, in fact, originate in the foundation, and this is peculiarly true of bridges. In the case of a wall, a failure—a yielding of the subsoil—may be merely annoying or disfiguring, but it is likely to lead on to ruin in the case of a bridge. The current record is distinctly bad. As even a cursory reading of the news will show, every freshet takes its toll of bridges; and with very rare exceptions the foundations are responsible. Great floods, like the Central States flood of 1913, exhibit the situation most impressively, but their teaching is perhaps least convincing. One is tempted to reason that it will not pay to sink the piers of every bridge throughout the country to a depth safe beyond all imaginable scour, merely to guard against the loss of a dozen or two in the great emergencies that may occur but once in fifty years. But there is a direct lesson in the losses in ordinary freshets: They constitute an indictment of our foundation practice, for it is the engineer's business to provide for all normal contingencies. The record of failures suggests that we do not regularly apply the same prudence and conservatism of technical judgment to the foundation as to the superstructure. Is this chargeable to the fact that we have no scientific knowledge of foundation problems, or is it due to a willingness to take chances with construction that is hidden below the ground? Correction of the existing situation depends on how this question is answered.

Problems of the County Highway Engineer

AS AN indication of the trend of thought of county highway engineers, the annual meeting last week of the New Jersey State Association of County Engineers, reported in the news section, deserves consideration. Each state, of course, has its own problems and without a thorough-going canvass there would be no grounds for asserting that the kind of thinking which Jersey's county engineers are doing is typical of that in other parts of the country. Nevertheless, the meeting emphasized several phases of the local highway administrator's work which are of first importance at the present time.

One clear inference from the Jersey meeting is the need for a number of amendments to state and county road laws. A score or more of proposed changes were offered. The county engineers recognize that the best interests of all concerned are furthered by meeting the contractor half way. As evidence of this feeling only one or two instances need be cited—the proposal to pay contractors 80 per cent of the value of road materials delivered at the site of the work; to retain not more than 10 per cent of the value of work in place, instead of 20 per cent as at present; and to accept completed work in units of one mile with provision for paying for each unit in full when completed and accepted. Obviously if such amendments are incorporated into the state's road laws the contractors' position will be vastly improved. Money has been tight and contractors are not now able to finance their work by borrowing at the low rates of interest prevalent in pre-war times. Any revision of the clauses in public works contracts which provide a more liberal policy of paying for work done without removing safeguards for honest, efficient work, is a step forward.

Transportation, as distinguished from the narrower field of merely building roads, is another of the subjects to which engineers, as evidenced by the New Jersey meeting, are devoting a great deal of thought. It is realized with fuller appreciation every year that the planning of extensions to state and county highway systems is a matter for the present—not for some indefinite future period. Attention is being given to putting the proper types of highway in the proper places, linking up important centers of manufacture or commerce, and providing routes so co-ordinated as best to serve the interests not only of state but of interstate traffic. The problem involves, also, a knowledge of traffic requirements, the protection of the vast capital investment in durable pavements by restricting the weight and size of vehicles and, what is of particular importance, the provision of means for enforcing such regulations as are placed upon the statute books. In New Jersey at present the maximum allowable weight for a vehicle is 30,000 lb. and it is worth noting that the State Highway Commission and the Motor Vehicle Department are to co-operate in enforcing this limitation by means of road scales, five of which, each with a capacity of 50,000 lb., are now being installed. It is only by such means that "teeth" can be put into any legislation designed to protect public highways from damage by vehicles carrying unreasonable loads.

Opinion on the traffic situation in Jersey was crystallized in a committee report which recommended a wider extension of traffic census and research work. The need for standardization of traffic census operations is recognized and the committee believes that advance planning of the highway system should look ahead twenty years so as to provide routes of ample widths and durability for future transportation needs.

The Associated General Contractors

PREVIOUS to the organization of the Associated General Contractors, to repeat a thought expressed in these columns two weeks ago, there were no contractors' meetings comparable in importance to those of the American Society of Civil Engineers. We also expressed then the belief that such meetings had now been made possible by the new association. Last week's convention of the contractors at New Orleans completely vindicated that faith. In fact, in virility and vision the promise is that the contractors will set a pace for their engineering associates.

The great outstanding accomplishment of the convention was the endorsement of the broad plans developed by the executive board during the past year. There were those who came to the convention half in the belief that the association was leaping before it had learned to run. With the progress of the convention the doubts disappeared, a settled conviction developed that the plans were none too big and that every activity had a sound basis and was intelligently planned and directed. At the last session the broad program received unanimous endorsement, through the approval of the year's budget. This action sets the seal on the association's future. With a remarkably competent leadership, and the present backing of 750 of the strongest contracting companies in the country, the association can be counted among the permanent and effective forces in service. One could not for three days listen to discussions in meetings and in corridors without learning that this was a work-a-day standard by which all the activities were to be tested.

Nor was there any wishy-washy sentimentality in the expression of the idea. It was mentioned as a matter of course, as one of settled conviction. Contractors are expected to be forceful personalities. They are—and they were at New Orleans. They did not mince words regarding their views. Although they hit hard when they thought hard hitting was called for, they gave evidence that they do not expect to "bull things through," but to secure acceptance of their positions by demonstration of their reasonableness. Out of that attitude came a second dominant note of the convention—that the best results for the public are to be accomplished not by the contractors playing a lone hand but by co-operating, where pertinent, with other branches of the construction industry.

A striking fact brought home by the convention—and it was repeatedly referred to on the floor—was that the personnel of the contracting business has undergone a radical change. The "rough-neck" contractor is passing, or has passed—never to return. Instead there is a keen, cleancut business man, adopting all the methods of modern business organization. This fact must be fully appreciated in order to understand the spirit of the A. G. C. and to have faith in the future.

To date the accomplishments are remarkable—again due to the business man in contracting. With standards pitched high, with energy, with vision, the work ahead will be of immense value to the construction industry and to the public. The convention just closed marked a great step forward in the construction world.

Handling Freight at New York

FULL consideration of the report of the New York-New Jersey Port and Harbor Development Commission must await the issuance of all of the detailed chapters summarized in the report made public last week.

The summary of the report indicates how completely the commission has made its study. It promises a wealth of material when all the data are published. For the first time the conditions in this port have been thoroughly analyzed and prospective development laid out on actual figures and not on assumed conditions. Generalities as to existing freight movements and prophecies which feature most of the previous port solutions are supplanted here by facts obtained at large expense. It is testimony to the good sense of those engineers who have worked on the problem in the past that even after all of the time and labor expended by the commission on this study, the report, so far as the summary discloses, reveals only one radical divergence from schemes that have been proposed in the past, and even this one resembles in a number of ways the suggestion made twelve years ago. The virtue of the report lies in selecting the best of the previous proposals for port improvement and in putting upon this consolidated selection the seal of approval backed up by two years of thorough technical investigation.

The commission endorses the railhead port idea. This necessarily involves belt line railways in New Jersey and Brooklyn and the consolidation and reduction of lighterage and railway pier stations in Manhattan. The plan further comprises a reform of the food marketing system of the district, the desirability of wider piers and of judicially selected handling machinery, the dredging of channels, and several such minor improvements. None of these is new, though the portions of the report not yet published may reveal some novel details. Especially interesting to those in the port outside of Manhattan Island will be the specific recommendations for the development of the outlying areas—Newark, Jamaica and the Upper bays for instance. The West Side Manhattan situation, emphasized so strongly by the commission, may be the root of the whole port problem, but the commission must recognize that the benefits accruing from its solution, while spreading over the whole port, do not spread equably, and that many in the district will have to see direct benefits to their own locality before they will approve the joint port idea.

The outstanding if not spectacular feature of the scheme is the so-called automatic electric railway loop to take care of Manhattan freight. By this arrangement Manhattan-bound freight would enter the Jersey yard in main-line freight cars and be classified on trailers and trucks which would be run into special standard-gage tunnel cars made up and directed in trains to specific terminals. When reaching the terminal the cars are lifted on an elevator to the drayage floor, the trailer trucks run out, and the contents either loaded on motor trucks or moved directly to the warehouse which would form the upper story of the terminal. Westbound freight would then be loaded on the cars and the train moved—always in the same direction—back to the classification yard.

So far this scheme has all of the characteristics of the solution proposed by Col. W. J. Wilgus in 1908 (*Engineering News*, Oct. 15, 1908, p. 403). The new features now submitted are a deep tunnel which would afford cheaper construction, the use of a super-standard car instead of a 10-ton tunnel car and above all the adoption of the automatic electric control whereby the tunnel trains move around the loop without motormen or riders. The commission holds that this automatic control is a vital part of the scheme, because only by the close spacing and uniform speed that such control assures can the necessary capacity be achieved, or at least that to get equal capacity on a man-operated system would require much more trackage and equipment at increased cost. Furthermore, it holds that the capitalized operating cost of the manual system far outweighs the first cost of the automatic control.

So elaborate an extension of the automatic control idea is far beyond any present engineering experience. It is simply one of those things that have never been done. That, however, need not condemn it, and the engineers of the commission not only are willing to stake their reputation on its succeeding but have the approval of a number of the experts of the electrical manufacturing companies to back them up. On the other hand, the published chapters of the report of the commission are singularly lacking in a comparison of the loop-elevator-special-car scheme for manual operation and in shallow tunnels with their favored solution. They analyze and reject two standard-car west side railways, one elevated and one in subway, in neither of which are included the feaures which contribute most to the "automatic" scheme, namely, the breaking of bulk in New Jersey, with the demountable body or trailer-truck loading in loop tunnel cars to Manhattan. It would seem incumbent on the commission to make as complete an analysis of the Wilgus scheme—with such amendments as twelve years advance suggest—as they have of their three schemes. Relative advantages and costs of the shallow and deep tunnel would be particularly interesting.

Unquestionably the commission is right in its contention that standard freight cars can no longer be profitably brought onto lower Manhattan Island. Bulk must be broken, and preferably sorted, somewhere on the mainland and the city freight brought in as nearly as possible in carriers which permit of mass distribution to the consignee. The new plan definitely promises a relief from the intolerable truck congestion around the pier stations and distributes the total motor truck traffic in the streets. In so far as ocean transshipment in Manhattan is concerned, the deep subway offers no improvement except perhaps in shorter truck hauls, if indeed it is intended that any freight between the ocean liners and rail haul is to be carried except by lighters. In other words, the subway and its terminals are mostly a solution of the problem of handling freight produced and consumed on the Island. It offers no relief for the handling of fuel or of passengers from the west.

These are merely the high spots of comment on the report. The important thing now is that the commission has all but completed its allotted task and has prepared an analysis of port development the like of which has never been seen. As it truly says, most of its labor will be in vain if the co-ordination of the port district is not in some way brought about so that the comprehensive plan—subject to such detail changes as further study and conference may develop—may be put under way. The immediate future is now in the hands of the state legislatures. Too great postponement of action will only bring about Federal intervention.

Road Construction in the Cypress Bottoms of Arkansas

Soils Rendered Unstable by Frequent Rainfall—Clearing and Grubbing Necessary—Backwater Overflow Frequently a Problem

By Don A. MacCrea
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Highway construction in the cypress bottom lands of the southern Mississippi River and its tributary streams is largely an operation in virgin territory. This description of the construction of the Arkansas-Louisiana Highway in southeastern Arkansas typifies both the conditions confronting the contractor and the means found most successful in meeting these conditions. The outsanding facts are:

(1) Clearing and grubbing is a construction task of magnitude.

(2) In undrained, unleveed bottom, overflow is a probable construction risk.

(3) Rainfall frequency is of extreme importance because the prevailing soils are easily affected by moisture and are slow to give up their water content.

(4) Heavy wheeled equipment, as graders and motor trucks, are impracticable because the soils are made unstable by frequent rains.

(5) Teams and scrapers are the most efficient grading equipment.

(6) Sand sub-base has proved its worth on clay and "buckshot" subsoils.

(7) Dry batch haulage to paving mixers by industrial railway best meets subgrade conditions in laying concrete base. Truck haulage of wet concrete from central plants is impracticable.

(8) In hauling bituminous surface material, heavy trucks give larger daily yardages, but light trucks give a better average progress for long periods.

(9) Flat topography and slow run-off make the drainage problem difficult.

(10) Probable future reclamation by drainage, counsels the construction of temporary bridges until stream changes and ditch locations are determined.

(11) Long mileage contracts involve risks which the state should share with the contractor.

(12) Construction camps will reduce labor turnover and loss of time.

(13) An engineering-construction organization based on railway practice best meets the requirements.

PAVED road construction in the Mississippi bottom lands, as exemplified by the Arkansas-Louisiana highway, presents unique characteristics. The natural conditions, as soil, weather, overflow and forest, necessitate special equipment and methods. Methods of organizing and financing the improvement place restrictions on freedom of engineering design and location and of contract practice. All of these factors appear in the operation named because of its great length of 153.67 miles in five counties, which also requires enough contractors to give variety of practice in planning construction outfits and ways of conducting work.

Except 11.87 miles of 7-in. trap rock macadam in Lincoln County and 28.57 miles of 7-in. bank gravel macadam in Ashley County, Fig. 1, the Arkansas-Louisiana highway is 2-in. Topeka mix on a 5-in. concrete base. On the sharper curves the road is widened to 16 and 18 ft., but elsewhere it is 14 ft. wide. This width is out to out of 6 x 7-in. curbs on the 113.18 miles of paved road. Both macadam and hard pavement are placed on a grade 22 ft. wide with side slopes of 1 on 1½, 1 on 2 and 1 on 3 according to the height of the fill. The 4-ft. shoulders are planted with Bermuda sod to hold them against wash. The width of right of way varies from 50 to 70 ft., except through towns, but in some places in only 40 ft., which has been found to be rather narrow even for very low embankment.

Concrete base design received special attention. Generally a 5-in. base of 1-3-6 concrete was employed. When the subgrade was particularly soft, the base was thickened slightly and a 4 to 7 in. sand sub-base was placed on the clay or gumbo grade. This sub-base was also employed on the macadam sections. Experience indicates this sand treatment of the clay and gumbo to be valuable. A pure sand was not used in all cases; soils containing a high percentage of sand were found satisfactory. Had not limitations of cost prevented, a greater thickness of base on bad subgrade would have been better engineering. A 2-ft., gravel macadam shoulder on each side would also be an improvement worth while even now, since it would provide an 18-ft. roadway at little additional cost and would reduce shoulder maintenance.

Much thought and study were given to the problem of expansion and contraction of the concrete base, and several experiments in controlling these actions were undertaken. In the beginning, some mileage was laid leaving a joint in the base at the end of each day's run and filling this joint when the asphalt top was placed. The result was a puffing of the asphalt over each joint in hot weather. On the sections without joints there was experienced last summer some slight buckling due to expansion; these "explosions" averaged about one every mile. In no case were expensive repairs necessary. When broken stone aggregate was employed there was less trouble from expansion than when the aggregate was gravel.

Summarized, the various types of construction and their volumes were:

Clearing, acres	351	Conc. base, sq.yd.	852,500
Grubbing, acres	370	Asph. top, sq.yd.	852,500
Embank. exc. cu.yd.	690,000	I-beams, lb.	76,000
Class A conc. cu.yd.	4,950	Piling, lin.ft.	17,600
Found. Exc. cu.yd.	7,430	Grav. macadam sq.yd.	234,800
Reinf. Steel, lb.	194,000	Stone macadam, sq.yd.	97,700

In this summary the quantities of clearing, grubbing and embankment are to be especially noted.

As shown by Fig. 1, the location is in the alluvial plain bordering the Mississippi River. Much of this area, previous to the leveeing of the Mississippi and Arkansas rivers, was subject to overflow. The topography is exceedingly flat and the rainfall run-off is correspondingly slow making the drainage of a highway very difficult.

Arkansas legislative restriction on engineering location were well typfied in the selection of the route. This route, by the act authorizing the improvement, was fixed for the most part on existing roads which in some cases were little more than trails. Therefore where changes of location were considered advisable, it was necessary under the state laws to secure the approval of the County Court before the changes could be made as it was also necessary so to secure right of way, this court in each county, having original jurisdiction over highway location and right of way. In many cases, where changes of alignment were recommended, approval was secured, but in a few cases local politics and local interests prevented the change being made.

As a result excess mileage and curvature appear in some instances where they could and should have been avoided. Also grade crossings were not eliminated where they might have been. Comparatively however, this condition has been much improved, fully 50 per cent of the old crossings having been eliminated and those existing having been confined within towns, near the stations where reduced speed can be expected.

Generally the location follows the tracks of the Missouri Pacific Ry., which gave good track facilities. Approximately 70 per cent of the route required clearing and grubbing and approximately 50 per cent is on clay and gumbo soils. This last fact has importance in connection with rainfall.

Normally Arkansas has 50 to 60 in. average annual rainfall. This average has been exceeded during the last two years as shown by the charts of Fig. 2. The more important indication of these charts is, however, the frequency of rainfall. This was the greater handicap to construction because the clay and buckshot soils become unstable with little moisture and recover very slowly from even light rainfall.

Construction Methods

Considering the operation as a whole, construction was begun and progress, to the end of 1920, was maintained as shown by the diagram Fig. 3. This diagram indicates also the main classes of work.

Long hauls generally were required for all materials. Broken stone for the Lincoln county macadam section required an average rail haul of 72 miles and gravel for the Ashley County section an average haul of 150 miles. Chats from the Missouri zinc mines for mixture with asphalt for the top, were hauled 350 miles. Sand and gravel for the concrete base was secured by the Arkansas Gravel Co., at Arkansas City. Here the material is pumped from the river, proportioned by screening and shipped as proportioned. As good concrete has been obtained with the porportioned aggregate as when the sand and gravel are mixed separately.

Heavy grading equipment proved impracticable. Several types of large and small blade graders, tractors and elevating graders were tried out very thoroughly but had to be abandoned because of the soil made unstable by frequent rains. About 90 per cent of the grading has been performed with teams, wheel and slip scrapers and Fresno scrapers and in some sections which have been particularly wet it has been necessary to place embankment by station men. Clearing and grubbing was a preliminary to practically all grading, as indicated by Fig. 4. These, as indicated by Fig. 3, were pushed the first year, so as to have the grading completed far enough ahead of the paving to ensure settled fills. In only a few instances has it been necessary to lay pavement on any fill of more than 2 ft. which was less than a year old.

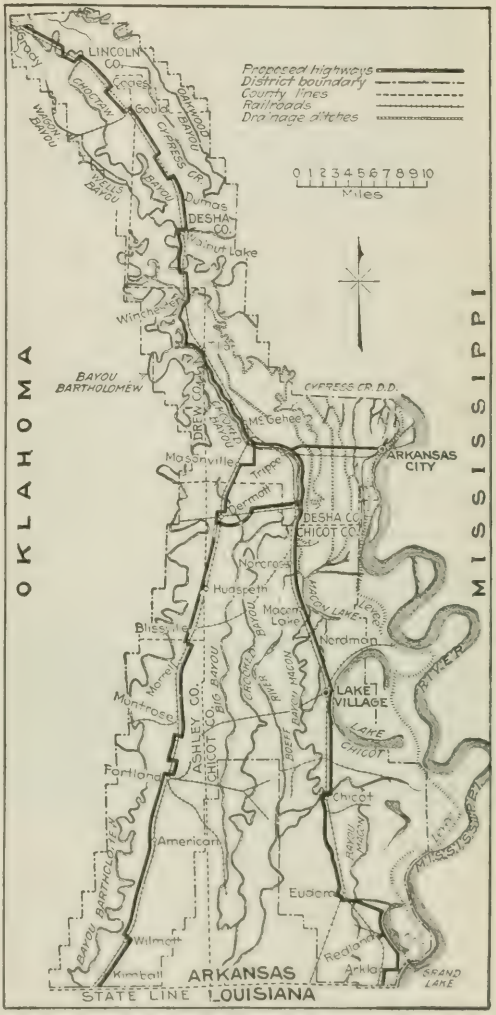


FIG. 1. LOCATION MAP OF 154-MILE ARKANSAS-LOUISIANA HIGHWAY

In constructing concrete base, the contractors are successfully using, for handling aggregate, unloading cranes and industrial railways, with steel cars and gasoline locomotives. The most successful arangements are those by which a removable car body or batch boxes are handled by a mixer crane. The dumping of sand and gravel on the subgrade by either cars or trucks and conveying them to the mixer have been abandoned. Wood ties for industrial track have been tried, but it has been found that sectional steel track has many advantages, especially if the steel ties have sufficient bearing area to carry the track on soft subgrade. Several types and weights of gasoline locomotives are being used, but experience has shown that they should be just as light as the grades will permit. With industrial railway haulage, maximum runs of 1,500 sq.yd. of

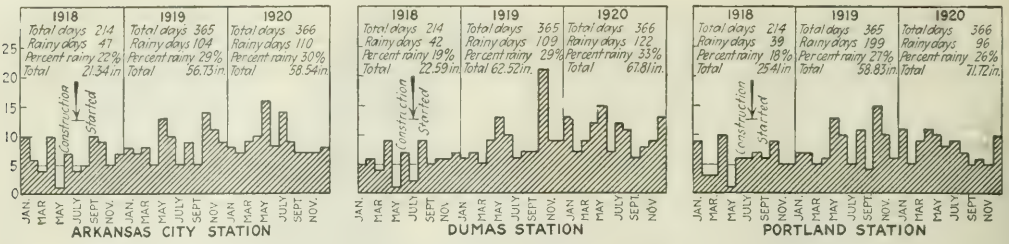


FIG. 2. DAYS ON WHICH THERE WAS MORE THAN ONE-HUNDREDTH INCH OF RAIN AT THREE OBSERVATION STATIONS

5-in. base per day have been made and one plant has averaged between 1,000 and 1,200 sq.yd. per day.

The use of central mixing plants, the hauling of the mixed concrete in 3½-ton trucks, and truck haulage of sand and gravel to the mixer, have all been abandoned after thorough trials of many months' duration for the reason that the character of the subgrade, Fig. 5, makes it impossible to use trucks except in very dry weather.

For placing asphalt top, standard railroad type portable asphalt plants are being used and runs of 1,500 to 2,200 sq.yd. per day have been made. Both large and small trucks are used for hauling. The use of heavy trucks gives much larger daily yardages, but a better average progress over long periods appears to be

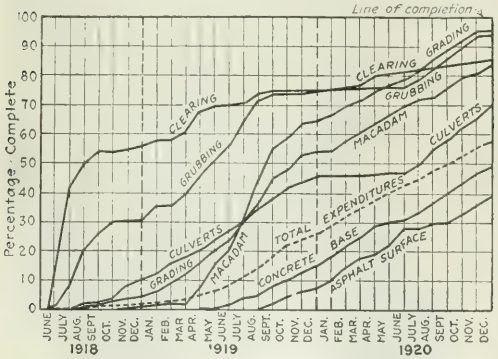


FIG. 3. CONSTRUCTION PROGRESS BY CLASSES OF WORK

obtained with small trucks. The latter are more easily handled and turned on light turntables pulled along just in advance of the rakers. Much time is lost in turning the heavy trucks on the narrow roadway. Generally the asphalt plant sites are kept three to five miles behind the base concreting so as always to have concrete base on which to haul the asphalt.

In addition to the usual difficulties of construction, there was added during the months of May and June of 1920, for a period of 60 days, the flooding by back water from the Mississippi River of the roadbed and right-of-way from a point near the town of Halley to the town of Chicot in Chicot County, and from a point near Trippe east to Arkansas City in Desha County. This flooding, Fig. 6, was caused by a gap left in the levee system, providing an outlet for Cypress Creek, which could not be closed until the contruction of the drainage system in Desha County had reached a point where these waters could be diverted south. It was planned that this gap would be closed in the year 1919, but due to excessive rainfall the contractors failed to complete the work. This permitted the waters from the Mississippi to flow into the basin after reaching an elevation on the gage which had not before been reached in the past seven years. Some of the embankment was covered with water to a depth of from 2 to 4 ft. However, the erosion loss was exceedingly slight and the tie-up and loss of time which occurred to the contractors' operations in laying pavement was the most serious feature. This gap in the levee system has now been closed and the highway should be free from further flooding unless exposed to an actual break in the levee system.

Reinforced-concrete box culverts up to 12-ft. size are employed either in single or double span for all sizes. Estimates made when the contracts were let indicated the cost of these culverts to be only 10 to 15 per cent greater than the cost of pipe and headwalls. For spans of 20 to 30 ft. steel I-beams and concrete slab construction was adopted. For long spans, pile and frame bridges were planned with the expectation of replacing them at the expiration of their life of 7 to 10 years with steel spans having concrete floors.

Two reasons counseled the use of temporary structures for long spans. One reason was the belief that in building the permanent structures later there would be a saving over present prices. The second and more important reason is one which prevails widely in river bottom lands whose reclamation by drainage is under way or is a future probability. With drainage many existing creeks and sloughs, which require bridging, will be eliminated by main ditches. Until reclamation plans disclose which of the present openings will be permanent and what new openings must be provided, plans for permanent bridges are impracticable.

Unit bids were taken on each of five sections, each section being an intra-county unit. This was necessary because there was suspicion among the property owners that in some way one county might be made to bear a portion of the expense in some other county. By taking bids, using each county as a section, the effect was to satisfy the property owners in this particular, since they could determine just what the cost of construction in each county would be. They were also convinced that whatever advantage any county had by reason of shorter hauls and other conditions was reflected in the unit prices. Under the plan of improvement in Arkansas, it is practically impossible to let construction contracts, otherwise than on a unit basis to the end that quite definite costs of construction can early be determined.

This project shows very clearly the heavy risk involved from a contractor's standpoint, when large mileages are bid upon, and a construction bond for the full 100 per cent cost of the work is furnished. This

FIG. 4. AVERAGE CONDITIONS OF CLEARING AND GRUBBING

is particularly true in times of wide fluctuation of labor and material prices as has been the case since these contracts were started. In addition to the great hazard of weather and other conditions there has been the exceedingly heavy increases in freight rates, this item alone involved an increased cost of approximately $175,000.

In addition it has been rather difficult for the contractor to obtain prices on materials which would hold

FIG. 5. SUBGRADE AND CONCRETE BASE

(The first view shows the condition of gumbo embankment, ahead of concrete mixer, after a rain, and which has been cut up by wagons hauling sand and gravel on a portion of the line where an industrial railway is not in use. This condition looks extremely bad, but the soft and muddy portion is only two or three inches deep and this soft material is removed before the concrete base is laid. The second view shows the method of roughening the concrete to improve the bond of the asphalt top.)

throughout the contract requiring 3½ to 4½ years to complete, and it is the writer's judgment that in all large contracts requiring two or more years to complete the contractors should be safeguarded and protected against many of the increases of cost which have occurred in this particular piece of work. It would seem fair also, in the future, that contracts of this size should permit the storage of construction materials as rapidly as possible with the District carrying the cost of materials and the freight thereon. The contracts provided for a maintenance bond of one year's duration after the completion of work on the macadam sections and a maintenance bond covering a 5-year period on the asphalt sections. However, on the asphalt portions, the contract provides for the acceptance and release of the reserved percentage and the date of the maintenance being started on 5-mile sections.

The contractors' organizations on the work presents no unusual features, however, it seems apparent, as indicated by the progress made by one of the contractors, that an assistant superintendent is of great advantage in any organization where so much machinery is used, and where work is proceeding with so many units constantly employed. The time spent in traveling about and seeing the different foremen and sub-foremen daily can be advantageously delegated to an assistant superintendent giving the superintendent all of his time for planning and safeguarding in various ways to avoid delays.

So far as possible the contractors have tried to avoid the use of camps and while the towns are close and provide housing facilities for the men, yet it seems very evident to the writer that this construction could be carried on much better (as has been proven heretofore in railroad construction) if portable camps were provided and moved along with the work. This method has the advantage of a smaller labor turnover and the added advantage of the foreman at all times having his labor where is can be reached and started to work without delays and loss of time.

The construction cost of the project, exclusive of interest charges on the bonds issued, will approximate $3,300,000, the entire amount of which, with the exception of $332,000 Federal and State Aid, will be paid from taxes assessed on the real property in the District. The work was taken by the engineers in charge on a percentage fee basis with provisions for additional compensation after time limits fixed in the contract for

FIG. 6. ROADBED FLOODED BY BACKWATER FROM RISE IN MISSISSIPPI RIVER

the completion of the work have been exceeded. The long time required to complete this particular project indicates that this form of contract is rather hazardous on the part of the engineer.

A chart, Fig. 7, is given showing the engineering organization and its relation to the Board, and other agencies, this organization being similar to the engineering organizations used 15 to 20 years ago in handling long extensions in railroad construction. The division engineers render weekly force reports on printed forms to both the resident engineer and the engineers in charge, and the resident engineer renders a weekly general report giving a summary of the work accomplished by each contractor, with delays to all plants and reasons therefor, together with any changes made in contractors' organizations and equipment, and also a record of construction materials received during the week. Inspectors render daily signed reports on standard forms as does aso the asphalt laboratory. Monthly reports are rendered the board by the engineers in charge, with a map covering progress and other details, at which time estimates are approved and vouchered. The engineering personnel is a follows: Ford & MacCrea, engineers in charge. A. R. Alling, office engineer; W. W. Mitchell, resident engineer at McGehee; J. R. Kline, R. L. Turrell and K. W. Lefever, division engineers. The contractors are as follows:

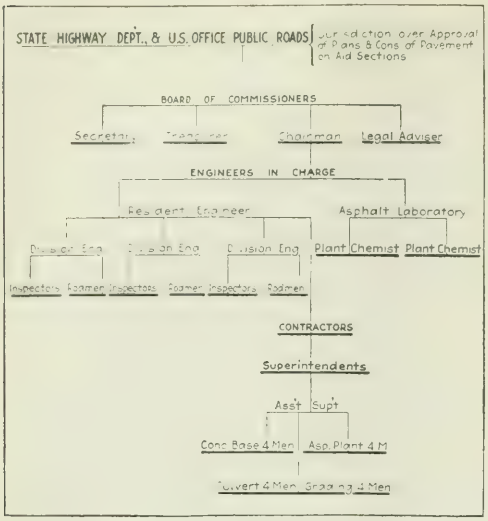


FIG. 7. CONSTRUCTION ORGANIZATION CHART

The Bryant Paving Co., Waterloo, Iowa, Chicot County Section, 57.51 miles, approximate amount, $1,284,000; The White Construction Co., Chicago, Ill.; Desha and Drew Counties Sections, 55.67 miles, approximate amount, $1,242,000; The Burke Construction Co., Fort Smith, Ark., Ashley County Section, 28.57 miles, approximate amount, $290,000; The Healey-Feild Construction Co., Denison, Tex., Lincoln County Section, 11.87 miles, approximate amount $184,000

Railway Electrification Plans in England

A committee to consider the question of electrification of railways was appointed last year by the British Ministry of Transport, one particular subject assigned being that of regulations to ensure such standard practice as to permit of interchange of rolling stock and uniformity of equipment. According to *The Engineer*, London, the report of the committee makes little advance toward standardization. Although in effect it recommends a 1,500-volt direct-current system as a future standard (which system is as yet little used in England) it also provides for continuance of the 600- and 1,200-volt and single-phase systems now in operation, their extension to be subject to the approval of the government.

Further, it provides also for the approval of systems using 750 volts or some other multiple of 1,500 volts. That standardization is likely to prove undesirable is the opinion of *The Engineer*, as a considerable amount of electrification has been carried out and it is doubtful whether any one particular system can be the most suitable for all railways. In fact, for the electrification of long lines it may be found that a higher pressure than 1,500 volts would result in considerable saving in cost of construction and operation. Several projects are under consideration by the railway companies but nothing is likely to be done until some definite position is taken by the government as to the future of the railways, the lines being still under government control.

Lessons of Patrol Maintenance

AFTER three years of full patrol maintenance of trunkline highways in Wisconsin, the lessons learned and the ideas successfully put into operation are summarized by J. T. Donaghey, maintenance engineer, as follows:

(1) A poor earth road may be changed to a good one for from $100 to $300 per mile by the use of a heavy blade grader and a large tractor.

(2) Width and smoothness of surface are of more importance than low grades.

(3) Where a patrol maintenance system is in operation no road should have more than a 4 to 6-in. crown for a 24-ft. shoulder to shoulder roadway.

(4) An application of 2 to 3 in. of sandy gravel, not larger than ¾ in. in size, on the surface of a clay road will give excellent results. Small stock piles of the material should be deposited along the roadside for the patrolman's use in strengthening the weak places. Ruts will occur, but persistent light grading or planing will result in an excellent and cheap temporary surface.

(5) Many roads ordinarily called "sand roads" can be converted into very satisfactory roads for light traffic by moving in to the center with a blade grader, the new top soil from the roadside for a wearing surface and keeping the surface smooth with a grader or planer. The bad sand requires a mixture of clay if available; if not, a covering of cedar shavings, marsh hay, straw, fine brush or weeds.

(6) Patrol sections should not exceed seven miles in length for team patrol and the patrolman should live on the section and as near the center of the section as possible. Where a competent patrolman cannot be secured who lives near the center of a section, it is economy for counties to build a shack for the patrolman to be located near the center of the section. The saving of time will repay the cost of the shack in two seasons or less.

(7) The best single tool for the patrolman's use in keeping the road surface smooth is the four-wheeled, two-horse road grader; next is the road planer.

(8) A wavy, uneven gravel road can be scarified and then reshaped with a grader at a cost of from $50 to $75 per mile, resulting in an excellent road. If new material is required it must be of a size passing a 1-in. ring.

(9) A 9-ft. gravel or macadm road can be scarified and widened to 16-ft. by covering the old surface and 3½ ft. of each shoulder with from 2 to 3 in. of fine graavel. The persistent use of the light grader or planer will produce a well-compacted surface without the use of a roller. This is both an excellent and a cheap method.

(10) A 9-ft. stone or gravel macadam road can be successfully widened to 16 ft. by resurfacing with 2 to 3 in. of stone, extending the stone over 3½ ft. of each shoulder and binding the new material with bitumen. If the road is properly constructed, the 3-in. depth of stone on the shoulder will amply care for reasonably heavy traffic.

(11) A badly worn macadam surface can be maintained more cheaply by the application of about 2 in. of sand and this will result in a more satisfactory road to travel than if a surface treatment is applied. It must be gone over frequently with the road grader or planer.

(12) No road should receive a bituminous surface treatment except where the surface is smooth and clean and when bitumen is used it should be of a quality and sufficient in quantity to penetrate the road surface thoroughly. Holes appearing in the surface should be patched immediately by the patrolman. It is a waste of funds to apply surface treatments and not use an absorbent of stone chips, pea gravel or torpedo sand. The surface treatment of roads taking care of heavy traffic that have been previously treated should be continued, provided they have been properly maintained.

Effects of Motor Operation Costs on Highway Location and Grade Design Summarized

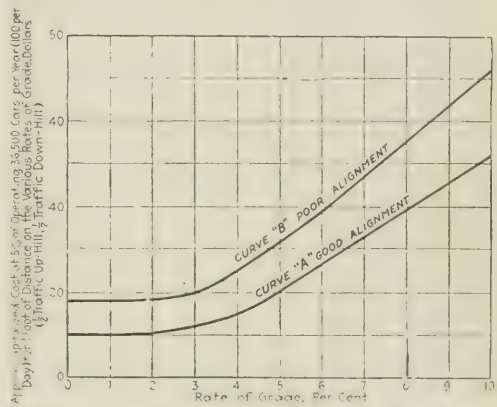
By Wilson G. Harger
Formerly Senior Highway Engineer, U. S. Bureau of Public Roads

This article supplements the one published in three parts beginning in the July 15, 1920, issue of "Engineering News-Record," p. 104, on the effect of motor operation costs on highway location and grade design. It has been written in response to a large number of requests as to the practical use of the approximate rather theoretical data previously given and to give a more definite idea of the effect of dangerous alignment. There is a very practical application of these figures. In any short article it is not possible to demonstrate the various detailed uses, but general rules may be summarized. The previous article was only intended to develop general principles. This article supplements it by some practical suggestions in the form of simple rules and simple methods of comparison which place a reasonable money value on proposed relocations.

Effect of Alignment—Dangerous sharp alignment increases motor operating costs. It decreases normal speed and results in the needless use of second or low gear climbing and excessive braking on down grades. This action only occurs, however, on a very small percentage of the distance on a well designed road, viz., at the danger points. That is, if the alignment is safe for traffic it does not affect the operating cost. If it is dangerous for traffic it does affect the operating cost. As real danger is a more vital matter in the design than cost of operation, alignment design is controlled by the factor of safety and not by considerations of operating cost. In other words, danger will be eliminated if it is possible to do so, and no consideration of cheaper operation would improve the alignment if the consideration of danger had not been sufficient to warrant it.

While there is no good data on the effect of alignment on operating cost, we have enough general data to state with reasonable assurance that if the radii of curvature are not sharper than from 250 to 300 ft. on the level or less than 400 to 600 ft. on grades and the sight distance is not less than 250 ft., reasonable speeds need not be reduced on account of alingnment and motor operating costs are not materially affected. For sharper curvature and shorter sight distance the cost of operation is probably increased. How much, we do not know, but purely as a matter of academic interest the author has modified the factors used in compiling diagram 2 for usual alignment, to conform with certain observed speeds on dangerous alignment. Diagram 1 shows the result. Curve A represents safe alignment. Curve B represents dangerous alignment.

We may say, both from the standpoints of safety and operating costs, that it is desirable to design special service commercial roads for a sight distance of about 350 ft. and local service or secondary state routes for about 250 ft. Considerable expenditure is justified to obtain this requirement, but large additional cost in order to further increase the sight distance is wasteful and poor engineering, particularly on roads of secondary importance. This caution is not a needless one, as the author has recently heard designers excuse excessive profile and section grading on the score that it increased the sight distance beyond the 350-ft. limit. This limit is not necessarily proper or liberal enough for all conditions, but it seems good sense to arrive at some limit suitable for the road in question and then eliminate additional expenditure for an additional sight distance which may be fine to have if you can afford it, but which is really not necessary. The tendency of almost all departments working with large appropriations is gradually to increase the *fancy extras* which may not



1 APPROXIMATE EFFECT OF DANGEROUS ALIGNMENT ON MOTOR-OPERATION COSTS

amount to much for one idea but grow in number like a snowball until you wonder why the cost of roads is going up and the mileage for your appropriations coming down.

The practical application of the analysis given in the previous articles can be summarized in the form of simple rules:

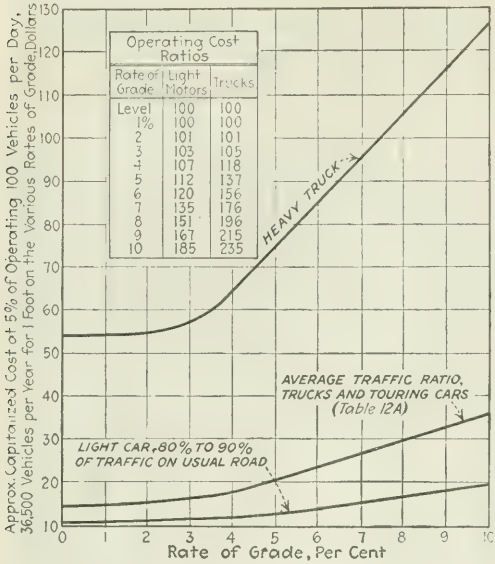
Climatic, drainage and soil conditions govern a location in respect to avoiding bad snow conditions, flood areas, needless stream crossings, slide or swamp formations and excessive rock work. The general requirements of line and grade discussed in the previous article are summarized as follows: The various principles are repeated conversely under the headings of grade, alignment, distance, rise and fall, and cut and fill grade reductions.

1. *Reasonable maximum grades are essential.* Recommended reasonable rates for various kinds of roads are given below. The following treatment is allowable to get a reasonable maximum:

(a) Any expenditure necessary.

(b) Distance may be increased in order to get a reasonable maximum grade but should not be increased for a fixed rise to reduce grade *below* a reasonable maximum.

(c) Poor alignment may be used if necessary to get a reasonable maximum grade if funds are low, but poor



2. DIAGRAM OF DATA GIVEN IN PREVIOUS ARTICLES

alignment should never be introduced to reduce grades *below* a reasonable maximum. Where poor alignment is necessary maximum rates must be reduced at the danger points (see below).

(d) For a fixed rise and distance, it is generally better to use a short length of reasonable maximum and for the balance of the distance a low rate, than to use a uniform moderate rate grade for the entire distance; this is not strictly in accord with the principles of cheap motor operation (diagram 3) but the net practical results are generally better. This means that if a road is running up a valley on an easy grade and must leave the bottom land and climb on a side hill location to reach a pass, it is generally better to make the climb as short in distance as possible, as a side hill location usually introduces poor alignment and generally increases the excavation per mile over a valley location.

2. *Alignment should be made as safe as possible considering the funds available.* Safety of traffic governs alignment practice. Cost of traffic operation has no practical effect.

(a) Good alignment should never be sacrificed to reduce grades below a reasonable maximum. For safe alignment practice see below.

(b) Good alignment may be sacrificed to get a reasonable maximum, but this condition necessitates the reduction of grade at the danger points (see below).

(c) Improved alignment warrants increased distance only when danger is eliminated. Increased distance is not warranted merely to make an easy curve easier.

(d) It is better to use a steeper grade (up to a reasonable maximum) with good alignment than to use poor alignment and a lower grade.

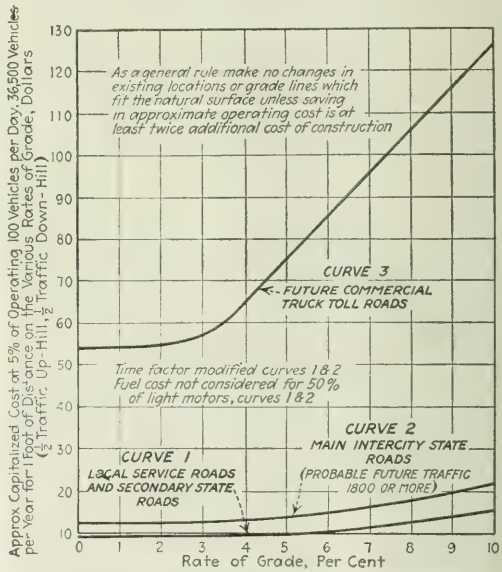
(e) Exceptionally good alignment (practically straight) may in some cases warrant an increase in the reasonable maximum grade above the rates recommended below. This modification would not, however, apply unless it were impossible to locate and grade the lower rate location so that the sight distance on it was at least 250 feet.

(f) An alignment and grading design which results in a sight distance of 250 to 350 ft. is safe and desirable but large expenditures to increase still further the sight distance must be used with caution unless the funds are unlimited. Increase in maximum grade above the recommended maximum in order to increase sight distance above 250 to 300 ft. is rarely warranted.

3. *Short distance is desirable provided considerations of safety, rise and fall, or reasonable maximum grades do not modify the conclusions.*

(a) Distance may be increased to reduce danger by better alignment at bridge approaches, railroad crossings or to avoid difficult topography. Recommended minimum radius of curvature are given below.

(b) Distance should be increased to get a reasonable



3. PRACTICAL BASIS OF COMPARISON, ALTERNATE LOCATIONS, ALIGNMENT ASSUMED TO BE FAIRLY GOOD

The costs given are conservative for curves 1 and 2. Further investigation and experiment will undoubtedly increase these values rather than reduce them.

maximum for a fixed rise, but rarely to reduce the grade below a reasonable maximum for a fixed rise.

(c) Distance should never be increased to reduce rise and fall on grades of 2 per cent or less.

(d) Distance may be increased to reduce rise and fall on grades over 2 per cent (use diagram 3 for comparisons of this kind), but for grades not exceeding the maximum it is rarely desirable to increase distance unless a noticeable rise and fall can be eliminated by a small additional distance. For ordinary easy rolling topography the principle of the straight line location is generally sound.

4. *The elimination of needless rise and fall is desirable, modified by certain conditions.*

(a) The elimination of rise on steep grades is desirable. Distance may be increased to accomplish this, provided the disadvantage of increased distance is balanced against the value of less rise (see diagram 3).

(b) The elimination of rise on grades of 2 per cent or less is of no value from a practical standpoint.

(c) Adverse grades may be used to eliminate dangerous alignment or shorten distance provided the shorter distance is of more value than the disadvantage of the extra rise (see diagram 3).

Summary of Cut and Fill Grade Reductions

Grade reductions by cut or fill assume that the road location is fixed for some reason and that further improvements must be by cut or fill. The distance is always fixed. Reasonable maximum grades are essential.

(a) For a fixed rise there is no practical advantage in reducing the rate of grade below a reasonable maximum.

(b) Reduction of total rise and fall on steep grades is desirable.

(c) Reduction of rise and fall on light grades has no practical advantage.

(d) The use of short adverse grades of 2 per cent or less on a long climb has no practical disadvantage.

The sources of justifiable economy in cut and fill design lie in the use of the short maximum in connection with the long ruling grade and the use of a rolling grade profile for all intermediate rates.

The application of these principles in conjunction with the "spotting method" of profile design generally results in a satisfactory road at a moderate grading cost. The violation of these principles of location and cut and fill profile design occur quite frequently.

Maximum Grade

From the standpoints of horse traffic, single unit motor traffic or trucks with one trailer, safe footing and economy of construction and maintenance the following recommended rates of maximum grades will give moderately good satisfaction. In unusual cases the possibility of the extensive use of long trailer trains would tend to reduce these recommended rates but the author wishes to emphasize the opinion that very few roads need be designed at this time primarily for long trailer trains. The following rates are satisfactory for the ordinary motor equipment used by the great majority of road users and additional expenditure would not be warranted for the benefit of a few men.

Main Commercial Roads in Flat Country—Long 2 per cent ruling grades are desirable but do not justify much additional construction cost. Any long ruling grade up to 5 per cent will probably be satisfactory. Short 6 per cent grades are not inconsistent. A large volume of hauling by trailer trains might warrant reductions below usual practice provided the interests operating such haulage paid the increased cost of construction.

Main Commercial Roads in Hilly Country (Well Settled Districts)—Long 5 per cent ruling grades are desirable and justify considerable expenditure provided they do not increase the total distance. Seven per cent grades are probably justified to prevent increase in distance for a fixed rise. Long 6 per cent grades are fairly satisfactory but as a rule if 5 per cent cannot be reasonably obtained it is just as well to jump to 7 per cent. Short 7 or 8 per cent grades are not inconsistent in connection with long 5 and 6 per cent grades provided the element of safe team footing is considered.

Main Roads Pioneer Districts—Long 5 per cent grades are very desirable provided they do not increase the total distance, particularly if the road is a natural soil road and considerable horse traffic prevails. Any long grade up to 7 per cent is fairly satisfactory. Short 7 and 10 per cent grades are not inconsistent except for trailer trains. Grades higher than 7 per cent are not, however, in much favor on account of danger and high maintenance cost.

Side Agricultural Roads or Unimportant Pioneer Roads—Any long grade up to 7 per cent is satisfactory. Short 10 per cent grades are consistent in connection with a 7 per cent ruling provided the element of safe footing is considered. Grades steeper than 7 per cent, however, have a high maintenance cost.

Scenic Roads—Long 6 per cent grades are convenient on account of preventing gear shifts. Ten per cent is not unreasonable for such roads except that on a 10 per cent grade the alignment should be easy, as later discussed, and the maintenance cost is high.

Effect of Alignment on Grade (Mountain Roads)—On sharp curves it is desirable for the driver to have first-class control on the score of safety. An extremely sharp curve with a large central angle also reduces the hauling capacity of a six-horse team by from 20 to 40 per cent. Considering both safety and team hauling it is, therefore, desirable to reduce ruling grades on sharp curves. These considerations have no practical value on mountain roads for curves having radii greater than 100 ft., but on sharper curves good practice recognizes this principle. Ordinary design uses radii of from 40 to 80 ft. on difficult switchback turns. For a 40-ft. radius the grade should not exceed 3 per cent; for an 80-ft. radius 4 per cent is a reasonable maximum.

Effect of Alignment on Grade (High-Class Roads, Well Settled Districts—Good practice reduces grade to 3 per cent or less where the sight distance is less than 250 ft. or where the radius of curvature on a steep grade is less than 400 feet.

The following summary agrees with general current practice and can often be used without raising the cost beyond the bounds of reason. A summary of this nature is of course of only general value. Each case must be worked out on its own merits. Broad generalizations of detail requirements are dangerous if used indiscriminately.

Main Commercial Roads (Well Settled Districts)	
Minimum sight distance	300 to 400 ft
Minimum radius of curvature at right angle turns on level outside of villages where sight distance does not control	250 to 400 ft.
Minimum radius of curvature on steep grades or at the foot of such grades where the sight distance is not the controlling factor	400 to 600 ft.
Ordinary Agricultural Roads (Local Service)	
Minimum sight distance	200 to 250 ft
Minimum radius of curvature at right angle turns on level outside of villages	100 to 200 ft.
Minimum radius of curvature on steep grades where sight distance does not govern	300 to 400 ft.
Mountain Roads	
No limitation on sight distance	
Warning signs used where necessary	
Minimum radius on steep grade	100 ft
Minimum radius in extremely rough country 40 ft. Grade not to exceed 3 per cent for a 40-ft. radius and not to exceed 4 per cent for a 80-ft. radius. And grade up to 8 per cent on a 100-ft. radius although desirable not to exceed 5 per cent on a 100-ft. radius or with a large central angle	

It is hoped that the foregoing simple rules and recommendations will dispel any uncertainty that the reader of the previous articles may have had as to the practical use of the analysis.

Mystery Solved: Workman Forgot To Open Valve

According to the *Canadian Engineer* it has been found after two years of poor water pressure in the business part of Chatham, Ont., that the trouble was due to the failure of a workman to open a force-main valve at the pumping station after it had been closed for repairs.

A Banker's Analysis—

The Outlook for Business

By Francis H. Sisson
Vice-President, Guaranty Trust Co. of New York

Digest of an address delivered Jan. 20 before the annual meeting of the American Society of Civil Engineers in New York City.

THE question uppermost in the minds of business men all over the world, is, "When will present readjustments be completed and a stable basis for business re-established?"

We may arrive at a better understanding of the problems presented by the present situation, perhaps, if we recall some of the important factors that have created existing conditions. The tremendous losses caused by the World War, of course, were primarily responsible for them. While it is impossible to arrive at an accurate computation of the costs or to reduce all of them to a monetary basis, it may be helpful to remember some reasonable estimates which conservatively place the gross monetary loss at approximately two hundred billion dollars (although other estimates run as high as three hundred and thirty-seven billion dollars); the known dead at ten million and seriously wounded at six and a quarter million; the total property loss at thirty billion dollars; the loss in man-power, measured in money, at one hundred and eighty billion dollars, and the national debts of the world in 1920 at two hundred and fifty-five billion dollars, as compared with forty-four billion dollars in 1914.

How Allies Were Aided

To meet the exigencies of war, the people of this country sent billions of dollars' worth of food, fuel, and munitions to Europe. We lent nearly two and three-quarter billions of dollars to the Allies through subscriptions to their bond issues and by extension of banking and commercial credits. We supplied the Allies with two and a half billion dollars more by re-purchasing American securities held abroad. When we entered the war we placed ten billion dollars in credit, of which nine and a half billions were used, at the disposal of the Allies. Since the armistice we have supplied foreign countries with one and one-quarter billions of dollars by absorbing various foreign bond offerings here and have advanced commercial credits to the aggregate, it is estimated, of about three billion dollars.

The period of unusually active business and rising prices, following the war, was characterized by a wave of extravagant buying by domestic consumers. This was made possible by an increase in purchasing power, as is indicated by the fact that the per capita circulation of money in the United States increased from $37.31 on Nov. 1, 1914, to $59.48 on Nov. 1, 1920, and was $59.12 on Jan. 1, 1921. Speculation was rampant. Capital expenditures in preparation for meeting the unusual demand on the part of the public for goods naturally tended to be excessive in many instances. In the first ten months of 1920 industrial financing broke all records, with an aggregate of more than two billion dollars in bonds, notes and stocks. During the corresponding period of 1919 the amount totaled more than one billion, six hundred million dollars, which was the record up to that time. This period was also characterized by extraordinary demands on the part of foreign countries for American goods, and those demands continue very heavy.

While, of course, years must elapse before the tremendous amount of life and property destroyed in the war can be fully replaced and the political and social problems it has created can be solved, there is ample ground for believing that we shall reach a relatively stable condition in this country in the very near future. We have undoubtedly passed through the most critical of our post-war readjustments, although many more must yet be made. It is encouraging to note, however, that the period of inflation apparently has passed, as is evidenced by the fact that during the last few weeks Federal Reserve notes to the value of $245,000,000 were retired from circulation. But any answer to the question that business men and others are seeking is contingent upon the length of time it takes to effect the remaining necessary readjustments.

I refer especially to the readjustment of retail prices to declining wholesale prices and the readjustment of the costs of production to present purchasing power. These necessary readjustments have been tardily started, as was to be expected, but they are now under way, fortunately, and will be completed gradually but with ever-accelerating speed. The sooner they are accomplished, with a minimum of distress, the sooner we will reach a comparatively stable business basis, but we cannot reach that basis until they are finished.

Problems of Readjustment

The adjustment of production costs will involve, and, in fact, will consist, chiefly of wage adjustments, although increased efficiency and decreased margins of profits must also play their part. As wages generally are reduced, of course, there will be curtailed purchasing power, but it should be remembered that decreased costs of production will lower commodity prices which will ultimately offset the reduced buying capacity of the public. The laborers who profited most from ever-soaring wages during the war and for some time after will feel the curtailment first and most, but they should be in a better position to bear it than their less fortunate fellow-workers. Those wage-earners and salaried workers whose incomes were little affected during the last five years and who suffered most from inflated prices will be afforded an increasing measure of relief from now on.

So there are compensating factors in the situation, deplorable as it is that some members of our body politic must always be penalized in periods of inflation and others be distressed in periods of deflation. That is only one of the many reasons why all of us at times would like "to mould the universe more to the heart's desire."

The curtailment of production which inevitably accompanies such industrial readjustments as we are now experiencing, however, will finally prove its own corrective. We are not in the throes of over-production, but merely temporary under-consumption. And it is significant, in this connection, to note that when goods are offered for sale at retail prices which the public believes to be fairly commensurate with prevailing wholesale prices and costs of production they are eagerly bought.

Despite the materially lessened purchasing power in agricultural sections, occasioned by the precipitate decline in the price of farm products, and in certain indus-

trial sections, because of closed plants or the part-time operation of factories and reductions in wages, there is still a tremendous buying power in the United States and always will be. When purchasing is resumed on a large scale it will be all the keener by reason of the delay and the deficits in present commodity stocks.

Thus, the existing situation is even now devising its own corrective, and the pendulum of business activity which has now swung to the two extremes of its arc is already returning to the mean of that arc. As a consequence of this movement, those commodity prices that have sagged too low will rectify themselves while the prices that have soared too high will reach their true level. And wages, which should not be considered in the light of money values but rather in that of purchasing power, will be more equitably adjusted on a sounder economic basis than at present—which will be as beneficial to labor, in the end, as to the whole business community. Wages cannot be sustained on an uneconomic basis any more than can farm products or any other commodities. All necessary liquidations must run their course, and the sooner and franker we face that fact and discount its inescapable consequences the better off we shall be.

The producers and merchants who persist in holding their goods for prices that the public will not pay are courting disaster and preparing to swell the number of commercial failures. They have not learned the elemental rules of successful merchandising that profits come from turning over capital. They are endeavoring to ignore the inexorable law of supply and demand. They are trying to shape business to their liking in ignorance, apparently, that practically every business today is directly or indirectly affected by world conditions that no individual or nation can control.

Foreign Trade

American business men must recognize the vital fact that one of the most important factors in our prosperity henceforth will be our foreign trade. The extent to which our overseas trade is sustained and increased will depend to a large degree upon the methods devised for financing it. And that is quite as much the concern of the business man, whether or not he is directly interested in exporting or importing, as it is of the banks, for the only way we can preserve our present prosperity is adequately to finance our foreign commerce and thereby keep our industries running at normal capacity, for our productive capacity is greater than the demands of our domestic markets. Our domestic prosperity, in fact, depends largely on our success in disposing of our surplus production abroad. And in order to finance our foreign trade adequately, the banks must have the co-operation of the farmers, the manufacturers, and business men generally.

The business conditions of this nation are fundamentally sound. But, after the great crisis through which we passed in the world war and in which we demonstrated our tremendous economic strength, we have relaxed and permitted ourselves to be bound like a Gulliver by lilliputian uncertainties and pessimistic reactions. With the richest and most abundant resources, facilities, and capabilities of any nation on earth we stand on the threshold of the New Year in the rôle of a Doubting Thomas, lacking faith in our manifest destiny, supplanting the eagle with the ostrich as our national emblem.

Leadership that will direct our national thought into logical channels is imperatively demanded at the beginning of 1921. And it will be the duty, as well as the opportunity, not only of the incoming Administration but also of Congress to assume that leadership. It is equally the duty, as well as the opportunity, of American business interests to co-operate fully in giving the country such leadership.

Specialized Use of Mechanical Equipment Features Road Job

Sand Screened From Pit Direct to Motor Trucks—Bucket Elevators Discharge Aggregate From Stockpiles to Trucktractors

By W. F. Welsch
Assistant Engineer, Bronx Parkway Commission, New York City

Rather unusual methods were adopted in the construction of the Bronx River Parkway Drive, extending from Scarsdale to White Plains, N. Y., a distance of about two and a half miles. The high cost of labor and a general demand for economy resulted in the concentration upon the use of mechanical equipment. The type of construction on that particular contract is asphalt block on a concrete foundation. The width of the paved roadway is 41 ft., including a 6-in. concrete edging on each side which is laid integral with the concrete base. Asphalt blocks are 5 x 12 x 2 in. are manufactured at Hastings-on-Hudson, N. Y., and shipped direct from plant to the job in motor trucks.

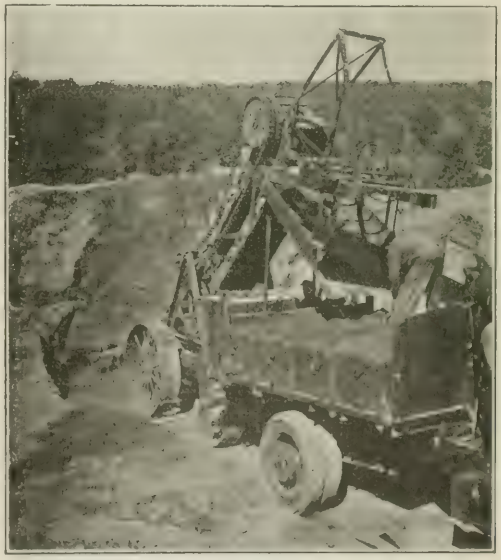


FIG. 1. SAND SCREENED FROM PIT TO TRUCK

The blocks are laid on a ½-in. mortar bed, the joints being sanded. The concrete base is a 1:3:6 mix, the bottom of the slab being a straight line from the center of the roadway to each side and having a rise of 3 in. from each side to the center. The top of the finished concrete base is a parabolic curve, the concrete being 7 in. thick at the center and 5 in. thick at the sides. The finished pavement has a 5-in. crown.

Equipment used in the placing of the concrete foundation and edging consisted of two one-bag batch mixers; three 1-yd. tructractors; two loading machines, and three 3½-hp. pumps for furnishing water from the Bronx River, which parallels the drive. Cement, sand and crushed stone were delivered to the road in 6½-ton capacity motor trucks. Due to possible delays in materials shipments if shipped by rail, the cement and crushed stone were shipped in barges, unloaded at the dock at Hastings-on-Hudson, and delivered to the road at an average haul of eight miles. The sand for the concrete was obtained about two miles from the work where it was screened directly from the pit into automobile trucks, having a capacity of 4 cu.yd., by means of a path-digging loader equipped with a screening device. The device consisted of a screen attached to the top of the loading machine with a power-vibrator attachment. In screening sand was deposited in the truck and overs were diverted into a deflector chute at the bottom of the screen and deposited alongside the trucks.

After being transported to the job, the sand was stockpiled on the subgrade along one side of the road at intervals of 10 ft., the crushed stone dumped on the other side of the road at intervals of 5 ft., in piles of about 4 cu.yd. each. The roadway was left clear for the transportation of cement and other materials, where necessary, to the mixer. The two concrete mixers were operated abreast, one on each side of the road, the concrete being placed, in one operation, for the full width of the pavement. Two loading machines were used in the handling of the crushed stone and sand. The stone was elevated from the stone piles in traveling buckets on the loading machines to measuring bins having the capacity required for a one-bag batch, and the sand was handled in the same manner by loading machines at the sand piles. The three-wheeled tructractors delivered the crushed stone and sand to the loading skips of the concrete mixers. The tractors traveled up to the sand loader, where the tractor operator opened a bin and received his charge of sand, and then drove to the stone loader, receiving a charge of stone, the mixture being delivered into the mixer hopper. Under ordinary conditions three tructractors were used around the mixers, and hardly ever was there any appreciable congestion.

The operating crew on concrete work consisted of thirty men distributed as follows: Two mixer operators, two loader operators, three tructractor operators, two concrete rakers, two chute men, two spreaders, two men handling cement at hoppers, five men placing forms, two men placing grade pins, etc., and four men delivering cement from storage piles to the mixers. An average rate of construction per day of 300 lin.ft. of 41-ft. road was maintained. Expressed in other terms, this is a rate of 260 cu.yd. of concrete per day.

FIG. 2 STOCKPILING PLAN AND LAYOUT OF MECHANICAL EQUIPMENT

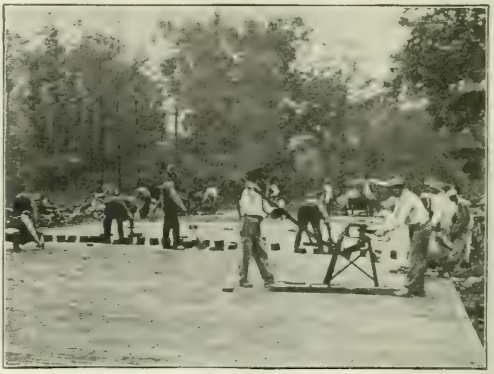


FIG. 3 LAYING ASPHALT BLOCKS ON MORTAR BED

The engineering and construction work upon the Bronx Parkway Drive was under the supervision of Jay Downer, engineer-secretary of the commission. L. G. Holleran is deputy chief engineer and Chester A. Garfield is field assistant engineer in charge of construction contracts. The writer acted as resident engineer on the construction of the pavement herein described. Leslie B. Farr was general superintendent for the contractor, the Hastings Pavement Co.

Dry Rot of Timbers

As applied by many persons any decay which is found in wood in a comparatively dry situation is called dry rot. Thus loosely used, the term actually includes all decay in wood, since wood kept sufficiently wet cannot decay. To the pathologist the term dry rot means a certain fungus, *merulius lachrymans*, which gains its distinction from the fact that it is frequently found growing in timbers without any apparent moisture supply. In reality it does not grow without moisture and is as powerless as any other fungus to infect thoroughly dry wood, according to the Forest Products Laboratory. Given moist wood in which to germinate, it is able to make its way a surprisingly long distance in dry timbers, drawing the water it needs from the moist wood through a conduit system of slender minutely porous strands. Wood in the typical advanced stage of dry rot is shrunken, yellow to brown in color, and filled with radial and longitudinal shrinkage cracks, roughly forming cubes. In many instances these cracks are filled with a white felty mass, the interwoven strands of the fungus. The decayed wood is so brittle and friable that it can easily be crushed into powder.

The dry rot fungus is active in nearly every region of this country, in Canada and in Europe. It is destructive to factory and house timbers and to logs in storage. Coniferous or soft woods are more commonly infected by it than hardwoods.

Report Constructively Criticises California's Road Policy

More Substantial Concrete Pavement, Shorter Life Bonds, Budget for Test Department, Among Auto Clubs' Recommendations

FAILURE of paved highways in California have become frequent in the past two years and consequent criticism of state highway standards and construction methods has been so general that the board of directors of the California State Automobile Association and the Automobile Club of Southern California decided to institute an engineering and economic study of all the paved state highways to determine their present condition, their sufficiency in width and their adequacy to carry the ever increasing volume and weight of traffic." In accordance with this announcement, made by the two California automobile clubs, engineers were retained who have just submitted the results of studies extending over a period of six months, in the form of a comprehensive report. This report is now being printed and, pending its appearance, a synopsis of the findings has been prepared and signed by four of the engineers who took a leading part in the study, namely, J. B. Lippincott, consulting engineer, Los Angeles, H. J. Brunnier, consulting structural engineer, San Francisco, Charles Derleth, Jr., Dean of civil engineering, University of California, and Walter C. Howe, consulting highway engineer, San Francisco. Some of the chief points in the findings are presented in the following extracts taken practically verbatim from the synopsis:

The California Highway Commission construction programs of 1913, 1914 and 1915 are highly commendable. Cleanness of administration and absence of scandal have been noticeable. Wilful waste and extravagance cannot be charged and honesty of purpose is freely admitted. It has been the first object of the present study to be constructive in criticisms. Where road failures have been found, an attempt has been made to determine the cause and indicate possible remedies with a sincere desire to profit by successes and failures.

Highway Commission Policy—The commission has lacked foresight and vision in failing to carry out adequate and sufficient experimentation, research and investigation in a broad and comprehensive scale. It has not taken advantage of the few experiments it did make. Until October, 1920, the commission used practically the same type of construction throughout the state, irrespective of traffic, sub-soil or drainage. Such a policy is economically and structurally unsound and open to grave criticisms. Despite innumerable failures of 4-in. concrete road, the commission has continued to build roads of this section in numerous instances under practically the same conditions and upon heavy sub-soils of questionable and uncertain character.

Through a headquarters policy which must be classed as most narrow and shortsighted, the responsibility of the division engineer has been so circumscribed that at times his work has resolved itself into mere routine. This robs the division of its individuality, kills the initiative of the division engineer and affects the entire division organization.

Present Condition of the State Highways—In southern California field inspections indicate as high as 30 per cent of the concrete pavement in poor condition, requiring reconstruction now or at an early date. An additional 19.3 per cent is in only fair condition, serious failure having already begun. This leaves only one half the pavement in this section in what might be termed good condition. In general, inspections in the southern part of the state have indicated higher percentages of failure than in the northern portion where the failure area is 17.7 per cent and pavements in fair condition aggregate 20 per cent, leaving 62.3 per cent of these pavements in good condition. Pavement failures are closely related to soil conditions. In the South 70 per cent of the failures have occurred on adobe subsoils; on sand, gravel or decomposed granite, from 70 to 75 per cent of the concrete roads are in good condition.

Recommended Types of Construction—It has been stated by the chairman of the highway commission that "The concensus of opinion of our engineers is that the reinforcing of the concrete highway is equivalent to thickening it at least 2 in." Tests show that a 6-in. plain concrete slab has a greater traffic capacity than 5-in. sections reinforced as proposed. Therefore, this statement has little foundation in fact. A 5-in. concrete slab is not thick enough to meet heavy traffic requirements. A study of maintenance charges and reconstruction costs during the past seven years leads to the inevitable conclusion that it is more economical to build thicker and more substantial pavements.

For trunk roads an average pavement thickness not less than 6 to 8 in. is recommended, dependent upon sub-grade drainage and traffic requirements. Where the sub-soil is treacherous and yielding, the pavement requires an amount of reinforcement proportional to the foundation difficulties to be overcome.

It is recommended that clays and adobes be adulterated by rolling into them such materials as sand, gravel or broken stone. Everything should be done that will tend to limit the tendency for change in adobe volume with change in moisture content. The shoulders should be not less than 3 ft. in width wherever the clay or adobe is questionable.

Greater width of permanent paved roadway is of extreme importance. Fifteen-foot pavements without shoulders are unsatisfactory and dangerous. The width of all double-track highways should never be less than 18 ft. on tangents and should be widened on curves and grades. Future traffic demands a minimum width of 20 ft. on important roads and near cities, or, wherever traffic is heavily congested, the width should be not less than 24 ft.

Traffic and Traffic Laws—During the past four months 2,000 trucks were weighed as they passed over state highways; 256 of these were found to be overloaded, in some instances as much as 100 per cent. Five hundred trucks gave rear-wheel loadings ranging from 4,275 lb. for 1-ton trucks to 11,280 lb. for 5-ton trucks. The California law provides a maximum weight of 800 lb. per inch width of tire in contact with the road. By actual measurement on 500 trucks the average load per inch width of tire on one rear wheel ranged from 831 lb. on 1½-ton trucks to 1,090 lb. on 5-ton trucks. The maximum load per inch width measured was 1,840 lb. More important than limiting the maximum load per inch width of tire is the need for limiting the maximum load put on any one wheel. The maximum load usually found on rear wheels of 3½-ton and 4-ton trucks is approximately 10,000 lb. The speed averaged 18.4 mi. per hour for 1-ton to 13 mi. per hour for 6-ton trucks.

California has completely neglected to enforce the laws relative to overloading the pavement slabs. There must be co-operation between truck dealers, truck operators and the state authorities in the enforcement of proper traffic laws. California should adopt a uniform motor vehicle law.

Research and Investigations—In work of the magnitude of the California highway program sufficient funds should be set aside for the continuous study of special problems. Some of these are (1) pressure capacity of sub-soils, tests of heavy clays and adobes, drainage and alkali, (2) tests on full-sized pavement to determine the relative advantages of reinforcement vs. greater thickness of slab and varying richness of mix, as well as a study of different types of reinforcement, (3) traffic studies to determine the effects of impact, roughness of pavement surface, design of trucks, etc.

Public Opinion—Public opinion in California demands more permanent types of construction, rather than mileage of highway. Public will not continue to support frail construction with long life bonds.

Conclusion—It is not intended that this report should convey the impression that the committee is opposed to the construction of concrete highways. The contrary is true. The committee believes that the most satisfactory type of pavement to stand heavy traffic conditions is an adequately and properly built concrete slab. The California Highway

Commission, while perhaps not legally and technically responsible for some of the conditions described in the report is, nevertheless, the state's authority having general supervision over the highway program. The commission and its engineering staff must take responsibility for the present highway situation.

Judging from past experience, all future work should be subject at intervals to careful inspection and review by competent representatives of the people.

Kansas Highway Bridge Conditions

Concrete Much Used—Cement Prices and Deliveries Troublesome—Roadway Widths—Many Twenty-Ton Vehicles

REPORTING to the Kansas Engineering Society at its meeting held Dec. 16, 1920, the bridge committee of the society (F. W. Epps, chairman, L. P. Scott and R. V. Leeson) reviewed the present problems and conditions of highway bridge construction in the state, pointing out some significant tendencies. It laid emphasis on roadway widths and load capacities, factors which are proving a puzzle in all parts of the country, and also referred to commercial difficulties which now hamper the construction of concrete bridges. The average cost of concrete in bridge construction during the past year is set at $30.69 per cu.yd. The report follows, slightly condensed:

Twenty years ago the popular type of bridge in Kansas was the steel truss span supported on either masonry or concrete abutments. In many cases these bridges have been neglected and allowed to rust out at vital points until they have failed under the modern loads which pass over them.

With the development of the cement industry, the price of cement has been lowered and the quality improved, until some five years ago, when the concrete structures were cheaper and far better than the steel ones. This period of cheap concrete bridges taught the public the advantages of this type of structure and they are now unwilling to go back to the old types. At present the concrete bridge work is being hindered by the fact that it is very difficult for the contractor to get his cement at a reasonable price and get delivery within a reasonable time. One instance is recorded where a contractor was unable to get cement from the local dealer, so he hauled it from the plant 45 miles away in his trucks. When his bill was presented it included the freight to the job and the local dealer's profit.

Many types of bridges are used in Kansas, but by far the most common is the concrete slab or T-girder span, as determined by the length required. In some counties steel spans have been used for the longer bridges, but always with a concrete floor. Other counties are more progressive and use the higher types, such as the through girder or the arch.

Minimum Roadway Widths Recommended

More trouble is experienced in Kansas with the proper regulation of clear roadways of bridges than with any other feature of bridge design. The law places a lower limit on the width of roadway but does not attempt to set any standards for the different classes of bridges. Section 9, Chapter 80, Session Laws of 1917 states that bridges must have a clear roadway of at least 16 ft., and culverts 20 ft. The bridge specifications of the state highway commission for 1917 recommended roadways as follows: For bridges 18 ft. and for culverts 24 ft. This has been supplemented by the requirement made on federal-aid roads, that bridges must have a width 2 ft. greater than the width of pavement on the road, which generally gives a 20-ft. clear roadway, and that culverts must have a roadway equal to the distance between the shoulders of the road.

While one would suppose that the Western counties would be the ones to call for narrower roadways, as their traffic is lighter and the need for economy greater, just the reverse is true, and the counties that object most strongly to doing more than complying with the law are located in the eastern part of the state.

Your committee wishes to go on record at this point as recommending the use of the following roadways: On township roads, bridges, 18 ft. standard but never less than 16 ft.; culverts, 24 ft. standard but never less than 20 ft. On county, roads, bridges, 20 ft. standard but never less than 18 ft.; on culverts, 28 ft. standard but never less than 24 ft.

In highway loadings the same trouble is experienced as in railway loadings. The loads are constantly increasing and old structures are becoming obsolete and too light for the modern trucks. This is shown on railroad work by the numerous replacements which are made by the larger railroads, many of which are made on bridges that are apparently in good condition although they are not heavy enough to carry the modern loads. Our truck loads are increasing as rapidly as railroad loads, and at present we find that there are in the neighborhood of 30 tractors in Kansas which have a capacity of 20 tons, which is the loading specified by the state highway commisssion for designing bridges in the state. This would indicate that it would only be a matter of time before the present bridges will be depending on their factor of safety to carry the load, and new bridges will have to be designed for a heavier loading.

Strange circumstances are often encountered at bridge lettings, such as at recent letting in one of the northern counties where about $70,000 worth of work was advertised. After contemplated the bids, which were below the estimate on all bridges, the commissioners rejected all bids without any explanation to the five contractors bidding on the work. It is also interesting to note that this county has not let a bridge contract for three years.

The total amount of bridge work approved by the state highway commission up to Dec. 1, 1920, was $2,301,981.05, while the total amount of bridge work approved since the commission started has been $4,475,178.91. The average cost of concrete bridges in Kansas during the past year is $30.69 per cubic yard. This price covers culverts as well as larger bridges.

Teakettles Better than Coffee Pots for Asphalting Pavement Cracks

ALTHOUGH coffee pots are used as vessels from which to pour asphalt into highway pavement cracks, the California highway commission has found that teakettles with a long and well-curved spout are superior for this purpose. The stream poured from a coffeepot, being an overflow, cannot be directed into a narrow crack accurately and is likely to be sprayed over the pavement by the wind. The long spout of the teakettle, on the other hand, delivers a stream from an orifice under pressure; the stream is round, or nearly so, holds together well in a wind and can easily be directed to the exact spot required. The curved spout of the teakettle also prevents drippings from running down the sides of the vessel and with a little care in filling it at the oil heater, its handle and entire outer surface can easily be kept clean throughout the job. Small sprinkling pots, with the perforated tip removed, have also been tried, but are not considered as good as teakettles.

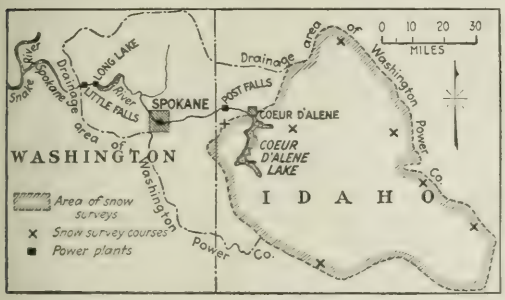
Stabilizing Softened Water

The latest step toward stabilizing a lime-softened water is the use of home-made phosphoric acid to produce a fully carbonated water free from any residual causticity. Laboratory experiments to effect this result have been under way many years and many chemicals have been tried both at Columbus and elsewhere. C. P. Hoover (p. 81) has now gone far enough to use the whole Columbus plant in an experiment with phosphoric acid.

Snow Survey for Water Power From Spokane River

Forecasts of Run-Off From Snow Fields Will Aid Economic Operation of Four Plants and Conserve Water Supply

A SYSTEM of annual snow surveys on the Spokane River watershed above Cœur d'Alene Lake, in Idaho, is to be inaugurated by the Washington Power Co. in order to secure data from which forecasts of the probable spring run-off may be secured, thus increasing materially the efficiency of operation and preventing unnecessary waste of water. The accompanying map shows the area to be covered and also the four hydro-electric plants on the Spokane River which are owned and operated by the company and which use the water stored in Cœur d'Alene Lake.



SNOW SURVEY COURSES ABOVE COEUR D'ALENE LAKE

These plants have a total normal rating of 93,050 kw.: Post Falls Island, 11,250 kw.; Spokane, Monroe St., 8,800 kw.; Long Lake, 52,500 kw.; Little Falls, 20,500 kw. The first of these is in Idaho, where the lake and the watershed to be surveyed are located.

The snow surveys will be made at the close of winter and before melting begins, in order to ascertain the amount of water in storage in the form of snow on the watershed. No attempt will be made to ascertain absolute quantities in storage, but it is believed that the relative amounts from year to year can be secured. The methods used will be essentially those adopted on the Lake Tahoe Basin, as developed by Prof. J. E. Church, Jr., of the University of Nevada (see *Engineering News*, May 29, 1913, p. 110; *Engineering Record*, April 17, 1915, p. 494; and *Engineering News-Record*, Oct. 23, 1919, p. 766).

Snow courses are selected at certain index points where the wind effect is minimized by topography or timber, these courses being indicated on the map. In the spring the snow is sampled and its water content measured at about 50 points on each course, the average being taken to represent the water in storage at that station. The run-off from each major portion of the drainage area is measured and compared with the amount of water in snow storage previously determined. In this manner it is hoped to develop a relation between the total spring run-off and the water previously held in snow storage at the index stations from year to year.

The problem is complicated by many factors, including spring rains, rapidity of melting, winter thaws or chinook winds prior to the effectual spring run-off. In order to secure data from which allowances for these factors can be made, two climatalogical stations are being installed in addition to those maintained by the U. S. Weather Bureau. At these stations temperatures, atmospheric pressures and precipitation of rain and snow will be noted continuously, besides which a certain amount of snow sampling will be carried on. Elevations on the area to be covered by the snow surveys vary from 2,120 ft. at the lake to more than 7,000 ft. on the eastern divide. The present plans contemplate the use of seven or eight well-distributed snow courses at elevations of from 3,000 to 6,000 ft., but it is hoped that this number can be reduced to four stations after the characteristics of the area have been studied for a few seasons.

Each of the four power plants noted above uses water stored in Cœur d'Alene Lake, the controlling works being located at Post Falls, nine miles below the lake outlet. At this point the river is in three channels, on the middle of which the power house is located. To control the lake level the north channel has two bear-trap dams each 53 ft. in length operating between El. 2,116.5 and El. 2,126.5; also seven 21-ft. openings and one 12-ft. opening controlled by Taintor gates above El. 2,116.5. In the south channel there is a dam with six gates each 6 ft. wide by 13 ft. high, with sills at El. 2,108.6. The extreme range of water level in the lake is 17.6 ft., from El. 2,120 to 2,137.6, as determined from records covering 29 years, and the company has secured by purchase and condemnation the right to hold water on all lands above Post Falls to El. 2,126.5. The natural rise of the lake has reached or exceeded that elevation in all years of record except 1905.

For control of the lake level above El. 2,126.5, all the gates at Post Falls are opened wide and the bear-trap dam is lowered in advance of the spring rise. After the natural spring flood peak has passed and the lake level has receded to El. 2,126.5, the bear-trap dam is raised and the lake level is held to that elevation by manipulation of the Taintor and other gates until the inflow has fallen to that required for power and irrigation. When this condition is reached all gates are closed and all water is passed through the Post Falls turbines and is used by the other plants in succession.

Snow survey work will be initiated under the direction of John C. Stevens, consulting engineer, Portland, Ore., and will be in immediate charge of J. B. Fisken, consulting engineer for the Washington Water Power Co. Whether it will be continued as a permanent institution will depend upon the results secured during the first few years.

New District for Alaskan Forest Reserves

Alaska has been designated by Secretary Meredith of the Department of Agriculture as a new national forest district and Charles H. Flory has been appointed district forester with headquarters at Juneau.

The two national forests in Alaska—Tongass in the southeastern section and Chugach in the Prince William Sound country—have previously been under the supervision of the Forest Service office in Portland, Ore. The change to a local administration has become necessary, it is announced, in order to handle efficiently the products of these national forests, which are increasing in importance.

Subgrade Support in Pavement Design

Corners Are Danger Points in Paved Roads—Capillary Seepage Destroys Supporting Power of Subsoils—Tentative Slab Formula Proposed

By Clifford Older
Chief Engineer, Division of Highways, Illinois Department of Public Works, Springfield, Ill.

REGARDLESS of the supporting capacity of the subgrade, the weak points of rigid slab pavements are the corners formed by the intersection of cracks and joints with each other and with the edges of the pavement. On the truck traffic roads of Illinois many broken corners have been observed in all types of rigid pavements, and only in a single instance has a traffic break been observed that was not readily traceable to the piecemeal breaking down of corners or narrow strips formed by longitudinal cracks making acute angles with the edge of the slab. The exception was an asphalt top on a 1-3-5-concrete base 4 in. thick at the sides and 5 in. thick at the center which broke into small pieces under excessive truck loads. An examination of the base showed that the transverse strength of the base had been exceeded not merely at corners but also at the edges and near the center of large slabs. No concrete slab or base 6 in. or more in thickness has broken except at corners.

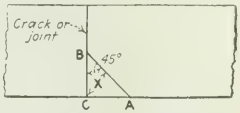


DIAGRAM ILLUSTRATING THEORY OF PAVEMENT DESIGN TO RESIST CORNER FAILURES

Until it is possible to control completely the cracking of rigid slabs it seems obvious that the entire slab must be designed to carry the imposed loads at the weak-points—the corners.

Subgrade support of corners.—Preliminary investigation by the Illinois Highway Department confirms the findings of the U. S. Office of Public Roads that the supporting capacity of clay soils is greatly decreased as the percentage of moisture increases. Further investigations have developed the following data:

(1) Illinois' corn-belt clay soil rapidly absorbs sufficient moisture to render its supporting capacity near the surface almost nil.

(2) Under the center of an 18-ft. concrete slab one month old, laid on a subgrade on which no rain had fallen for six weeks, the subgrade soil was found to contain about 17 per cent moisture after a two days' drizzling rain.

(3) The subgrade under pavements laid on both cut and fill sections with 6-ft. earth shoulders, but without tile drains, appeared practically saturated when investigated three or more days after the beginning of a rainy period.

(4) A very narrow crack will permit the passage of large volumes of water to the subgrade. The practical saturation of the subgrade soil for several feet each side of a narrow crack is but a matter of a few hours' time during a period of continuous rain or melting snow.

(5) The repeated passage of heavy wheel loads over corners, even when such corners are supported by comparatively dry clay subgrades, causes, within certain limits, a progressive depression of the soil under the corners.

These investigations, although not as yet extended enough to be conclusive, indicate strongly that it may be difficult, if not economically impracticable, by any system of drainage, combined possibly with a water proofing of the subgrade, to maintain a clay subgrade dry enough to afford any reliable support to the corners.

Method of Design.—In developing a tentative method of design the following assumptions are made:

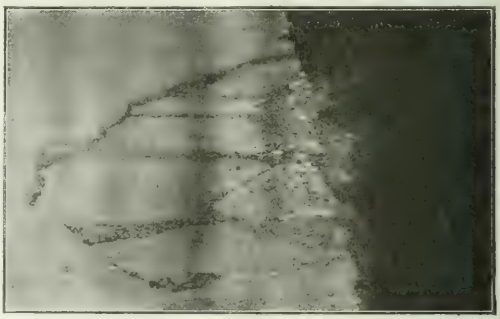
(1) As corners are obviously weaker than other portions of the slab only the corners need be considered.

(2) Until erratic cracking can be controlled it is necessary to build all portions of the slab on the basis of corner strength.

(3) Considerations of economy prohibit the use of reinforcing steel as a srength factor. Many calculations have been made by the Illinois department in an attempt to find an economical design of reinforcement.

(4) Until conclusive observations of the dependable supporting capacity of subgrade soils can be made, taking into account the possible control of the moisture content, *support of corners by the subgrade should be practically neglected.*

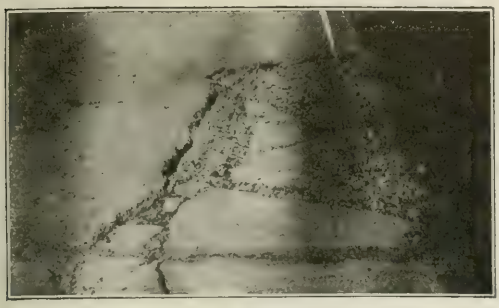
(5) When bituminous filled expansion joints are omitted, and frequent dividing planes with dowel pins or tongue and groove joints are used, so that erratic transverse cracks may not be expected to open materially, a wheel load placed on one side of a joint or crack near a corner may be considered as divided equally between the adjacent corners or slabs. (It is suggested that contraction joints be formed by galvanized or painted corrugated sheet metal or metal sheets so bent as to provide tongue and groove joints.)

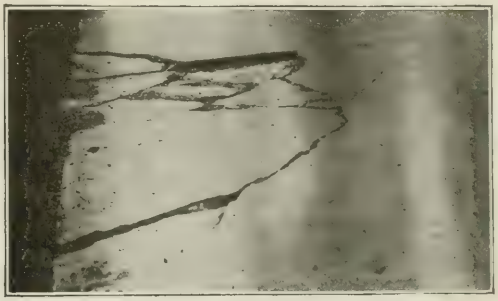


CORNER FAILURE, CONCRETE PAVEMENT

(6) When bituminous filled expansion joints are used or when frequent contraction joints are not used, thus increasing the probability of the wide separation of occasional cracks, the entire maximum wheel load should be considered as supported by one corner.

(7) The effect of impact on a rigid slab constructed strictly in accordance with rigid specifications as to surface smoothness may be considered as offset by subgrade support. The improbability of the maximum wheel load ever being applied at the point causing maximum moment provides an additional factor of





TWO OTHER EXAMPLES OF CORNER FAILURES OF CONCRETE PAVEMENTS IN ILLINOIS

safety. (Observation of the pointer of an Ames dial set to measure the deflection of corners failed to show visible vibration during the close passage of moving truck wheels. These tests were made on a federal aid section of concrete road constructed by contract with no attempt to secure unusual smoothness. It is possible, although not probable, that impact vibration, too rapid to be detected by ordinary means, may have been present.)

(8) The necessity for designing for tensile fiber stress only need be considered.

In Fig. 1 W = maximum wheel load, one-half of which is to be considered as applied at C.

x = the distance from the load to the critical section equal the moment arm.

$AB = 2x$ = the critical section located on a line making an angle of 45 deg. with edges of slab.

S = the allowable tensile stress of the material forming the upper surface of the transverse strength element of the slab.

d = the depth of the slab.

I = the moment of inertia of a cross section of slab at the critical section $= \frac{2\,x\,d^3}{12}$.

M = bending moment wx

Substituting these values in the formula $S = \frac{Mc}{I}$, this formula reduces to $S = \frac{1.5W}{d^2}$ or $d = \sqrt{\frac{1.5W}{S}}$.

Assuming the whole load carried by one corner only, this formula would become, $S = \frac{3W}{d^2}$ or $d = \sqrt{\frac{3W}{S}}$.

It is to be noted that at right angled corners the critical section may be at any distance from the loaded point. In practice the subgrade under the corners of a heavy double line traffic slab will be depressed more than elsewhere, leaving the subgrade support some distance back.

Perhaps it would be safer to consider the entire wheel load as carried by one corner, although the few experiments so far made in Illinois show equal deflections of adjacent corners when such corners are formed by narrow cracks or dowelled dividing planes, the load being imposed upon one corner only.

If one corner only is considered as carrying the whole load, then the above formula is undoubtedly on the safe side if the pavement is built with a sufficiently smooth surface to reduce impact to a negligible quantity.

The accompanying views show corner breaks in a pavement 6 in. thick at the sides, and 8 in. thick at the center, composed 1 : 2 : 3½ wet mix concrete, with a roller and belt finish. No expansion joints were used; header boards provided dividing planes at the end of each day's work. The breaks were all at corners formed by rather wide cracks, and were definitely known to have been caused by certain trucks hauling crushed stone.

In accordance with the above formula and assuming no subgrade support or mutual support of adjacent corners, the fiber stress in the concrete would figure about 750 lb. per square inch. The actual stress developed at the right angled corners was no doubt less than this as it would have been impossible for the entire wheel load to come upon the extreme corner. The modulus of rupture of the concrete was not known, but probably was between 500 and 600 lb. per square inch.

Only twelve corners were broken out of several hundred which existed in the length of road used by these trucks. The fact that all corners were not broken was probably due to partial subgrade support and to partial mutual support of adjacent corners, but largely to the fact that the loaded trucks traveled close to the edge of the 18 ft. slab only when passing empty trucks going in the opposite direction. There was no traffic on the road aside from the stone trucks. The loading of the corners, therefore, occurred only at infrequent intervals when trucks passed at cracks or joints. A total of about 1,500 loads was hauled. This instance would seem to afford a rough check on the formula.

Further Research Planned.—Further investigation of slab deflections and stresses; the effect of mix, type of wearing surface, etc., on modulus of rupture; the supporting capacity of soils with varying moisture content; the variation of the moisture content and supporting capacity of such soils under pavement slabs at different seasons and with different types of drainage systems; the compression of soils under repeated loads; the possibility of largely controlling the location of longitudinal and transverse cracks by sheet metal divisions; the mutual support of adjacent slabs afforded by friction of the rough surfaces at cracks; the mutual support of adjacent slabs which may be secured by artificial means at dividing planes, and other items affecting the transverse supporting capacity of pavement slabs, is being carried on in connection with a two-mile test road being constructed by the Illinois Highway Department and at favorable points on old pavements.

The test road was designed to determine as far as possible the load supporting capacity of various types of pavements, laid on a uniform subgrade as affected by

thickness and other elements governing transverse strength.

Great care was used in selecting the site in order that uniform subgrade, alignment and grade conditions might prevail. The road will be closed to public traffic until the test is complete. Upon the completion and the curing of the pavement the road will be subjected to an artificial truck traffic, gradually increasing in weight until the legal load limit of Illinois has been exceeded by about 50 per cent.

Four principal types of pavement are used: macadam base with brick and bituminous concrete wearing surfaces, concrete base with bituminous top, concrete base with monolithic and soft filler brick top, and one course concrete. Generally each test section is 200 ft. long. The series of sections for each type begins with a thickness roughly estimated as equivalent to 4 in. of concrete and increases to the approximate equivalent of 9 in. of concrete.

The behavior of the subgrade before and during loading will be observed by means of pressure cells secured from the United States Office of Public Roads, and by means of special observation devices consisting essentially of sections of iron pipe set in the slab, protected at the top by removable plugs and containing a loose brass disk in contact with the subgrade. By means of an inner pipe this disk is forced down when the pavement deflects under load and remains in contact with the subgrade as the slab recovers. Thus a means is provided to observe, with an Ames dial, the permanent or temporary depression of the subgrade. The supporting capacity of the subgrade may also be observed at any time by loading the disk. By removing the disk moisture samples may be obtained.

A descriptive bulletin is being prepared which will give in detail the design of the various sections, methods and control of construction, description and use of special apparatus, observations under way and contemplated, plan of loading, etc. It is expected that the loading will be started in July or August, 1921. It is hoped that when completed the above briefly described investigations may aid materially in determining a rational method for the design of rigid slabs. In the meantime the foregoing provisional method of design is suggested for use.

Typhoid and Some Other Death Rates in 1919

Deaths from typhoid fever in the registration area of the United States in 1919, according to the Census Bureau, totaled 7,860 in a population of 85,147,892, giving a typhoid rate of 9.2 per 100,000. Typhoid caused 0.7 per cent of the total of 1,096,436 deaths for the year. Suicide exceeded typhoid as a cause of death, there being 9,732 reported cases of suicide, giving a death rate of 11.4 per 100,000. Tuberculosis (all forms) caused between 13 and 14 times as many deaths as typhoid, the total number of tuberculosis deaths being 106,985—or 125.6 per 100,000 and 9.8 per cent of all the deaths for the year. Pneumonia was a close second to tuberculosis and influenza was also high, the death rates being 123.6 for the first and 98.8 for the second. Going to the other extreme, small pox caused but 358 deaths and a death rate per 100,000 of only 0.4 in 1919. The general death rate for 1919 was 12.9 per 1,000, the lowest on record in the registration area, which now includes 33 states, the District of Columbia and 18 cities in non-registration states.

Steel from Slag Concrete Shows Little Corrosion

AN EXCELLENT condition generally of reinforcing steel was disclosed by the recent wrecking of a 15-year old slag concrete building in Cleveland, Ohio. There was local corrosion and corrosion of individual bars or stirrups, where faults in construction coincided with possibilities for the accumulation of moisture, but the steel showed no evidence of general attack by rust. It appeared, on the contrary, notably clean and the faces of the concrete which had been in contact with the steel presented little discoloration.

APPEARANCE OF FLOOR SLAB REINFORCEMENT

The structure being wrecked is a four-story and basement building between two older buildings. It consists of wall columns and girders and two rows of interior columns connected by girders carrying a 4-in. floor slab designed for a load of 125 lb. per square foot. Construction was begun in 1905, continued through the winter, and was completed in the spring of 1906. The

CONDITION OF CONCRETE AND STEEL GIRDER END

concrete was a 1:2:4 mixture with a coarse aggregate of ¾ to 1 in. slag from Cleveland furnaces. Round bars, with pipe couplings, were used in the columns, but all other reinforcement was of twisted square bars, ¾-in. for floor slabs and 1 in. for girders.

Generally the concrete was excellent but there were occasional places where it was porous or had not been worked to close contact with the steel and the steel in more numerous places was not covered with the proper thickness of concrete. These were the places where corrosion was found. There was also corrosion of the

slab rods in one panel containing the toilets and where there was well defined leakage from the plumbing.

Observation of the corroded steel indicated that where the concrete covering was shallow (less than one inch) moisture had penetrated to the steel, or that, by way of some local fault, moisture had worked along the bar between it and the enveloping concrete.

Reclamation Service Achievements to June 30, 1920

PROGRESS in the reclamation of semi-arid lands by the U. S. Reclamation Service since June 17, 1902, the date of the approval of the reclamation act, is indicated strikingly by the statistics in the annual report of the Secretary of the Interior for the fiscal year ending June 30, 1920. Twenty-four primary projects and four Indian projects have been constructed in whole or in part at a net cost of $125,000,000. The value of crops grown in 1919 on lands served either in whole or in part from the works of the service amounted to nearly $153,000,000. About $89,000,000 represents the value of crops grown on the 1,113,469 acres of cropped land on the projects proper and the balance is an estimated amount from approximately 1,000,000 acres served with water under the Warren Act from the works of the service. Projects already completed will comprise ultimately an area of more than 3,300,000 acres.

The following projects reported crop values in excess of $100 per acre: Salt River, $126.27; Yuma, $134; Carlsbad, $106.04; Okanogan, $367.23; Yakima, Sunnyside unit, $167.07; Yakima, Tieton unit, $154.10. The annual farm census of the service shows that the value of products on reclamation projects, nearly $80, is twice as large per acre as the average yield on unirrigated land in the humid region.

The progressive increase in irrigable acreage, irrigated acreage, cropped acreage and crop value since 1913 on the service projects proper are shown in the table.

Year:	Irrigable Acreage	Irrigated Acreage	Cropped Acreage	Crop Value
1913	1,181,362	694,142	637,227	$15,676,411
1914	1,240,875	761,271	703,424	16,475,517
1915	1,330,222	814,906	757,613	18,164,452
1916	1,405,452	922,821	858,291	32,815,972
1917	1,502,468	1,026,663	966,784	56,462,313
1918	1,601,934	1,119,566	1,051,193	66,821,396
1919	1,636,159	1,187,255	1,113,469	88,974,137

Special emphasis is laid in the report on the necessity of providing for adequate drainage on practically every project to prevent or check seepage and waterlogging of the soil and deposition of alkali. The problem is closely allied with that of the excessive use of water but irrespective of the methods employed in the delivery of water there will be a drainage problem on most projects since the escape of some water to the lower levels cannot be avoided. A large part of the funds available necessarily has been and must continue, according to the report, to be employed in the construction of drainage work, but the results accomplished fully justify the cost.

The Salt River project reported a total crop value of $23,000,000. This is more than twice the amount that the Water Users' Association is to repay to the United States over a period of 20 years, and most of this money will be supplied by power profits from the project works. On other projects the development has reached the stage where the annual crop value is comparable to the total cost of building the irrigation works as indicated in the following tabulation:

Project	Value of Irrigated Crops, 1919	Net Construction Cost to June 30, 1920	Operation and Maintenance Cost, 1919
Salt River, Ariz.[1]	$23,768,000	$10,548,000	(1)
Yuma, Ariz.-Calif.	7,012,000	8,980,000	$238,500
Orland, Calif.	892,000	965,000	23,200
Minidoka, Idaho[2]	5,926,000	5,820,000	[2] 143,200
Carlsbad, N. Mex.	1,989,000	1,380,000	58,200
Okanogan, Wash.	1,951,000	1,093,000	33,500
Yakima, Wash.[3]	16,731,000	10,150,000	[3] 210,000

[1] Works operated by Water Users' Association.

[2] Gravity unit operated by water users. Costs include storage works serving large area under Warren Act, for which crop returns are not here included.

[3] Costs include storage works serving areas under Warren Act for which crop returns are not here included.

Alfalfa continues to be the principal crop grown, covering 40 per cent of the acreage cropped. Wheat comes next with 15 per cent; then pastures, 10.3 per cent and cotton 9.7 per cent.

No new projects have been undertaken because of lack of funds. This condition results from the progressive decline in the receipts from the sale of public land, combined with the comparatively small returns from construction repayments resulting from the 20-year repayment law and the necessity of setting aside annually $1,000,000 to repay advances from the $20,000,000 revolving fund. It is expected that several million dollars will be transfered to the reclamation fund under the provisions of the act of Feb. 25, 1920, providing for leasing lands containing coal, oil, etc. The reclamation fund has received $100,078,476 from the sale of public lands, $493,330 from the sale of town lots and $20,000,000 from the revolving fund.

Fire Danger in Parked Automobiles

Traffic congestion is not the only evil result of the custom of parking automobiles on city streets as the following note from the "Quarterly" of the National Fire Protection Association, January, 1921, indicates.

Chief John C. McDonnell, that capable and serious minded official who has continually in view, and very rightly so, the possibilities of a serious conflagration in Chicago, has broken silence in a communication to the local transportation committee of the Chicago City Council on a matter that is becoming more or less of an obsession to the fire chiefs of all our cities, and which must continually impress any thoughtful pedestrian in a city street: the choking of our street areas by the parking of automobiles and the difficulty of clearing the streets of them for the operations of the fire department in case of a big, quick-spreading fire. Most cities prohibit parking at the curb within 25 or 30 ft. of a hydrant, but this does not relieve the streets of congestion which frequently dangerously delays the fire apparatus in responding to downtown fires; nor relieve the firemen of the necessity of wasting precious moments in moving parked automobiles to make room for an effective handling of the apparatus. To safeguard cars against theft, special locks are provided, and when the fire occurs the owner of the parked car, the only person able to unlock it, may be at a matinee or in some remote part of the city. The operated cars themselves present a sufficient impediment at certain moments, as was sufficiently demonstrated at a spectacular fire in Salt Lake City last year, which occurred about shop-closing time and attracted such a number of spectators in automobiles as to close several avenues of approach to the second-call apparatus. Although but a few blocks away, the trucks dodged about for fifteen minutes before gaining successful access to the fire area. This matter of street congestion is one to which traffic experts may very well give their prayerful attention. There is untold potential danger in it to every city in North America.

Highway Bridge Conditions and Requirements

—*A Symposium*

Modern Traffic Loads and Speeds in Relation to the Adequacy of Old Bridges—Official Views from Various States on Maintenance, Reinforcement and Permanent Construction

REPORTING on methods of strengthening highway bridges, a special committee of the American Road Builders' Association recently stated, "It has been estimated that more than 80 per cent of the highway bridges are a distinct menace." One of the New Jersey highway commissioners resigned, a few weeks ago, on account of the serious condition of the state's road bridges; and at that time the commission made a demand upon the state legislature for an appropriation of several millions for immediately urgent bridge reconstruction, to be increased to a total of $18,000,000 within the next ten years.

These facts evidence a serious view of the highway bridge situation. A more optimistic view was presented by M. W. Torkelson, bridge engineer of the Wisconsin Highway Commission, in *Engineering News-Record* of Jan. 13, 1921, p. 61. Denying that the condition of highway bridges is a menace, Mr. Torkelson says, as to Wisconsin, "At the present rate of accomplishment we expect to keep ahead of our traffic problem."

In order to bring out the facts concerning highway bridges more fully, *Engineering News-Record* requested a number of state highway departments to comment on Mr. Torkelson's statement of the case. Their replies, given below, indicate that while in some states the bridge problem is merely one of maintenance, in others it is necessary to plan for large-scale reconstruction.

A Program of Bridge Construction Vital

By Clarence L. Hussey
Bridge Engineer, State Board of Public Roads, Providence, R. I.

The views on the safety of old highway bridges expressed by Mr. Torkelson have been read with much interest and some concern. Apparently his purpose is to prevent unnecessary repairs to bridge superstructures, and the motive is commendable, but the effect, locally at least, may be unfortunate. Many public officials who by choice or expediency are acting without technical knowledge or proper advice will be overconfident through misinterpretation of this article. Funds required for bridgework may be diverted until a series of accidents results in loss of life, damage to property, and expensive emergency work. The fact that there are relatively few instances of actual collapse of bridges in service is not reassuring in itself.

The conditions affecting the construction and maintenance of bridges in Rhode Island are serious. There are *no limits in weight* or tire pressures of highway vehicles fixed by statute in this state, and there are therefore very considerable numbers of vehicles in use which weigh with their loads between 15 and 20 tons. Needless to say, a great many of our highway bridges are not capable of carrying such loads without grave danger.

The writer cannot endorse the opinion that old highway bridges are a secondary risk. Accidents at other parts of highways are not strictly comparable to accidents resulting from defects in bridges, because structural weakness is less evident and its consequences usually more serious.

Present maximum load requirements evidently do not vary much in different localities. Future loads, however, are speculative and should not be estimated too conservatively. Trucks with trailers approximating railway loadings are a possibility. Considering the locomotive as a parallel case, the increase in weight has been beyond all prediction. The writer feels that 20-ton loads should be a minimum requirement for all reconstruction, and that for permanent or semi-permanent structures this load should preferably be assumed as concentrated on a single axle.

Failure of plank or stringers is usually the first indication of overloading, though if heavy trucks were to cross our old truss bridges in close formation the trusses would be as likely to fail as the floor. Truck drivers instinctively operate at considerable headway, and failures usually occur in the order of plank, stringers, trusses and supports. Plank failures are common, and the writer has noted instances of badly bent floor stringers. Maintenance to the extent of relaying thicker plank and reinforcing the stringers in special instances generally is warranted, and the contention that this be taken as the usual limit of maintenance work is logical.

The writer believes that no exaggeration of the conditions of our old highway structures is necessary, that the simple facts are sufficiently disconcerting and that a program of permanent bridge construction is a vital issue in most of our states. In Rhode Island more than two-thirds of our state highway bridges are of concrete, designed for an indefinite future with ample provision for any reasonable increase of loading.

A reconstruction policy must of course be adapted to local conditions, but pending the erection of new bridges every precaution should be taken to insure the safety of our old structures. The writer believes that nearly all old highway bridges excepting some masonry arches involve elements of risk, many of them serious enough to be regarded as a menace to travel.

Minnesota Bridge Conditions

By J. T. Ellison
Chief Bridge Engineer, Minnesota Highway Department, St. Paul

In Minnesota traffic has not as yet reached the density which is found on some of the eastern highways, but our highways and bridges are subjected to as heavy individual loads as is the case in any part of this country. Serious accidents resulting from the failure of bridges have been very few and far between, averaging not over one or two per year for the last four or five years. These accidents have in nearly every case resulted from the failure of the floor system of steel truss bridges which have been in place from 10 to 30 years, and in nearly every case the failure was due to the poor condition of the timber joists. I do not believe we have had a failure in this state involving the fracture of steel joists or tension members of a truss span. During the period following the year 1910, we had several failures due to the buckling of the top chord of trusses built on the section commonly known as

"T-chord." These bridges have been practically eliminated in this state, except for a few on minor highways.

Insofar as the main arterial highways of this state are concerned, one is absolutely safe with a load of 10 tons, provided reasonable speed is observed in crossing some of the timber floor bridges.

During the past years we have built many hundreds of bridges, primarily on the main arterial systems, and all of these bridges are designed for a 20-ton tractor, with 15 tons carried on the rear axle. This gives a very heavy floor system and I believe makes our bridges adequate for any load that is likely to be imposed upon them on the future. Of the bridges on the proposed trunk highway system of this state, between 65 to 70 per cent are of permanent construction and are safe for the above load, and I am of the opinion that within the period of the next five years practically every bridge on the trunk highway system will have been rebuilt or repaired to make it safe for the maximum load provided by our specifications.

Bridges in Ohio Probably Better Than Roads

By Charles Ash
Deputy Highway Commissioner, Ohio Bureau of Bridges, Columbus

A large number of timber truss bridges ranging from 40 to 200 ft. span are still in use in this section, and although many have been built and have been in use for over 50 years they are in a remarkable state of preservation. Several spans in excess of 200 ft. and located on main traveled thoroughfares give no indications of weakness and are constantly being used up to the 12-ton maximum limit allowed by the laws of Ohio. A notable exception to this statement is the timber bridge over the Scioto River near Waverly; this bridge has been condemned and an endeavor is now being made to replace it. As a general proposition the old timber truss bridges will carry the 12-ton load allowed. Of course the plank floor and floor joist must be looked after and replaced when necessary.

The older iron and steel bridges are as a rule in much poorer state of preservation than the old timber structures, due to lack of paint and a tendency to shave on the design. Some years ago there was quite a crusade against "tin bridges," and we have quite a few of the horrible examples still with us. Lack of proper bracing caused the destruction of a 200-ft. span in the northern part of the state; other shorter spans are standing for no very apparent reason. However, this type of bridge is not as common as its notoriety would indicate. There are hundreds of substantial steel highway bridges in all sections of the state which are giving little or no trouble to maintain.

Certainly one must put new floors on bridges, and if this is neglected trouble ensues. Local officials appreciate that a pavement must be maintained, but there is a tendency to take the stand that by some magic the pavement or floor of a bridge is good for the life of the bridge regardless of how many times the highway leading to the bridge is resurfaced or repaved.

The old masonry arches and culverts, which are rather numerous in certain sections, cause some little care. Occasionally a wing wall washes out or the side walls are undermined, but many old bridges which have stood the better part of a century are still in service and going strong.

All new bridges are designed for a 15-ton live loading and although this is above the maximum loading allowed on a public highway by law there is no doubt that both old and new structures are called to carry not less than a 50 per cent increase over this load. The net result has been a few floor systems ruined,but no failures as to the bridge trusses themselves. In fact in the coal-producing sections, where excessive overloads have destroyed hundreds of thousands of dollars' worth of pavements, no bridge failures have been reported.

Design, construction, maintenance and repair of bridges in the state of Ohio is on a par with, if not in advance of, construction of pavements leading over these structures. This is due to the state law, that no bridge costing in excess of $10,000 can be built unless the plans and specifications have been approved by the highway department, which gives technical supervision of all bridges in the state, whether on state, county or township roads.

Longitudinal Flooring Reduces Impact

By John N. Mackall
Chief Engineer, Maryland State Roads Commission, Baltimore

The article by M. W. Torkelson, "Assuring Safety in Old Highway Bridges," covers in a general way the attitude held by the writer as regards old highway bridges on the Maryland state road system.

In Maryland the very few old highway bridges on the state roads are under the control of a district engineer, who is responsible for the inspection and maintenance of each structure in his district. Should repairs become necessary that can be made in the field, i.e., repairs to parts of the floor system, minor truss repairs, pointing or strengthening of masonry, they are made immediately. But if of a larger order, requiring extensive repairs to the trusses, or involving a large expenditure in proportion to the replacement cost, the repairs are not made. Instead, the bridge is rated and posted with respect to gross load and speed, and falsework is employed so as to enable, if possible, the permissible load to closely approach that allowed by law on the highways adjacent. This bridge is then placed on the list of primary or secondary bridges with respect to location, and in this manner it is comparatively easy to prepare the program each year of bridge reconstruction.

In order to increase the load capacity of certain old highway bridges it has been the practice in this state to decrease the impact effect by the use of a longitudinal flooring or longitudinal runways on a sub-flooring, together with proper approaches, and the effect obtained is so noticeable that laymen comment on the difference. The load permitted by law on the state roads system is 10 tons gross, and through the careful watch to prevent overloading by the Roads Commission it is but rarely exceeded. On the main highways are located scales on which to weigh trucks. Should there appear to be an excess load on a truck it is promptly removed until the gross load is within that allowed by law and the owner haled to the traffic court. In this way the overloading of trucks has been practically abolished.

All other bridges in this state are either under the control of the county commissioners, private companies or individuals, and may be regulated as to gross load permitted and rate of speed by state law. By this law, before any bridge can be posted with respect to load and speed an inspection of the structure must first be made under the supervision of the chief engineer of the state

roads commission, who then gives the authority for the posting of the structure regarding load and speed. After this is done the inspection and maintenance is under the control of the county commissioners or others, as the case may be, and their attitude toward the proper maintenance of a structure for the load permitted as mentioned above is variable.

Over 25,000 Inadequate Bridges in Illinois

By G. F. Burch

Bridge Engineer, Division of Highways, Springfield, Ill.

Before the state highway department began operations in 1905, very few highway bridges were built of sufficient strength to carry with safety the loads which were prevalent at that time. Since then, and until quite recent years, many more bridges of insufficient strength or improper design have been erected by local highway authorities who did not see fit to avail themselves of the free service rendered by the state. Since the office of county superintendent of highways was created in 1913, however, the state has had much better control of highway work, and practically all bridges of any size have been designed and built to carry modern traffic.

A bridge survey of the state was made in 1914, through the co-operation of the county superintendents of highways. Figures compiled by the survey indicate that there were then in existence some 41,000 bridges of questionable strength, of span lengths greater than 8 ft. Spans of 8 ft. and less are not considered in this connection because the probability of serious accidents due to structural failure is more remote than for larger structures. Many of these bridges have been replaced with permanent structures, properly designed to carry modern traffic, but because of the many sources from which funds are derived exact figures on the number of replacements are not available. However, an estimate, based on the average length of life of the various types of bridges represented and the funds available for new construction, indicates that approximately 28,000 to 30,000 of these inadequate bridges were still in service at the close of the year 1920.

The highway department has had occasion to investigate the carrying capacity of many of these bridges, and, to date, not one has been found which is strong enough to carry modern highway traffic with safety. Generally, it is found that the truss members will carry a uniform live load of 60 to 70 lb. per square foot of roadway surface; the floor beams will carry a concentrated load of 8 to 10 tons; and the stringers will carry a concentrated load of 4 to 7 tons. Such bridges are not safe for anything heavier than pleasure vehicles and ordinary wagon loads, and it must be remembered that these figures were derived from bridges where there was some question regarding the strength, the majority of investigations being made to determine the advisability of replacing the old plank floor with a new floor of reinforced concrete. At the same time there are undoubtedly many other bridges which, beyond all question, are too weak to carry highway traffic with any degree of safety.

Failure of truss members is of rare occurrence because a uniform live load of sufficient size to develop the full strength of the truss members is less common than heavy concentrated loads which will cause failure of the stringers or floor beams. This fact bears out the figures given above.

The logical conclusion is that the majority of highway bridges which have been in service for ten or fifteen years are unsafe for modern traffic. As extensive repairs are usually not economical, the only solution of the problem is to replace such bridges as rapidly as the funds available will allow. This policy, we believe, is being followed consistently in Illinois.

Systematic Investigation of Highway Bridges

By W. D. Uhler

Chief Engineer, Pennsylvania State Highway Department, Harrisburg

It is a well known fact that the present condition of many bridges on main trunk highways in this country is far from safe, and I believe that the progress report of the bridge committee of the American Road Builders' Association should be carefully noted by all state organizations with a view toward their carrying on much more detailed investigations of their bridges in a systematic manner, such as Mr. Torkelson's article has elaborated upon.

In any investigation involving the detailed analysis or field investigation of a great number of structures there is a grave chance that the investigation will be undertaken before a proper outline has been prepared. I believe that Mr. Torkelson's description of the Wisconsin method could very readily be adapted to conditions encountered in all states. This phase, as shown both by Mr. Torkelson's and the committee's report, accentuates the need of this systematic outline before proceeding with field work. Field investigations must be handled by men conversant with bridge design, and systematic field inspection must be premised upon the preparation of span diagrams which can quickly and easily be interpreted by the office engineer.

Bridge Renewal Must Follow Adequate Repairs

By C. J. Bennett

State Highway Commissioner, Hartford, Conn.

I thoroughly agree with Mr. Torkelson that what we need to do is to take better care of our bridges by moderate-priced repairs. We are prone to look at a bridge as being useless when it is of poor appearance or of some age. I have long been of the opinion that we should pay more attention to the smoothness of highway bridge floors in order to reduce the impact. We must, however, realize that our bridges are not up to the demands of modern traffic, particularly here in the East, and on the side roads.

There is no foretelling just where it may be desired to operate a 5-ton truck. There are countless bridges, on the back roads in this state at least, which are dangerous when subjected to a fully loaded 5-ton truck, especially when impact is taken into consideration. Generally, the approaches to these bridges are rough, and the vehicle strikes the floor of the bridge in such a manner as to cause serious impact. Many of these bridges are of timber and have not been kept in proper repair, due particularly to the fact that the small towns have not sufficient funds to make the necessary improvements. While I do not think that 80 per cent of all bridges come under this category, certainly there are a large number.

Furthermore, we have many bridges which, while sufficiently strong to carry the necessary loads, are not of adequate width to permit of the passage of two vehicles. This difficulty is a serious one, particularly at night, so that the bridge problem in this section of the country

is not particularly easy of solution. A reasonable plan should be worked out so that our bridges may be improved and replaced as rapidly as possible, but meanwhile adequate repairs should be provided for, so that disaster may not ensue.

Most failures are floor failures. It is very seldom that a load sufficiently heavy to rupture the truss will be carried by the floor. As a matter of fact, bridge failures of serious nature are comparatively few, although there are many bridges which should fail under the loads to which they are subjected. The writer is of the opinion that these bridges stand up merely from force of habit.

Concrete Pavement on a Saturated Adobe Foundation

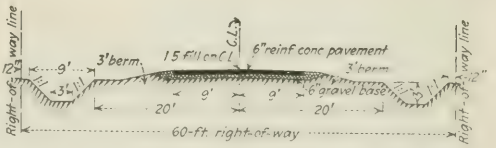
Large Drainage Ditches and Gravel Subbase to Meet Special Requirements in California Rice Growing District

By T. E. Stanton
Assistant Highway Engineer, California Highway Commission

In recent years rice culture in the Sacramento Valley has introduced highway problems new to California. In many of the rice districts there is a preponderance of adobe soil, and on this the rice growers put an average of 8 ft. of water between May and October. In the early stages of the rice industry the rice growers gave very little attention to drainage, so that the ground under the roads, which were subjected to excessively heavy truck haul from the rice fields, was in a state of heavy saturation. Under these conditions there has been practically complete failure on three or four miles of 4-in. concrete base and partial failure of at least ten miles more. These roads were constructed prior to the advent of the rice industry. One of the problems before the Highway Commission therefore has been to build a type of road that would give satisfactory service under the conditions obtaining in these districts. A specific instance of how this problem is being solved is described in the following.

PAVED ROAD BEFORE VENTING DRAINAGE DITCHES

Bids for grading a section of the highway between Biggs and Nelson in Butte County (in the rice growing district) were called for in November, 1917, and again in June, 1918, without getting any response from contractors. It was felt that this lack of interest was at least partly due to previous failures of concrete pavement in the rice district, and the current belief that saturated adobe subgrade and the possibility of alkali in the drainage water would call for special methods on the Butte county work.



CROSS-SECTION OF ROAD IN RICE DISTRICT

Work was accordingly started by the highway commission on the day labor plan in the latter part of 1918. It was soon found that at this time of year it would be impossible to handle the water-soaked adobe with teams and fresnos. A ditching machine was therefore sent to the job with which a ditch was excavated on each side of the highway, 3 ft. deep and 3 ft. wide on the bottom, with 1 to 1 slopes, making a top width of 9 ft. Excavated material was deposited in the center of the roadway, leaving a 3-ft. berm between the toe of the roadway slope and the edge of the ditch. The outer edge of each ditch was kept within one foot of the 60-ft. right-of-way line and the material from both ditches was used to raise the level of the ground between them.

Wherever possible the roadside ditches were provided with outlets into main drainage ditches excavated by the land owners. Although it has not been possible to provide outlets at all the desired points, and seepage water is standing in the ditches part of the way, yet endeavor is being made to provide enough outlets to keep the entire length of roadside ditches free from standing water.

When the excavated material deposited on the roadway had drained and dried out sufficiently fresno and grader teams were put on and it was worked down to the desired grade. On the grade thus built, and for a width of 22 ft., there was spread 6 in. of gravel which was worked into the comparatively soft adobe subgrade to a considerable extent by traffic and was then rolled and thoroughly compacted. A 6-in. layer of 1:2:4 concrete, 18 ft. wide, was then spread, reinforced with ⅝-in. square rods, laid across the roadway on 18-in. centers, and a ⅝-in. rod was laid along each edge.

Of the twelve and a half miles of road built on this job six and a half miles were through the adobe formation which had been planted to rice and which required the special construction provisions described. Although alkali was undoubtedly a contributory cause in the failure of several miles of concrete pavement in Glenn County, which traversed a district in many respects resembling that described in the foregoing, no alkali was found on the Butte county job and no special provisions for it were therefore considered necessary.

Ask for New Point Bridge

Investigation of the condition of the Point Bridge by the city council has been requested by the Chamber of Commerce of Pittsburgh. A committee report of the chamber sets forth that the bridge is not strong enough to bear the heavy trucks being hauled over it, is dangerous, and should be rebuilt.

Results of 15 Years' Operation of the Indianapolis Filters

Rates of Filtration Have Been Doubled Maintaining Efficient Bacterial Removal and Reducing Unit Costs

SINCE 1904 when the Indianapolis slow sand filters were put into operation little or no information as to results has been given the public by the Indianapolis Water Co. A paper by H. E. Jordan, superintendent of filtration, was presented by title to the Indiana Sanitary and Water Supply Association at its 1920 convention but it has been completed only recently for inclusion in the proceedings. The paper is replete with tables and extended discussions of the reasons for the progressive steps from large plain uncovered low rate sand filters for a raw water averaging 40 p.p.m. turbidity to the present smaller covered units operating at more than double the originally designed rate on a water pretreated with coagulant and two days settling plus treatment for algæ in summer. The first five years' operation, which consisted of filtration and laboratory control only, cost $5.28 per million gallons. The five years' operation, ending Dec. 31, 1919, included additional charges for pre-treatment and sterilization, but the cost was only $4.50.

Details of the maintenance of the sand layer, the essential item in slow sand filter operation, are described by Mr. Jordan as follows:

In the years preceding the adoption of the pre-treatment process the average number of days a filter would run before it needed cleaning approximated 25 and the average output per acre of sand surface 62,500,000 gal. At the close of these runs the removal of sand necessary to place the unit in satisfactory operating condition for the succeeding run averaged 2.6 cu.yd. per million gallons of water produced. The improvement in the quality of the water entering the filters has been manifest during the past five years by an increase in the number of days run between cleanings to 42.8 and an average million gallons produced between cleanings of from 135 in 1915 to 247.2 per acre in 1919, and whereas the average running rate per day in 1906, 1907 and 1908 averaged 2.5, the running rates in 1916 and 1917 was 5,000,000 gal. per acre per day and in 1919, 5,940,000 gal. At the same time the necessity of removing 2.5 yd. of sand per million gallons of water filtered, has been reduced to approximately 1 yd. in 1913-14-15 and 0.705 yd. in 1919. These results of the improved character of the water entering the filters are of course intimately correlated. The reduction in the amount of sand handled per yard is directly proportional to the amount of material which the filter is compelled to remove and the conditions of this material as to the ability of the filter to remove it immediately at the sand surface or fractions of an inch below. The reduction in the amount of sand removed also obviously reduces the amount of time which the filter must remain out of service for cleaning and sand restoring purposes. The reduction in this amount of lost time then increases the available running time of the unit and the total output of the plant.

Sand Handling and Cleaning Methods—The methods in use in handling sand have materially aided the increased production of water. When the plant was first put in service material was placed in the filters by hand, using wheelbarrows, and the soiled material was removed in the same fashion. The first improvement in sand handling methods was the adoption of the sand ejector for removing material from the filter, but clean sand was still replaced by wheeling ing. Next the wheeling-in method was discarded and the material was washed back into the filter from the ejector into a double box arrangement from which the sand, first drained of its carrying water, was thrown by hand into place in the filter. There was, about 1908, in use in Washington what is known as the washing-in method of sand restoration; that is, carrying above the filter surface a head of water approximately the depth to which it was desired to restore sand, returning the sand to the filter with the ejector and allowing it to flow from an open end of the hose suspended at the end of the boat, into the water where it fell to the sand surface and piled up to the height desired. While this method was used for several years at the Indianapolis plant, it was discarded because of the fact that it did not seem possible to avoid the formation of a silt layer at the point where the old and new sand layers joined and at the same time to bring about a decided stratification of the sand dependent upon the relative specific gravity of the various grain components of the total sand layer. In 1914 a modification of the Nichols washing-in-place method was adopted and still is used.

The original method, with labor costing from 12½c. to 15c. an hour, involved the expenditure of $1.25 per yard of material handled for removal, washing and replacing. The use of the stilling box instead of the wheeling-in reduced the cost to $1 per yard. Various improvements in the sand handling capacity of ejectors used and the washing-in method of restoring reduced the cost until in 1911 and 1912 the total expenditure was 40.5c. per cubic yard for scraping, ejecting, washing, replacing and smoothing sand. Adoption of the washing-in-place method eliminated an additional handling of sand outside the filter unit and with labor at 22½c. an hour made the total cost of sand handling 25c. a cubic yard in 1917. In 1919, with labor at 40c. instead of 22½c., and decreased efficiency of the laborers, the cost increased to 55c.

Remembering the fundamental proposition that sand handling is the key to the successful operation of the slow sand filtration plant, it becomes increasingly a matter of displeasure to the writer to confess the relatively small mechanical improvements which have been made in this operation. The Pittsburgh plant installed equipment built by the Blaisdell Manufacturing Co. for removing and restoring sand. Likewise Wilmington, Del., constructed its filtration plant in such a way as to accommodate the Blaisdell washing-in-place machine. Later developments under the direction of Nichols at Philadelphia have resulted in certain improvements in the method of removing soiled sand from the filter. It still remains necessary, however, under the present condition of labor shortage and inefficiency to attempt to increase in every way possible the mechanical methods of handling sand and the chief thing to be desired in the operation of a slow sand plant is a piece of equipment—relatively light and easily movable—which will remove soiled sand, wash it and replace it in the sand layer.

False information obtained by turbidity averages is no more clearly shown than by the Indianapolis experience. For 56.1 per cent of the time the turbidity of White River is less than 30 p.p.m. and for the whole period of record the average is below 40. Only 18.6 per cent of the time does it exceed 50 p.p.m. On only 2.7 per cent of the days during the entire life of the plant has the turbidity exceeded 200 p.p.m. Yet the operating data indicates beyond question the cumulative effect of handling without preliminary treatment the excess turbidity in so small a percentage of days. To resume the quotation from the report:

The days of the year during which coagulant was applied to the raw water have varied from 149 to 225, and the average pounds per million of coagulant used ranged from 118 to 275.

It was the opinion when pre-treatment was first decided upon that lime-and-iron treatment would be applicable to the local situation. This opinion was furthered by the conspicuous success of two plants nearby which operated with raw water having high turbidity. Experience showed that White River water on very few days in the year carries such character and quantity of suspended material as to make this method satisfactory, and on a great many days of the year a relatively slightly turbid water (and this

turbidity largely colloidal) is not satisfactorily treated except with sulphate of alumina.

In very condensed form the range of raw water turbidity and rate of coagulant required may be expressed as follows:

RAW WATER TURBIDITY AND COAGULANT USED

Range	Total Test Days 1904-1919	Per cent of Time	Pounds per m.g. Alum Used
0- 10	1,154	20.7	...
11- 20	1,044	18.8	..
21- 30	926	16.6	...
31- 40	898	16.1	65
41- 50	514	9.2	95
51-100	618	11.1	180
101-150	170	3.0	285
151-200	98	1.8	370
Over 200	150	2.7	450

Bacterial Results—Daily examinations of the plant effluent with incubation at 20 deg. C. were carried on from the beginning of the operation of the laboratory. Counts at 37 deg. C. were not made continuously until 1912. From that date until the present time an analysis of the figures indicates that 43.5 per cent of the time the 37 deg. C. count is less than 5 per c.c., 33.5 per cent of the time from 6 to 10; 17 per cent of the time from 11 to 20; 2.9 per cent of the time from 21 to 30; 3.8 per cent of the time from 30 to 100; with one day since the beginning of the 37 deg. C. counts a bacterial content of the filter plant effluent in excess of 100 per c.c. The average by years has ranged from 5 per c.c. in 1916 to 12 in 1912. Studying the quality of the finished water as referred to the presence of B. coli, during 74.5 per cent of the time no B. coli were found in 100 c.c. of the effluent; 17.9 per cent of the time 1 or 2 B. coli per 100 c.c. were present; 3.5 per cent of the time 3, 4 or 5 per 100 c.c.; 3.3 per cent of the time from 6 to 10 inclusive, and for 0.52 per cent of the time more than 10. The average B. coli content per 100 c.c. of the filter plant effluent was 0.85.

Typhoid Reduction

Previous to this installation of the filtration plant, the typhoid death rate was high, reaching epidemic conditions in 1893, 1895 and 1904. The average for all years of record was 51.8.

After the plant was placed in operation, the reduction in rates proceeded slowly, but finally to a very satisfactory rate in 1918 and 1919. In 1916 there was a decided rise in typhoid deaths, summer typhoid associated with swimming in polluted streams. The general average typhoid rate since 1905 ha sbeen 22, a reduction to 43 per cent of the pre-filtration days.

In 1904, when there was an investigation of the water supply and general sanitary conditions in Indianapolis, in addition to recognizing the necessity of completing the filtration plant already under construction it was recommended that the large number of private wells and unsanitary privies be eliminated. Repeatedly since that time various individuals have urged that the same action be taken, but no result has been obtained.

Studies of typhoid cases over a period of years locates over 80 per cent of the total as occurring where a private well or privy or both are used. If Indianapolis performed its duty in improving sanitary conditions as well as the Indianapolis Water Co. has fulfilled its duty to the public the typhoid death rate would be less than 1 per 100,000.

Mr. Jordan summarizes the results of the operation of this modified slow sand filter from the standpoint of quality and cost of operation as follows.

The prime requirement of successful operation of slow sand filters is a proper condition of the sand layer. Operating in favor of this is the increased size of the particles applied in a pre-treated water, as well as reduced total suspended matter. Operating against the condition of the sand layer are two main factors. The first is the summer increase in micro-organisms which is a far more important factor in water purification in the Central West than is generally recognized. Algæ and other micro-organisms interfere with satisfactory operation of rapid sand filters. The second is air-binding, which may manifest itself in a spongy consistency of the sand layer quite comparable to quicksand when the water is drained off. It is also evidenced by small craters or rosettes of sand, scattered indiscriminately over the surface where the air has gathered in large particles and forced its way to the surface. This problem has been the source of very serious difficulties, notably at the Wilmington, Del., plant, and represents at the present time one difficult factor in the operation of all plants, but notably in slow sand units during cold weather.

The operation of slow sand filter plants, while it has extended over a great many years, has not been the subject of such careful study in this country as have the operations of mechanical filter plants. The best summary of the basic rules of slow sand filtration of water was made by George W. Fuller at the Lawrence Experiment Station at Lawrence, Mass., in 1894. These fundamentals may be re-stated briefly as follows:

1. Bacterial efficiency of slow sand filters increases with age, other conditions being equal.

2. New filter sand is quite unlike that taken from filters which have been in operation for some time. The grains of the latter are covered with a sticky coating; in the case of grains situated at or just below the upper surface layer of sand this coating is so thick that the grains are considerably discolored. Here it is that the applied bacteria are detained in the largest numbers.

3. In new filters, and in old filters which have been out of operation for a considerable period, normal bacterial results do not appear to be obtained until these films are formed.

4. In old filters which are in regular operation, and which yield normal chemical and bacterial results, a marked deterioration in these results occurs when for any reason there is a well-defined mechanical disturbance of the main body of sand, whereby the continuity of the films is broken to a certain degree.

5. Low rates are undoubtedly safer than high rates; but, nevertheless, up to a certain limit the rate apparently exerts very little influence, and this limit is different for different filters and varies with other conditions in the case of the same filter.

6. With our present knowledge it may be stated that the factor which causes the effect of the rate of filtration upon bacterial efficiency to become practically nil, under normal conditions, is chiefly the age of the filter.

In the operation of the Indianapolis plant, the studies made during the fifteen years makes it possible to add to these observations the following:

The pre-treatment by coagulant of a water supplied to slow sand filters results in the grouping together of the suspended particles in fairly large aggregates which are a substitute in a measure for the sticky coating of the surface layer. The bacterial content of a sand layer filtering pre-treated water is not so high in total numbers nor so active as in the case of a filter handling untreated influent.

The bacterial efficiency of filters operating in this fashion is less than that of filters operating with an untreated influent. The removal of organic material from the water to be filtered lessens the supply of material to be deposited in the filters, and at the same time interferes with certain biological processes which are more active in the plain type.

Slow sand filters operating with a pre-treated water are more susceptible to seasonal variations of bacterial flora, both in the influent water and in the sand layer, and may at times unload somewhat in the fashion of sewage filters. This unloading process has no relation to the quality of raw water and with a sterilization treatment following is not apparent in the finished product.

Shutting off units and allowing them to stand for twenty-four to forty-eight hours does not seem to interfere with efficiency. Continued suspension, however, for a week or more seems to result in the deposition of material within the upper sand layer which materially reduces the production of the filter unit during the ensuing run.

Variations in depth of sand layer from 8 to 30 in. have been permitted at the local plant, and the results of operation indicate that the thinner layers give no less satisfactory purification. In point of ease of handling the filter unit, the thinner layer is preferable.

Superelevated Curve Practice on Minnesota Highways

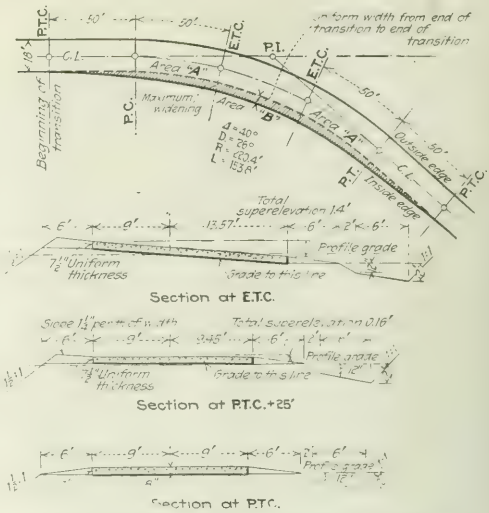
PRACTICE in widening and superelevating highway curves has been standardized in Minnesota by adopting a ring method of widening and by setting speed and curve limits for superelevation. This action, with the preparation of suitable charts, has simplified field work and office computation, particularly in determining additional area due to widening.

Referring to the drawing it will be seen that the widening is uniform between two transition curves to the tangents. By adopting a uniform length of transition and calculating offsets and areas as in the table the area of extra pavement required is quickly computed.

Taking the curve illustrated as an example the procedure is: From the table, under area in square yards for two transition curves and 18 ft. width of pavement, opposite 26 degrees, the sum of the areas A and 4 is obtained and is 48.819 sq.yd. From the same table under area in square yards per 100 lin. ft. and 18 ft. width of pavement, opposite 26 degrees, is obtained the figure 48.178. The product of this figure and $\frac{L}{100} - \frac{100}{100}$ is the area B, or $48.178 \times \frac{153.8 - 100}{100}$ 25.919 sq.yd. The area of extra pavement required by widening is, therefore, $48.819 + 25.919 = 74.74$ sq.yd.

Study of conditions by the department engineers decided them to specify that for curves from 2 deg. to 7 deg. the pavement should be superelevated to compensate for a speed of 27 mi. per hour, the maximum superelevation being ⅞-in. per foot of width. The maximum superelevation adopted for curves from 7 to 29 deg. compensates for speeds decreasing uniformly from 27 mi. to 12 mi. per hour. After the maximum superelevation is reached at 7 deg. the pavement is given a graduated additional widening commencing with 2 ft. for 8 deg. and increasing uniformly to 5 ft. for 29 deg.

Supplemented by a tabulation of superelevation pitches per foot width, the illustration and table enable precise and quick office calculation and field location of widened and superelevated curves. Information concerning the method was furnished by O. L. Kipp, construction engineer, Minnesota Highway Department, St. Paul, Minn.



PLAN AND SECTIONS OF CURVE, SHOWING METHOD OF WIDENING

TABLE I—OFFSETS AND AREAS FOR EXTRA WIDENING OF CURVES ON PAVEMENT

Dist. from P. T. C	Perpendicular Offset from Inner Edge of Pavement on Tangent					Radial Offset from Inner Edge of Pavement on Curve					Area Sq. Yd. for Two Transition Curves		Area Sq. Yd. Per 100 Lin. Ft. of Curve for Extra Pavement	
											Width of Pavement			
Degrees D	Ft 10	Ft 20	Ft 30	Ft 40	Ft 50	Ft 60	Ft 70	Ft 80	Ft. 90	Ft 100	Ft 18	Ft. 20	Ft. 18	Ft. 20
8	0.03	0.16	0.37	0.64	0.99	1.33	1.62	1.83	1.97	2.00	21.858	21.833	21.912	21.881
9	0.03	0.17	0.39	0.68	1.06	1.43	1.74	1.97	2.11	2.14	23.393	23.361	23.402	23.364
10	0.03	0.17	0.40	0.72	1.13	1.54	1.87	2.11	2.25	2.29	24.927	24.889	24.994	24.950
11	0.03	0.18	0.42	0.76	1.20	1.64	1.99	2.24	2.39	2.43	26.462	26.418	26.471	26.419
12	0.04	0.18	0.44	0.80	1.27	1.74	2.12	2.38	2.54	2.57	27.996	27.946	27.948	27.881
13	0.04	0.19	0.46	0.84	1.34	1.85	2.24	2.52	2.68	2.72	29.531	29.474	29.512	29.443
14	0.04	0.19	0.47	0.88	1.42	1.95	2.37	2.66	2.82	2.86	31.037	30.972	30.968	30.890
15	0.04	0.20	0.49	0.92	1.49	2.05	2.49	2.79	2.96	3.00	32.543	32.470	32.417	32.330
16	0.04	0.20	0.51	0.96	1.56	2.16	2.62	2.93	3.10	3.14	34.050	33.967	33.859	33.762
17	0.04	0.21	0.52	1.00	1.63	2.26	2.74	3.07	3.24	2.29	35.556	35.464	35.401	35.295
18	0.05	0.21	0.54	1.04	1.70	2.36	2.87	3.21	3.38	3.43	37.062	36.962	36.828	36.709
19	0.05	0.22	0.56	1.07	1.77	2.47	2.99	3.34	3.53	3.57	38.534	38.422	38.248	38.117
20	0.05	0.22	0.58	1.11	1.84	2.57	3.12	3.48	3.67	3.72	40.006	39.884	39.767	39.622
21	0.05	0.23	0.59	1.15	1.91	2.67	3.24	3.62	3.81	3.86	41.478	41.344	41.171	41.014
22	0.05	0.23	0.61	1.19	1.98	2.78	3.37	3.76	3.95	4.00	42.950	42.805	42.567	42.397
23	0.05	0.24	0.63	1.23	2.05	2.88	3.49	3.89	4.09	4.14	44.422	44.266	43.956	43.771
24	0.06	0.24	0.64	1.27	2.12	2.98	3.62	4.03	4.23	4.29	45.888	45.718	45.441	45.241
25	0.06	0.25	0.66	1.31	2.20	3.09	3.74	4.17	4.37	4.43	47.353	47.170	46.814	46.599
26	0.06	0.25	0.68	1.35	2.27	3.19	3.86	4.31	4.52	4.57	48.819	48.622	48.178	47.947
27	0.06	0.26	0.69	1.39	2.34	3.29	3.99	4.44	4.66	4.72	50.284	50.074	49.637	49.390
28	0.06	0.26	0.71	1.43	2.41	3.40	4.11	4.58	4.80	4.86	51.750	51.526	50.984	50.720
29	0.06	0.27	0.73	1.47	2.48	3.50	4.24	4.72	4.94	5.00	53.216	52.978	52.322	52.041

Science and Research Bodies to Have New Home in Washington

A home for the National Academy of Sciences and the National Research Council is to be built in Washington. Donations from a number of friends of the two organizations have enabled them to purchase the block bounded by B and C Sts. and 21st and 22d Sts. N. W., facing the Lincoln Memorial in Potomac Park. The cost was about $200,000. The Carnegie Corporation will defray the cost of the building itself. The donors of funds for the land purchase include Ambrose Swasey, E. A. Deeds, Charles F. Kettering, Henry Ford, George Eastman, Adolph Lomb, Charles F. Brush, P. S. du Pont and the Corning Glass Works.

Sewage-Works for Lincoln, Nebraska and Suburban Towns

SETTLING tanks of the separate digestion type, to which sewage is pumped from a receiving basin and from which the effluent passes to sprinkling filters, constitute the main element of sewage-works recommended to serve a sanitary district comprising the city of Lincoln, Neb., and four suburban towns, the amount of sewage having become too great for adequate dilution in Salt Creek. This plant will treat all the sewage discharged above the works at 27th St. and for about ten years there will be ample dilution for sewage entering below that point. When this latter sewage increases to such an extent as to cause a nuisance, settling tanks may be constructed for the two suburban towns of Havelock and University Place, to be supplemented later by sprinkling filters if necessary. The above statement is summarized from a recent report by Alvord & Burdick, consulting engineers, Chicago, on the proposed sanitary district.

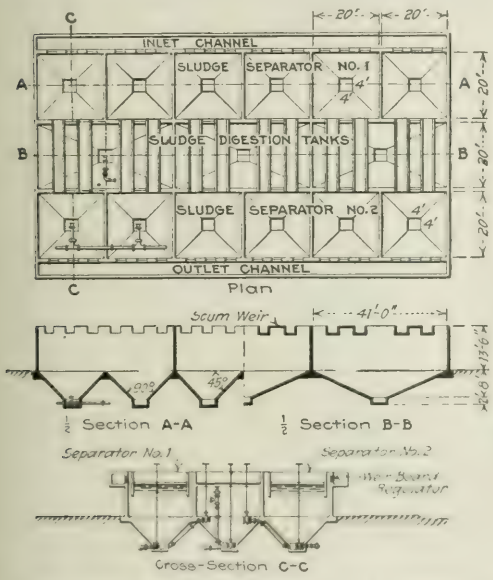


FIG. 1 SETTLING TANKS AND SLUDGE CHAMBER

Lincoln and the four suburban towns have a population of 70,000 and more than 100 miles of sewers on the separate system. With the extensions to be built this year nearly 100 per cent of the population will be served. The daily sewerage discharge of the entire district is about 4,500,000 gal., nearly 80 per cent of this being from the city of Lincoln. It is estimated that by 1950 the population will be 175,000, the daily sewage discharge 13,000,000 gal., and the area increased from 8,000 to 23,000 acres by extending the city limits.

The sewage is typically domestic and varies from fresh to a maximum age of five hours. Salt Creek has a minimum flow of 50 sec.-ft. and during a considerable part of the year it is a nuisance owing to odors and deposits. The principal requirements for the effluent of the sewage-works are that it must be stable and odorless and reasonably free from suspended matter, particularly coarse material. It is considered that further refinements, if involving additional expense, are not warranted.

To abate the present nuisance, an intercepting sewer

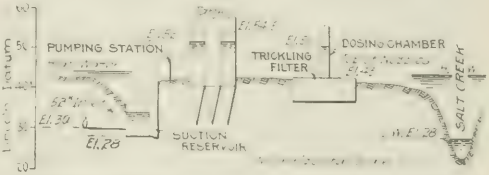


FIG. 2 DIAGRAMMATIC SECTION OF SEWAGE-WORKS

is being built parallel with the creek and will be extended to the new plant. As all sewage will have to be pumped to give a gravity flow through the plant, the interceptor will discharge into a 125,000-gal. two-compartment reservoir to supply the pumps, which will be driven by electric motors and controlled automatically by floats. This interceptor is designed with sufficient capacity for 1950 conditions, but the sewage-works are designed for the conditions of 1930, with a population of 100,000, in order to allow for possible development in methods of sewage treatment. A diagrammatic section through the plant is shown in Fig. 2.

The type of tank proposed is adapted particularly for such conditions as those at Lincoln, where the sewage is domestic and relatively fresh and will form considerable quantities of both sludge and scum. This type was designed first by Mr. Alvord for the plant at Madison, Wis. (see *Engineering News-Record*, Sept. 11, 1919, p. 510), and was used later for the naval training station at Great Lakes, Ill. As shown in Fig. 1, it includes baffled, hopper-bottom primary and secondary compartments separated by a sludge digestion chamber, each compartment being connected to this chamber by sludge pipes and scum weirs. Each of the six tanks will have a working capacity of 1,000,000 gal. daily, with a detention of 45 minutes in each compartment. This total detention period of 1½ hours is sufficient for reduction of about 75 per cent of the solids, but is not so long as to make the sewage too stale for economical subsequent treatment.

From the tanks, the sewage will flow to dosing chambers in circular sprinkling filters 375 ft. in diameter, two of which will be sufficient for conditions up to 1930, when the tank effluent will be at the rate of about 4,500,000 gal. daily. The beds will be 6 ft. deep, filled with broken stone ranging from 3-in. size at the bottom to ¾-in. at the top. They will be equipped with cast-iron distributors and risers having nozzles spaced 12 ft. c. to c. Secondary sedimentation is believed unnecessary in view of the amount of dilution available. It is pointed out that the filter effluent will carry practically the same amount of suspended matter as the tank effluent, or 20 per cent of that in the raw sewage, but that these solids will be finely divided and as stable as the effluent.

The recommended plans of the engineers have been adopted, and the city will extend the intercepting sewer to the plant at an estimated cost of $140,000. This will be done under the direction of George W. Bates, city engineer. As the city and four independent suburban towns will be served the sanitary district already

mentioned has been organized to build and operate the works. The cost for a plant sufficient for 1930 conditions is estimated at $330,000, with an annual operating cost of $12,500.

Three other disposal methods were considered, but the operating costs were considerably higher, although the activated-sludge process gave a lower construction cost. For tanks and sand filters the estimated construction cost was $525,800 and the annual operating cost $15,400. With the activated-sludge process preceded by tank treatment the construction cost would be $250,000, and for an activated-sludge alone it would be $212,000. The corresponding annual operating costs would be $44,800 and $77,700, as compared with $12,500 for the plant as adopted. Fixed charges are not considered in any of the estimates.

Averages and Maximum Runs in Concrete Paving

Relation Shown by Graphs of Sixteen Minnesota Paving Operations—Maximum Record Outfits Described

AVERAGE speeds per working day in placing concrete road slab were about half the speed recorded by the maximum day's run during any month's operation in 1920 on sixteen paving contracts in Minnesota. Ordinarily the maximum day's run, when it was extraordinary, exceeded greatly that of any other day. However, operations which exhibited an extraordinary day's performance also showed high averages both for the month and the season.

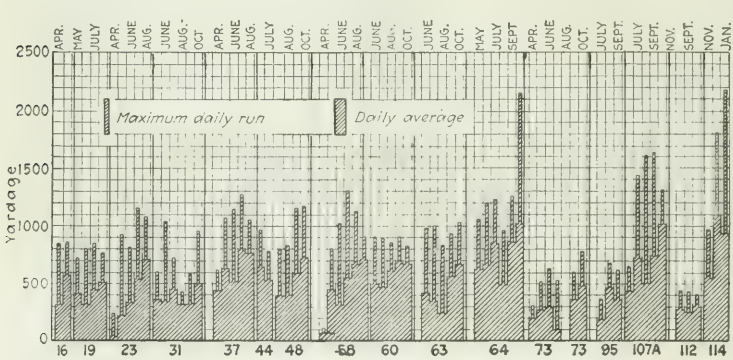


FIG. 1. DAILY AVERAGE AND MAXIMUM DAY'S RUN FOR EACH MONTH ON SIXTEEN PAVING OPERATIONS

Besides the facts noted, the graph by months of the season's operations indicates peak performances perhaps never surpassed in concrete pavement construction. The high records were on operations 64 and 114 and in both, 18 ft. one-course concrete slab, 7½ in thick, was being constructed. On the basis of 2 sq.yd. per lineal foot of pavement the maximum day's run of completed pavement was 1,072.6 ft. on operation 64, and 1,098 ft. on operation 114. The nearest equal record to these Minnesota performances, reported in 1920, was 1,034 ft. of 18-ft. slab, 8 in. thick, laid in one 10-hour day in Michigan.

With the background of averages given by the diagram, peak performances are presented in their proper relation to construction progress. The two, which have been enumerated, command especial attention because of the extreme height of the pinnacle reached.

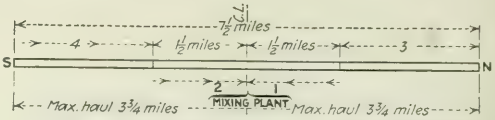


FIG. 2. PAVING PLAN DEVISED TO REDUCE EARTH ROAD HAUL

2,196 Sq.Yd. in Less than 10 Hr.—Operation 114, which exhibited the best performance, covers two full months and 13 days in August. Exceptional speed was attained continuously after the preliminary adjustment period—the average, as read from the diagram, was over 1,000 sq.yd. per working day for two months. The peak run of 2,196 sq.yd., it is stated, was made in less than ten hours, lack of cement compelling work to be stopped at 4 p.m.

A flat country was traversed by the road, which was 7½ miles long, paved 18 ft. wide with a 6½ and 7½-in. slab of 1–2–4 stone concrete. In Minnesota, when machine finishing is employed, a 1–2–4 concrete with 2-in. slump is specified. For hand finishing a wet mixture, 6-in. slump, is allowed but the proportion of coarse aggregate is reduced to 3½ parts.

A central mixing plant was adopted by the contractor, with wet batch haulage in 2½-ton motor trucks equipped with 2-cu.yd. Lee bodies for end dumping. The mixing plant was located about midway of the 7½-mile road, and paving proceeded as indicated by the numerals and arrow heads, Fig. 2. With sections 1 and 2 paved, the contractor had 1½ miles of paved road over which to haul in paving sections 3 and 4. Reduction of earth road haul, these roads being very soft in wet weather, was effected by this plan as follows: With a maximum haul of 3¾ miles, the maximum earth road haul was 2 miles, the maximum average was 1 mile and the average was ⅞ mile. At the mixing plant, sand was hauled 1¾ miles by motor trucks to a ground hopper from which a belt conveyor carried it to the mixer sand bin. Another belt conveyor from the cement house to the mixer floor handled the cement in bags. Stone coming in on gondola cars was unloaded by derrick and clamshell into the mixer stone bin or into stockpile. The 1 cu.yd. mixer, mixing a full minute, discharged into a 2 cu.yd. hopper under which the trucks drove and received their loads averaging 1½ cu.yd. At the pavement the dumped concrete was roughly spread by a horse-drawn scraper and then finished by a finishing machine.

The contractors for this road were McCree, Moos & Co., St. Paul, Minn. Their crew ran from 38 to 51 men.

2,145 Sq.Yd. in 10 Hr. 21 Min.—Operation 64, on which the second best performance was made, covered a period of six months. As shown by the diagram, Fig. 1, the peak performance was an isolated one, but

the average for the season was the high one of 880 sq.yd. per working day. On the day of the peak performance, work was begun at 6:15 a.m. and was stopped at 5.35 p.m., with 30 min. for lunch and 30 min. delay due to a breakdown. The average haul of proportioned batches by industrial railway was 2,500 ft. The pavement

FIG. 3. TRACTOR-HAULED MIXER OUTFIT

dimensions and specifications were the same as in the operation previously described.

In this operation the only features unusual to the normal industrial railway, batch-box haulage method were the use of two finishing machines, one operating about 50 ft. behind the other, and the special mixer outfit illustrated by Fig. 3. A 4-bag paver was mounted on an old steam shovel base and provided with a tower and crane hoist for handling the batch boxes. A steam tractor moved the mixer and supplied steam for it and the hoist engine.

The contractors for this road were Siems, Helmers & Schaffner, St. Paul, Minn. Their crew ran about 66 men, as follows: Overhead 2, materials yard 11, transportation 9, mixer 17, grading and form setting 18, maintenance and repair 6, and miscellaneous 3.

Conclusions—Star performances in pavement laying, ordinarily, are either staged ahead or occur because of an exceptional combination of favorable conditions. The perfection of direction, equipment and working crew which enables a peak performance on occasion is generally reflected by unusually good average performances. The old-time contractor's axiom that "stunts don't make estimates," is not as axiomatic as may be thought. It is true that best days' records are about twice average days' records on any job.

Copper Sulphate for Cleaning Basin Walls

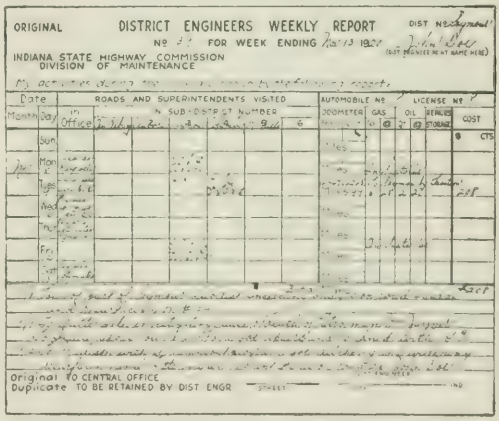
For cleaning algae from the sedimentation basins of the Kansas City water-works at Quindaro, copper sulphate is sprayed on to the surface after lowering the water level a few feet. George F. Gilkinson, chief chemist of the water department, described the methods employed in a paper presented recently before the Iowa section of the American Water-Works Association. Satisfactory results were obtained by spraying the walls to which the algae cling, after drawing down the water, with a paint-spraying pump attached to an 8-gal. keg mounted on wheels. A 5-per cent solution was used. An hour after application the walls are scrubbed with a wire brush and the basin refilled. One gallon covers 125 sq.ft. of wall. Mr. Wilkinson stated that the walls are kept comparatively free from algæ by an application every two months during the summer.

District Maintenance Engineers' Report Blank

Daily Activities Recorded on Special Blank and by Map Showing Roads Inspected Each Week

A HELPFUL check is kept on the activities of district engineers of highway maintenance in Indiana by means of a weekly report blank and map. Often it is desired to know more than is told by mileages and expenditures concerning the personal touch which the engineer maintains with his roads and with his assistants. The report blank and the map give this information satisfactorily, both when the chief engineer wishes to determine at a glance whether the district man is covering his job and when he wishes to analyze in detail the distribution of his time by the district man. The map proves valuable for the first purpose.

To bring out clearly the effectiveness of the method an actual report is given, except that names are omitted. The map is printed on the back of the blank form herewith reproduced, the routes of trips made by the district engineer being depicted in colored ink and marked with dates. Symbols are employed to economize space. For example, a section of road is referred to by



ORIGINAL DISTRICT ENGINEERS WEEKLY REPORT DIST No. Seymour

No. FOR WEEK ENDING 1921

INDIANA STATE HIGHWAY COMMISSION
DIVISION OF MAINTENANCE

Date		ROADS AND SUPERINTENDENTS VISITED							AUTOMOBILE No. LICENSE No.						
Month	Day	In Office	In Subdistrict Number					6	Odometer	Gas	@	Oil	@	Repairs Storage	Cost
	Sun														$ CTS
	Mon														
	Tues														
	Wed														
	Thur														
	Fri														
	Sat														

Original TO CENTRAL OFFICE
Duplicate TO BE RETAINED BY DIST ENGR

DISTRICT MAINTENANCE ENGINEER REPORTS DAILY ACTIVITIES AND EXPENSES

road number and section letter. Employees with whom conference is had are indicated by a number or letter placed within a circle. Thus, referring to the blank, the entry on Monday of *4-P-Q*, followed by the letter *S* in a circle, indicates that on that day the district engineer inspected sections *P* and *Q* of road *No. 4* and consulted with the superintendent of the Seymour subdistrict. Other entries as given are self-explanatory. The map serves merely to indicate graphically the routes and distances covered by inspections.

This blank and map were devised by A. H. Hinkle, chief maintenance engineer, State Highway Commission of Indiana.

New Jersey Bridges

New Jersey owns 704.2 miles of highways on which exist 568 bridges of over 5-ft. span, 80 per cent of which are incapable of meeting the demands of modern traffic, according to Charles A. Mead, bridge engineer.

Cost-Plus Contract Successful on Georgia Road Work

By W. R. Neel
State Highway Engineer, Atlanta, Ga.

Highway construction costs were reduced last year in Georgia by the adoption of a form of cost-plus contract. This contract was devised to moderate bidding prices, which had been progressively increasing, by relieving the contractor from the burden of risk and the expense of financing the work. Its character and the results obtained by its use are summarized here from a paper read at the Washington meeting of the American Association of State Highway Officials.—Editor.

COMPETITION is not eliminated by a new form of cost-plus contract for highway construction in Georgia. The contractor in submitting his bid divides it into two parts, the estimated cost and the desired compensation. In order to have an incentive to keep down the cost, the contractor is allowed 25 per cent of any saving on the estimated cost, provided it does not exceed 50 per cent of the total compensation in the proposal, and should the cost exceed the estimate, 50 per cent of this excess is deducted from the compensation, with the provision that the compensation must not be reduced more than 75 per cent. Therefore, the contractor is assured of at least 25 per cent of the compensation, as shown in his bid, for which he must furnish at his expense a superintendent and any overhead expense, such as the maintenance of his general office. It is calculated that the 25 per cent will allow the contractor to break even with no loss other than that of his time.

The contract also provides for machinery and equipment rental, a form being provided which must be filled out and which is a part of the contract cost of work. However, the rental schedule is fixed, and only the interest on the value of the equipment is allowed, plus a fair compensation for depreciation, insurance and estimated repairs. In this way no profit can be made other than that shown as compensation, and this amount varies with the skill and zeal used in prosecuting the work.

All cost of the work is paid by the owner. A bonded accountant makes up pay-rolls and supervises the paying of all labor, etc. All materials are purchased by the purchasing agent of the State Highway Department, and the prices for all materials, f.o.b. railroad siding, are included in the proposal. In this way, the only financing required by the contractor is in purchasing equipment, and in paying the salary of his superintendent.

Practical Results Obtained

This new form of contract has permitted honest contractors of small means to show their ability on a larger scale than would be possible with the old form under which a surety bond is required for the full amount of the contract, which many contractors of small means are unable to make. The facilities for financing this contract have opened a field for intelligent, honest bidders who would otherwise be unable to participate in a project of very great magnitude, except as subcontractors, although their ability might be ample to handle the work.

On a recently completed concrete paving project, the successful bidder could not have financed the project under the old form of contract and yet he has had charge of the construction of more miles of concrete pavement within the state than any other contractor. The result was that 5½ miles of 18-ft. concrete pavement were laid in 3¾ months at a 15 per cent net saving on the contract as awarded. The contractor not only earned his compensation as set forth in his bid, but an additional 50 per cent, the maximum amount permissible. The bid was 24 per cent lass than the next lowest bid which was on the old form of contract. On another project a saving of 11.3 per cent is shown. A grading job showed a saving of 13.2 per cent when the work had been under way for more than three months.

The cost-plus contracts now under way in Georgia amount to over $1,500,000 and a saving of a little over $20,000 has been effected in bond premiums alone, as a minimum bond is required under this form of contract.

Life of Ties and Timbers in Mexico

UNTREATED pine timber on railways in the coastal plain of Mexico along the Gulf of California has a probable life of only three to four years for ties and six years for trestle timbers, according to a report by J. D. Mathews, engineer of maintenance of way, published in the *Cross Tie Bulletin*. Trestles only nine years old, and which had carried no traffic for five years, owing to the revolutionary troubles, were found rotten and sagging with their own weight.

This condition is due to the extremely rapid decay under the influence of warm and moist atmosphere, a jungle growth of trees and vegetation and an annual rainfall of 30 to 40 in. Creosoted pine had suffered little in nine years. Cedar piles, after the same period, were only approaching the point when renewals would be required. Redwood caps, posts and ties were also in good condition, the ties indicating a minimum life of eight years and a considerably longer average life. Replacement of pine by redwood for ties and all trestle timbers except stringers will be an immediate rather than an ultimate economy under the above conditions, according to Mr. Mathews.

Studying Power Possibilities on the Tennessee

An engineering and economic survey of the Tennessee River, its tributaries and its basin is being made by the Corps of Engineers, U. S. Army. The survey includes a study of the resources of the basin with the idea of determining the influence of water transportation on their development and the amount of tonnage that they might contribute for transportation by water. The work is being done under a Federal appropriation with co-operative work by the Tennessee River Improvement Association. The mountain areas which fringe the Tennessee Basin are being mapped aërially. One of the important features of the report will be the effect on the main stream by power developments on a non-navigable tributary. This qusetion is a live one because of the many proposed water-power developments. The Parr Shoals dam on the non-navigable Broad River, near Columbia, S.C., so affected the flow of water in the Congaree River as to make navigation impracticable. The Chattahoochee River is navigable to Columbus, Ga. When a large power plant above Columbus finds it necessary to draw out the maximum quantity of water that is uses, boats frequently must be tied up until the needs of the power plant have been supplied.

Employment Relations in the Construction Industry

AS A GUIDE for the conduct of the future activities of the Associated General Contractors, that organization's committee on labor submitted to the annual meeting held at New Orleans, Jan. 25-27, a constitution of industrial relations supplemented by a statute of employment relations applied to the construction industry, both of which are reprinted below. The committee, which is headed by L. C. Wason, believes that a good deal of difficulty in industrial relations has been caused by confusing fundamental principles with the details of application. The obligations and duties of employer and employee to one another, to capital and to the public have often been mixed in a single document. The committee is of the opinion, therefore, that the separate documents which it has prepared will eliminate, in part, this confusion.

The labor committee's report was approved by the convention.

Fundamental Principles of Industrial Employment Relations

Preamble—Employment relations should accord with and express ideals of justice, equality, and individual liberty. The terms of employment should conform to the essential requirements of economic law and should, through intelligent co-operation, based on a recognition of mutuality of interest, conduce to high productive efficiency. They should reflect an effort to realize ideals of individual and social betterment.

The interest of the public, which includes every individual in the community, is paramount. It is composed of interdependent interests whose just balance necessitates that impartial justice be accorded to every individual.

There is a mutuality of interest among employers, employees, and investors. Their interests as well as the public interest must be defined and protected and to this end public opinion must be kept informed and enlightened.

The first step toward industrial peace will be a realization of the interdependence of all elements related to industry and a recognition of their responsibility one to another.

In government and public service employment the orderly administration of government must be assured, and the paramount interest of the public protected.

Briefly stated, *Justice* to all interests, *Co-operation* between employer and employee, produces *Service* to the public.

Principles

1—Employment Relation—Every person possesses the right to engage in any lawful business or occupation and to enter, individually or collectively, into any lawful contract of employment either as employer or as employee.

2—The Open Shop—The right of employer and employee to enter into and to determine the conditions of employment relations with each other (without reference to the affiliation or non-affiliation of either with any organization) is an individual right of free contract possessed by each of the parties.

3—Right of Association—All men possess the equal right to associate voluntarily for the accomplishment of lawful purposes by lawful means. The association of men whether of employers, employees, or others, for collective action or dealing, confers no authority over and must not deny any right of those who do not desire to act or deal with them.

4—Responsibility of Combinations—The public welfare, the protection of the individual, and sound employment relations equally require all associations or combinations be be subject to the authority of the state. As the public interest is paramount, full publicity of facts of industrial relations is necessary.

5—Obligation to Secure Production—To develop, with due regard for the health, safety and well-being of the individual, the maximum capacity and output required of industry is the common social obligation of all engaged therein.

6—Wages and Management—The wage of labor must be drawn from the product of industry and must therefore be earned and measured by its contribution to production. All employees are entitled to complete business information in matters affecting the terms of their employment; and frankness is essential. In order that the worker, in his own and the general interest may develop his full productive capacity, it is the duty of management to assist him to secure regular employment suited to his abilities, to furnish him with incentive and opportunity for self improvement, and to provide proper safeguards for his health and safety.

7—Hours of Labor—The number of hours in the work day or week in which required maximum output, consistent with the well-being of the workers, can be maintained in a given industry should be ascertained by careful study and never should be exceeded except in case of emergency. One day of rest in seven, or its equivalent, should be provided.

8—Adjustment of Employment Relations—Adequate means satisfactory both the employer and his employees, and voluntarily agreed to by them, should be provided for mutual discussion and adjustment of employment relations.

9—Community of Interest—The greatest measure of reward and well-being for both employer and employee, and the full social value of their service to the public must be sought in the successful conduct and full development of the industrial establishment in which they are associated. Intelligent and practical co-operation based upon a mutual recognition of this community of interest constitutes the true basis of sound industrial relations.

10—Government Employment—The state is sovereign and cannot tolerate a divided allegiance on the part of its officers and servants. While the right of government employees, national, state or municipal, to be heard and to secure consideration and just treatment should be amply safeguarded, the community welfare demands that no combination shall be permitted to prevent or impair the operation of government or of any governmental function.

11—Public Service Employment—In public service activities the public interest and well-being must be the paramount and controlling consideration. The power of regulation and protection exercised by the state over the corporation should properly extend to the employees in so far as may be necessary to assure the adequate, continuous, and unimpaired operation of public utility service.

A Statute of Employment Relations Applied to the Construction Industry

1.—Employment

(1) The value of a good spirit in an organization is vital to successful industry. The organization may think favorably or unfavorably of its employers, may work with enthusiasm or without any, depending upon what the individual thinks of his employers and the work they are doing. Therefore, there must be frankness between employer and employee, perfect freedom in action and expression of thought, to maintain mutual friendly relations.

(2) When hiring an employee, a complete record of his experience should be obtained. He should be fully informed of the conditions of his employment, wages, hours, location, living conditions, dangers, etc., and the methods of his employer and what he expects of his employee. That is, there should be frankness, mutual confidence, and respect on both sides from the start. Continuous efforts must be made to advance and increase these mutual relations in order to prevent or adjust misunderstandings as soon as they are discovered.

(3) The fact is recognized that in many locations and establishments the basic eight-hour day, or a weekly equivalent, has been adopted as the usual standard. As the number of hours properly constituting a day's work varies in some locations and classes of construction work, it is recommended that changes from the usual standard be so made as not to disrupt or disorganize the rest of the industry.

(4) Overtime work should be discouraged. Where the nature of the work is such as to require employees to work beyond the established hours, they should receive an extra rate of compensation for such overtime.

(5) Continuity of employment is desirable and should be maintained as far as possible.

(6) Apprentices should not be limited in number in any trade. If equitable rules as to the period of service and the degree of skill required of apprentices are made by the various trades, the law of supply and demand will regulate the number.

(7) Discrimination against the use of apprentices by organized labor must not be permitted. Employers in large communities should encourage the establishment of public trade schools and the attendance of the youth at them.

2.—Working Conditions

(1) The public interest and the comfort and health of individual employees demand that every effort should be made to perfect the conditions of employment, with special reference to sanitary conditions, heat, light, ventilation; safeguarding the health of workers and providing protection against, and treatment in cases of accidents; suitable rest periods where necessary; and due warning to the worker if he is undertaking to perform a hazardous operation.

(2) Provide safety devices and guards against accident and disease. Mechanical plants, stagings, ways and works should be inspected daily. Where temporary camps are used, provide proper inspection for sanitation, food supply, water, and the welfare of the men.

(3) Employees should be safeguarded against unjust treatment or abitrary discharge by their foremen or immediate superiors. In justice to employees, adequate advance notice should be given, whenever possible, to those who must necessarily be laid off. Likewise, an employee should give reasonable notice to his employer of his intention to leave the service.

(4) The temperament of the gang boss or foreman in direct contact with the hand workers is most important. He must be fair and give his men a square deal.

(5) Establish by conference between the parties what facts concerning the company's and men's activities should be common knowledge to both, and provide for giving these facts fullest publicity.

(6) All states should enact compulsory workmen's compensation insurance laws that are just both to the employer and employed.

3.—Production

(1) Public interest requires increasing output per man as a prime factor in reducing construction costs.

(2) Employees should not, therefore, intentionally restrict individual output to create an artificial scarcity of labor as a means of increasing wages or continuity of employment, or of equalizing the productivity and wages of workers having different degrees of skill and ability. Employees should also co-operate with the employer in the adoption of new and improved machinery and methods with a view to increasing efficiency, thereby lowering the cost of construction.

(3) The value of industrial training as a means of increasing production is recognized. Such training should be encouraged by employers and employees.

(4) The reduction in working hours below the economic limit in order to secure greater leisure for the individual should be made only with full understanding and acceptance of the fact that it involves a commensurate loss in the earning power of the workers, a limitation and a shortage of the output of the industry, and an increase in the cost of construction, with all the necessary effect of these things upon the interests of the community and the nation.

(5) As an incentive to greater production, make provision for increasing compensation whereby men of extra skill and knowledge may add to their regular wage.

(6) Make some expression of appreciation, by word or letter, as reward for duty well done.

(7) Make an incentive to extra effort for production by promotion where possible for those who prove worthy.

4.—Right of Association

(1) The association in groups of employees not affiliated with an organization of non-employees should be encouraged. The right of employees to organize into trade unions is recognized.

(2) Employees should not require of their employer that employment be conditioned on membership or non-membership in a trades or labor union. Employees should not coerce fellow employees to join, or refrain from joining, a trades or labor union.

(3) Freedom of contract of employment must never be impaired. However, employers should not so exercise this right as to discriminate in the employment or discharge of employees on the ground that they are, or are not, members of a trades or labor union.

(4) Means should be devised to create public sentiment in favor of these principles and to keep the community informed of all action at variance to them.

(5) Capital, employers and employees should be subject to law and its processes with equal facility. Special legislation which may benefit either to the possible injury of the other, or to the possible injury of the consumer, is detrimental—and a consequent menace to the community.

5.—Adjustment of Disputes

(1) Adequate means, satisfactory to both employer and employee, and voluntarily agreed to by them, should be provided for mutual discussion and adjustment of employment relations.

(2) Where the channel of communication existing between an employer and the individual employee does not offer employees suitable means of negotiation with their employer, the employer should seek to establish mutually satisfactory means. For this purpose representative negotiation is advocated.

(3) Representative negotiation is defined as that form of collective bargaining which provides for negotiation between an employer and duly accredited representatives of his employees, regarding hours, wages, and all other matters properly affecting their relationship. Employees' representatives should be duly accredited, should be chosen by the employees, from among their own number unless otherwise agreed by employer and employees, and be empowered by the employees to negotiate for them. Such negotiation should be under control of the parties immediately concerned and should they fail to reach an agreement the employer and the group of employees' representatives should each have the option of choosing, without restriction by the other party, a reputable and competent advisor or advocate to meet with them in the continued negotiations. Representatives of employees, selected by and from among their own number, should be assured by their employer that no discrimination will be made against them because of anything said or done in their representative capacity.

(4) As it is often impractical, owing to the nature of the industry, for a single employer to reach a final conclusion with his own employees, a group of employers should negotiate with a group of employees. Such group negotiations should be conducted as far as possible in accordance with the plan of representative negotiations above outlined.

(5) Nothing herein is intended to abrogate the right of an individual employee to negotiate directly with his employer.

(6) Employers and employees should uphold in their integrity all arbitration awards or agreements entered into between them.

(7) While the employer and employee may reach a settlement of their individual relations without reference to outside aid, this solution may affect the rest of the industry, locally, as well as the interest of the public, which is paramount. Therefore, the public's representative ought to have a right of review of a settlement to ensure that its interests

are protected. The interest of the public in reviewing adjustments of industrial relations can be well performed by the establishment of Industrial Courts.

(8) There must be no coercion by either party toward the other. Public sentiment should support all public officials in enforcing the laws in respect to these practices.

(9) The fact should be recognized that both employer and employee are servants of the public, that every disagreement adds to the cost of living and that the final judge in all disputes should be the public. The public should give expression to its views through a board of advisers whose decision should be recognized by both parties as final. Disputes, ill feeling, and discord invariably fade, once the facts are aired and given to the public.

Minimizing the Risk in Contracting
—*and the Engineer's Part Therein*

An Address (Slightly Condensed) Delivered Jan. 25 Before the New Orleans Convention of the Associated General Contractors

By William B. King
Of the Bar of the Court of Claims, Washington, D. C.

CONTRACTING is far too much gambling and not business, with the cards stacked against the contractor. This fact is partly due to inherent conditions under which the work is done, such as the uncertainties of markets, wages, labor productivity, and weather, but partly to conditions now prevailing, but not necessarily inherent in the work, such as loose methods of estimating and accounting, faulty specifications and vicious forms of contract. This paper is an effort to suggest some aid in eliminating and reducing these gambling elements.

These suggestions must be prefaced by two remarks: First, that the chief elements by which risk can be eliminated are those common to other lines; namely, good judgment in bidding for work and a thoroughly capable organization for executing it; and, second, that these suggestions, derived from long acquaintance and study of the problems of contracting from the outside in litigated cases, are subject to correction by the contractors themselves from their intimate knowledge of the practical side of contracting.

Basis of Contract

Construction work is commonly carried on under one of three forms of contract, the cost-plus, unit price or lump sum contract.

Cost Plus—If the cost-plus contract could generally be adopted the risk in contracting would largely be eliminated. Many of the abuses hereafter discussed find no place under it. Its uses are limited. It was the only possible form for much of the work during the war, but in spite of the fact that it achieved splendid results it fell into popular disfavor.

It changes the fundamental relation of owner and contractor. Under other forms of contract the financial interests of contractor and owner, as to excellence of workmanship and completeness of compliance with the specifications, are opposed; under a proper cost-plus system they agree.

Whether this extremely advantageous method of contracting comes into general use depends largely upon the confidence which individual contractors are able to inspire in the minds of owners, personal or corporate, and upon the recognition by owners that their greatest interest is in having the best building and paying a reasonable price for it

In promoting the cost-plus contract the effort should be in favor of some form of *cost-plus-fixed-fee*, rather than cost-plus-percentage. It will be much easier to establish the former than the latter.

Unit Price—The unit-price system tends to eliminate the contractor's risk by paying him upon the basis of the work actually done rather than making him responsible for errors in estimating the work to be done. It is otherwise open to the same abuses as the lump-sum contract and the dangers hereafter pointed out and the remedies suggested are equally pertinent to it.

It is much more applicable to engineering than building contracts. It ought to be used in preference to a lump-sum contract, if cost-plus is not available, in all cases where the work to be done is susceptible of division into prescribed units and where there is any uncertainty about the ultimate plans or the conditions to be encountered. But there should always be a proper variation in the unit prices if the number of units varies materially.

Lump Sum—The lump-sum contract in its ordinary form throws upon the contractor not only the legitimate risk, but also the risk of the correctness of his calculation of quantities and of the sound judgment and personal disposition of the architect or engineer. Some of these risks can be eliminated, as will be hereafter discussed.

Every lump-sum contract possesses in the minds of most owners one substantial merit often outweighing all others; namely, that the owner knows in advance what the work is to cost. This will keep the method in general use; so the contractor's interests, therefore, must be carefully safeguarded.

Quantity Survey

Under present systems of lump-sum contracts the contractor has three branches of work, equally necessary for his financial success. The first is estimating the quantities of material; the second is estimating the cost of placing these materials in the work; the third is the ability to do the work economically and within the estimates.

The estimating of costs and the execution of the work within those costs are uncertain factors. The skill of the contractor finds its opportunity here. His judgment as to markets, his business connections, his judgment as to the future cost and efficiency of labor decide his estimates. His ability to select suitable superintendents and foremen, his elimination of unnecessary overhead and the capacity of his organization for teamwork determine whether he can execute his work within his estimates. These are the legitimate fields for competition, where the most competent man will prove most successful. Variations cannot be eliminated as long as men are of varying degrees of ability.

The estimate of quantities is a different matter; this is purely mathematical. Generally speaking, there can be but one bill of quantities if the plans and specifications are clear and susceptible of but one meaning. The figuring of quantities is really a part of the specifications. It often requires the interpretation of them. A bill of quantities is a definition of the extent of the work required by the specifications. It is the part of the owner to declare to the contractor not only the ultimate structure to be achieved but also the necessary constituents to that result. The contract fixes the conditions of performance of the work, the drawings show the structure to be built, the specifications describe the material to be used and the manner of use, and the bill of quantities, to complete the description of the job, should state the quantities of materials to be used according to the owner's interpretation of the drawings.

In Great Britain it has long been recognized that the bill of quantities is the owner's responsibility. In this country the contractor has assumed this risk. The British practice is sounder in principle.

Beside eliminating the contractor's risk as to quantities the quantity survey presents two other distinct advantages:

a. The efficient contractor has usually built up an adequate estimating department. The more efficient this is the more certain it is to include the entire quantity of every material. The efficient contractor has as a competitor a host of inefficient contractors who have no capable estimating organization. They are far more likely to estimate quantities too low than too high. The inefficient contractor, by reason of estimating quantities too low, bids low, gets the job and loses money on it. His error thus deprives the efficient contractor of an opportunity to do the work to the satisfaction of the owner and at a profit to himself. The adoption of the quantity survey would relieve the efficient and skilful bidder of the fallacious competition of the man who figures quantities too low. The quantities should be figured and guaranteed by the owner and provision made in the contract for an increase or reduction of the contract price for errors in the guaranteed quantities.

b. This practice would save the contractor's overhead. The cost of the estimate on the work not secured either eats up the contractor's profits or is paid by the owner whose work he gets. In any event, someone pays for on the average probably ten times as much estimating of quantities as is necessary. If a quantity survey is made and guaranteed by the owner the cost is of only one estimate and it falls directly where it ought to fall—upon the owner.

Specifications

This country is deficient in specifications of material and of methods of work. It ought to be possible in the case of almost every material to say that it shall conform to a given grade of fixed and known standards prescribed by a central organization. This would take the place of the old and inexact form: "Unless otherwise prescribed, all material shall be of the best quality."

The contracts of the United States engineering department fix the quality of cement by reference to tests prescribed by certain official publications. Lumber is often specified to conform to the classifications of the lumber manufacturers' associations. The U. S. Bureau of Standards has published some standards of quality. There are standard codes of practice for electric and gas installation. Very fine constructive work has been done by the American Society for Testing Materials. These definitions have generally been of materials and have not included methods of doing work. Like standards and exact definitions should be made of every material used in construction and of every process of installation. The result would be that every contractor would know at once exactly what he was required to furnish and would not be dependent upon interpretation by any engineer or his subordinate.

How loose these specifications have been in the past is illustrated by a case in my own practice in a contract made some years ago by the United States. The specification for framing lumber was in the following terms:

> All framing or other lumber to be thoroughly seasoned, straight-grained and square-edged, free from shakes, wanes, large or loose knots, and other imperfections impairing its durability.

This is supplemented by the following:

> All framing and other lumber, except where specified below, to be bright Southern yellow pine; sap on one edge and extending from this not more than one-third on each face will be admissible.

It is not surprising that the general contractors endeavoring to obtain bids from lumber manufacturers under this specification were advised generally by them that they would not not bid on such vague specifications and were obliged to go back to the United States officer and insist upon his amending the specifications so as to permit the use of lumber in accordance with the carefully detailed classification of the Southern Lumber Manufacturers' Association.

Loose, uncertain and discretionary specifications should be excluded. In a recent contract for paving the streets of a town in Virginia the materials were defined with a moderate degree of accuracy, but the specifications contained the following loose requirement:

> The materials used must comply with the requirements of these specifications and be suitable for use upon the street or streets to be paved. They shall be mixed in definite proportions by weight, depending upon their character and the traffic upon the street, and such materials and proportions must be satisfactory to the engineer.

The engineer was quite unfamiliar with street paving and varied his requirements of quantities of the different materials from day to day, finally stationing at the mixer a man who dictated what should be done according to his own daily judgment. Any practical man knows what the result of this must have been upon orderly work at the mixer, upon obtaining the proper materials and having them delivered on time. The specification quoted was a cover for a want of definite knowledge as to what was required.

In the same specifications for street paving the town assumed the responsibility for putting in sewer and water pipes. It relieved itself from any definite obligations by the following provision:

> The town will use all reasonable care and diligence to have sewer, water pipes or other connections and improvements constructed in advance of the laying of the pavement, but will reserve the right to open the street to perform such subsurface work during the progress of the work under this contract which in its judgment it may deem necessary.

No contractor should be obliged to bid on such an indefinite obligation.

In a recent case coming before the courts the specifications provided for a classification of excavation as "either common excavation or rock excavation." These were defined as follows:

> Common excavation shall include all material that can be removed with pick or shovel or by dipper dredge without blasting. Rock excavation shall include boulders exceeding 9 cu.ft. in volume and material requiring blasting for removal.

The contractors came upon sunken logs not expected by either party. These had to be removed by hand and cost the contractors more than twice what they were paid for rock excavation and more than twelve times what they were paid for common excavation. The War Department said that it could find no provision in the contract for paying them anything more than the common excavation price for this unusual condition. Contractors should be protected against such loose specifications as these by expressing in the general conditions that, where unexpected conditions are met, a reasonable allowance shall be made.

This association can render valuable service in co-operating with other organizations to secure more exact definitions of materials and more precise forms of specifications.

General Conditions of Contract

The American Institute of Architects has prescribed a form of general conditions of contract which is far in advance of any other form in recognizing the contractor's rights as an equal part to a contract. It is not too much to say that every other form in common use is so vague that it is within the power of the architect or engineer to make or break the contractor.

A standard form of general conditions should be framed by engineers and contractors working together and made a part of every engineering contract. It should be carefully prepared upon the principle of doing equal justice to both parties to the contract. There are two primary principles which should control in the preparation of such forms:

a. Proper responsibility should be assumed by each party in his appropriate sphere:

b. All disputed questions should be finally settled through the action of an impartial tribunal.

A form extensively used in contracts with the War Department contained the following provision violative of the first of the above principles:

> It is distinctly understood and agreed that the contractor assumes all risks under and in connection with this contract on account of delays in the work due to any cause.

In another government contract for public buildings the following provision occurred:

> That no claim shall be made or allowed for damages which may arise out of any delay caused by the party of the first part.

The party of the first part was the government and it actually delayed the contractor. The court before which the case came held, as it was obliged to do, that the contractor could recover no damages for delay caused to it by the United States. The injustice of these provisions cannot

be denied, but they occur over and over again in public and private contracts and should be eliminated through the action of an organization like this.

At the present time it is usual to place responsibility upon the contractor for underground or underwater conditions. The owner makes some explorations and places these at the disposal of the contractor, but guards himself from responsibility by some such clause as this:

The material to be excavated, as far as known, is shown by borings plotted on the drawings herewith (Sheets Nos. 11, 18 and 25), but bidders must inform and satisfy themselves as to the nature of the material. The United States will not guarantee the accuracy of its information.

Usually no time is left for the contractor to make explorations. If there were the cost would be prohibitive. Conditions are found very different from those represented by the borings and the contractor suffers a loss. The courts will give no relief save under exceptional conditions because, they say, the contractor had accepted the responsibility in signing the contract. It is entirely wrong to throw the risk for underground conditions upon the contractor. The site is the owner's and he should assume responsibility. He should make sufficient preliminary surveys through borings or otherwise to satisfy himself of the true conditions and these should be described and guaranteed by him. Thus the minds of the owner and contractor would meet upon a definite work to be done. If other conditions are found upon excavation the compensation should be increased or reduced.

The Engineer's Decision

The contracts generally in use make the architect or engineer the final authority upon all questions arising under building and engineering contracts. The following is a provision from a government contract:

These specifications are intended to be full, clear and complete. Any doubt as to their meaning or any obscurity in the wording of them will be explained by the Engineer Officer, who shall also have the right to correct any errors or omissions in them whenever such errors or omissions become apparent. His decision in all such cases and upon all matters relating to the work shall be final and binding upon the contractor.

This is frequently justified on the ground that he is the author of the specifications and therefore the person best able to construe them. This very fact affords the best of reasons why he should not construe them. The engineer writes what in his judgment has a certain meaning; the contractor reads them with another meaning. The proper person to decide what the specifications mean is someone who is acquainted with the general subject-matter but whose mind is not already made up as to the meaning. The question for decision is not the intention of the author of the specifications when he wrote them; it is the intention properly conveyed by the expression used. There should in every instance be an independent tribunal created by the contract from which an appeal could be taken from every decision of the architect or engineer.

The standard documents of the American Institute of Architects, by way of contrast to the above, thus define the architect's rights:

The architect shall have general supervision and direction of the work. He is the agent of the owner only to the extent provided in the contract documents and when in special instances he is authorized by the owner so to act, and in such instances he shall, upon request, show the contractor written authority.

As the architect is, in the first instance, the interpreter of the conditions of the contract and the judge of its performance, he shall side neither with the owner nor with the contractor, but shall use his powers under the contract to enforce its faithful performance by both.

The architect shall, within a reasonable time, make decisions on all claims of the owner or contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

The architect's decisions, in matters relating to artistic effect, shall be final, if within the terms of the contract documents.

Except as above or as otherwise expressly provided in these general conditions or in the specifications all the architect's decisions are subject to arbitration.

The easy devolution of authority to the architect or engineer to decide all uncertainties directly encourages vagueness in writing specifications. If the engineer knew that the meaning of his specifications is to be determined not by himself but by independent authority, he would take every possible care to write the specifications with exactness.

Where the right to make final decisions is conferred by the contract upon the architect or engineers, and he decides erroneously, it is held by the courts that no correction can be made, even if he is wrong, no matter how much injustice may result.

This association has already done much preliminary work in exposing the wrongs of the present forms of contract and in pointing out the changes needed. The form of lump-sum building contract in the *Bulletin* for January, founded on the standard documents of the American Institute of Architects, forms an excellent basis of discussion. The committee on contracts may well continue its work by securing the co-operation of other organizations, such as the engineering societies, railroad and municipal engineers, owners of office buildings and realtors' organizations in the adoption of a just form of contract to be adopted for general use

Uniform Cost Keeping

Another method of eliminating risk arises in the adoption of proper systems of cost keeping. Here again is an instance where the skillful and efficient contractor is at a disadvantage in obtaining contracts. The inexperienced man underestimates his costs and his quantities, and thus underbids the efficient contractor and in the end loses money. Generally he has no proper acquaintance with overhead. The job is lost to the efficient contractor through this unnecessary competition with a possible profit at a reasonable price. Thus both are losers, while the owner, who has been struggling with a losing contractor, is equally dissatisfied.

I recall hearing a distinguished architect say that he considered one of his first duties to an owner was to see that he paid a sufficient price for his work, meaning that this is the only method in which a good job could be insured. An opportunity for extremely valuable work by this association is presented by instructing their inexperienced competitors as to the meaning of overhead and by agitating for a uniform cost-keeping system, whereby it would be certain that every contractor had considered all the elements of cost before making his bid.

A manufacturer doing a large business in a common building material in a middle western city told me that he had found it to his advantage to publish a pamphlet containing his entire cost system and to employ capable men to go about among his competitors and explain to them the advantages of cost keeping on this basis. This subject is ably treated in an article by J. L. Jacobs, the well-known cost accountant, in the Bulletin of this association for June, 1920, and he not only concludes that uniform cost accounting is practicable but he says: "As a result not only are unintelligent competition and unprofitable undertakings largely eliminated, but a closer co-operation and more friendly competition is created throughout the entire industry."

Conclusion

The result of eliminating the risk as far as possible from construction work is not alone for the benefit of the contractor. Whatever unnecessary risk the contractor assumes must ultimately be included in the cost which the owner pays. There is no other paymaster but the owner. Contractors cannot live without charging a percentage, payable by the owner, to cover unnecessary risk. This becomes a part of the ultimate actual cost. By such risks owners would be relieved of such additional charges and would obtain rock-bottom prices based upon actual work and a complete understanding of the work to be done. Besides this competition would be increased. Yet the contractors would be greatly benefited because the ever-present fear of loss would be measurably reduced.

No contractors' organization in this country has ever been placed upon a sufficiently firm basis to permit it to undertake these movements for the benefit of contractors as a whole until the organization of this association along broad lines, with sufficient financial support to insure beneficial results to the entire body of contractors of the United States.

Snow Removal and Drift Prevention on Highways

Principles and Practices of Pennsylvania Highway Department Developed During Two Years of Successful Snow Fighting

By George H. Bil
Assistant Commissioner, Pennsylvania Highway Department, Harrisburg, Pa.

SUCCESS in keeping highways clear of snow requires first a comprehensive, quick-acting general maintenance organization which can be turned to the task. Preparedness in respect to equipment and, also, through foreknowledge of when and where action will be required is the second important requisite. Finally there must be perseverance or continuously applied effort. Strictly speaking, preparedness includes organization, but for emphasis the two are set apart.

Primarily highways are kept clean from snow to serve traffic. Traffic need of an open road the year round does not exist on all highways, but there are main routes connecting industrial communities and market centers and traversing productive farm country which are of great economic value as all-season highways. This value is intensified by the failure, during the last two or three years, of the railways to meet traffic demands. These highways should, by drift prevention and snow removal, be kept open in winter as well as in other seasons; in fact this accomplishment should not be at the option of highway officials but should be required, if necessary, by legislative act.

DRAG AND V-PLOW WORK

Snow removal, however, has an economic value of another sort. On certain types of improved highways there is no doubt that keeping the snow off the surface of the road is of inestimable benefit, as it allows much more uniformity in the action of the frost and in the distribution of the traffic over the entire width of the road metal. A good example of this is shown on some of the modern types of roadway. When the snow has been removed and the traffic wears down the center of the roadway to a point, when melting begins, of exposing the road surface, leaving the sides piled high with snow and fully protected, the earth under the pavement in the center thaws sooner than that upon the sides and the result is that the pavement is fractured or is left spotted in such a manner that future traffic will cause serious detriment.

Snow removal, properly considered is not an emergency operation, it is a permanent function of the maintenance department. Organization for snow removal is, therefore, an inherent part of the general organization for maintenance. In Pennsylvania it consists of the district engineers, county superintendents, foremen and laborers, exactly the same organization, which, during the summer months, does the resurfacing, oiling and general repair work. Under preparedness comes first the necessity of properly protecting by snow fences the points upon the highway where past experience has shown drifting is most liable to occur. There are a number of locations in this state where, previous to the erection of a snow fence, it was necessary to remove by hand deep drifts at a great expense and consequent delay to traffic. After these locations were properly protected, the department's motor-driven snow plows or road machines kept the snow clear.

A fair average price for the fence complete in place at the present time is 50c. per foot. The design is similar to the standard used by the large railroad companies, consisting of eight hemlock boards 10 ft. long 6 in. wide and 1 in. thick placed 6 in. apart and framed together with three braces of 2 x 4-in. hemlock, placed 3 ft. apart from the center, to which are bolted 9 in. from their tops 2 x 4-in. supports 6½ ft. long. These supports are bolted to hemlock stakes driven 15 in. into the ground; the stakes are 2 x 3 in. x 2½ ft. Similar

TRACTOR-OPERATED ROAD MACHINE

stakes driven vertically in front of the frame help to hold it fast. There are about 75 ft. b.m. in each 10-ft. section of this fence.

While the snow fence might, in a sense, be considered as equipment, it is assumed that equipment consists of snow plows, motor trucks, drags and road machines. On the first of October, instructions were issued to the several engineers and superintendents to place the different equipment at designated points or sections from where experience has shown they can be most advantageously worked.

Weather forecasts are another preparedness measure. The United States Weather Bureau advises the different superintendents of any severe storms that are expected to sweep over any section of the state. The forewarning gives the organization sufficient time to get into the harness and anticipate the conditions. In further co-operation, the Department furnishes the bureau with a daily statement of the road conditions upon all continuously improved highways. The thought in doing this was that the work thatis being done would not be of benefit to the people unless they were properly advised and had this advice when it was current enough to be of benefit in planning trips.

Methods and Costs

Fundamentally the method of removal is to start work as soon as the snow begins to fall and keep the snow pushed back off the road as fast as it falls. Methods and equipment are perhaps best explained by a description of the procedure last winter of keeping open for United States motor convoys the 225-mile route across the state from Ohio to Maryland.

The patrolmen who were employed regularly on the highway formed a nucleus to create the larger forces

PLOW ATTACHMENT FOR MOTOR TRUCKS

to handle the work. Each caretaker or patrolman was assigned to a section with instructions to report conditions immediately to the district head or superintendent, who in turn either wired or phoned the main office at Harrisburg. If the conditions were abnormal, the superintendent communicated with the assistant engineer, who arranged an immediate inspection and authorized such steps to be taken as were deemed necessary to expedite the work. The first report of the local

SHOVEL GANGS FOR DEEP DRIFTS

man was followed by a postal card report giving the details and addressed to the central office. This information was charted as soon as received and a bulletin maintained at all times for general information. If the drifts were unusually deep and the road not open within 24 hours, headquarters was advised, which afforded an opportunity to keep in complete control of the entire work at all times.

Work began by breaking a track with road drags and small V-shaped plows drawn by teams. These were followed by road machines or motor trucks, with plow attachments. Turnouts were made at convenient intervals and as soon as possible thereafter the road was widened to between 14 and 18 ft., depending upon the location. The entire travelable width of roadway was finally opened in order that traffic would not cut through to the road surface during periods of freezing and thawing. The snow at first was removed to within 3 in. of the road surface and what did not melt afterward was removed entirely.

These methods apply particularly to improved roads, for if traffic is permitted to track during periods of freezing and thawing on such highways, the surface becomes affected to various degrees, depending on the type of the road. There are a number of miles of waterbound macadam roads with bituminous surface treatments on the main trunk lines and in order to preserve them during such periods it is essential to distribute the traffic. On the unimproved roads the snow is not taken off entirely down to the surface, but several inches are left for the travel to pack, and as it softens, more snow is dragged from the sides, in order to keep the surface comparatively smooth at all times. Rolling of snow is done on the less important lines, but this has not been very satisfactory on the roads where there is much motor traffic, on account of the rough condition that results when the surface becomes cut up. The snow being rolled and wet from time to time with sleet and rainstorms becomes almost as hard as ice. However, there are a number of roads where the travel is light and used mostly by horse-drawn vehicles, where this method will suffice.

There were heavy drifted conditions where special treatment had to be resorted to. These were generally located in cuts where drifts were so deep and banks so high that the snow had to be shoveled and hauled out. As soon as any portion of roadway was open, shovelers followed cutting openings from the edge of the road to the side ditches at various points along the road which

assisted greatly in the protection and drainage of the surface. In addition to this, all side drainage and culverts were kept open and free of obstruction. This precautionary measure produced very good results and when the snow passed away in the spring, the general conditions were better both as to drainage and surface than they had been at any previous time, in spite of the fact that the roads had greater traffic and loads than at any other time in their history.

Snow up to 12 in. in depth can be handled advantageously with road machines and from 12 to 36 in., if not too heavy, can be moved with motor trucks with plow attachments, with excellent results. The truck is run along one side of the highway and back on the opposite side at the rate of about four miles per hour and carries a small crew of men with shovels that are used when the snow piles up in front of the blade which it will do, especially when wet. When there is a greater depth than 3 ft. a large A-shaped plow is used. This implement is 30 in. high at the nose and 6 ft. at the back, with 20 ft. legs, and is 16 ft. wide at the back. It is made of 2½-in. oak plank and 4 x 4-in. framing, held together with movable braces. Drawn by a heavy tractor, it has proved a very economical and effective device. The movable braces are provided for the purpose of permitting vehicles to pass during operation. The light tractors do not hold the road and have been found unsatisfactory for this work. Mechanical devices are preferable in the majority of cases, but if the drifting is a continuous performance in cuts, it resolves itself into a shoveling proposition.

It is impossible to estimate what it will cost to keep different highways open for any winter. During the winter of 1919-1920, which was the most severe in years in this section of the country, the cost ranged from $75 to $350 per mile, while during the year of 1918-1919, the cost ranged from $10 to $30 per mile the entire winter.

Changes in the World's Shipbuilding

THE following statements, compiled by the U. S. Bureau of Navigation from the quarterly shipbuilding returns of Lloyd's Register, show, says *Commerce Reports*, the merchant ships under construction throughout the world on Sept. 30, 1920, compared with the situation for Sept. 30, 1919.

Country	Steel Number	Steel Gross	Wood Number	Wood Gross	Total Number	Total Gross
SEPTEMBER 30, 1920						
United States	290	1,739,783	22	32,410	312	1,772,193
United Kingdom	955	3,728,627	6	2,471	961	3,731,098
British Dominions	61	196,208	28	17,686	89	213,894
Japan	72	262,407	...	.....	72	262,407
Holland	165	423,400	...	.....	165	423,400
Italy	67	332,713	89	32,600	156	365,313
France	79	289,936	10	2,672	89	292,608
Sweden	59	118,635	10	3,214	69	121,849
Others	166	365,336	26	17,073	192	382,409
Total	1,914	7,457,045	191	108,126	2,105	7,565,171
SEPTEMBER 30, 1919						
United States	593	3,088,488	174	382,260	767	3,470,74
United Kingdom	752	2,802,903	29	13,870	781	2,806,773
British Dominions	76	238,649	98	69,816	174	308,465
Japan	64	299,600	...	.....	64	209,600
Holland	113	288,042	...	.....	113	288,042
Italy	59	261,328	49	24,600	108	285,928
France	48	169,452	16	5,284	64	174,736
Sweden	44	94,477	20	6,740	64	101,217
Others	137	283,393	56	19,680	193	303,073
Total	1,886	7,526,332	442	522,250	2,328	8,048,582

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worthwhile letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Am. Soc. C. E. Committee Chairmanships

Sir—There have been appointed recently two very important committees by the board of direction of the American Society of Civil Engineers; the committee on constitutional amendments and the committee on external relations. The chairman of the former committee was elected a member of the society 15 months prior to his appointment to the committee, and the chairman of the latter committee was elected a member 18 months before his appointment.

There can be no objection to the appointment of a small minority of newborn members to any committee; in fact it might be a desirable custom. But why appoint such newcomers to important chairmanships? Are there no members of from five to ten years' membership qualified for these positions, and posssibly more in touch with the society's traditions and aspirations?

Again, why were these chairmen selected from those recently connected with the late construction division of the army?

At least some members of the society would like to know.

Chicago, Dec. 22, 1920. A. T. NORTH, M. Am. Soc. C. E.

[In accordance with the usual practice in such criticisms as this, Mr. Worth's letter was submitted to the recently retired board of direction of the American Society of Civil Engineers, which made the appointments referred to. Under date of Jan. 22 the acting secretary of the society writes: "I am instructed by the board of direction to advise you that no reply will be made by it to your communication."—EDITOR].

Analysis of Double Footing Pressures

Sir—In *Engineering News-Record* Sept. 9, 1920, p. 494, there appears an interesting article by Marshall G. Findley dealing with the maximum compression on the foundations or joints of piers not capable of resisting tension when these are subjected, in addition to evenly distributed vertical loads, to the moments of horizontal forces acting at angles to each other; such as occurs, for example, if a railway train is being braked when passing over a high bridge pier while at the same time the wind is blowing at a considerable angle to the running direction of the train. It is stated in the paper referred to that the methods in current use applied to the solution of this problem not only give results inconsistent with each other but that the results thus arrived at could be proved in many cases to be far from correct.

The problem involved came under my notice many years ago, and while moderately familiar with a number of American engineering text-books and periodicals I have not previously found in them any mention of the matter concerned; so what follows is restricted to some technical publications available elsewhere.

These are:

(a) A paper by the undersigned in the "Proceedings of the Institute of Civil Engineers (London), Vol. CLXV, Session 1905-6, Part 3."

(b) A paper by Prof. Morike in "Beton & Eisen (Berlin), March 1, 1913, p. 9."

(c) A letter by the undersigned in reference to paper (b)—"Beton & Eisen, Feb. 10, 1913, p. 353." (containing incidentally also an easy method of finding the core of any section).

Prof. Morike finds his results by means of a method of

trial, and an example worked out by him corresponds with what is obtained from my tabulation, while my own demonstration seems to be almost the same as that given by Mr. Findley; at any rate the results obtained from the table practically agree with those worked out by him in the four examples detailed, as will be seen in the following comparison:

Example	Mr. Findley's Multipliers	Multipliers from My Table
I	1.25	1.25
II	3.00	2.99
III	4.29	4.30
IV	13.5	13.5

(The last figure—13.5—is not in the table, but is obtainable from an item mentioned in the paper.)

A table was worked out in my contribution making it easy to find out the multipliers of the unit compression for any center of pressure (within practical limits) due to the action of horizontal forces on a pier with a rectangular section and enables a result to be established within a few minutes.

Melbourne, Australia, Dec. 4, 1920. F. K. ESLING.

Concrete T-Beams Designed as Truss

Sir—Recent communications to your journal regarding simple and safe methods of designing reinforced concrete seem to be much to the point. In an effort to arrive at the design of large T-beams by short but rational calculations the writer was led to the method shown in Fig. 1.

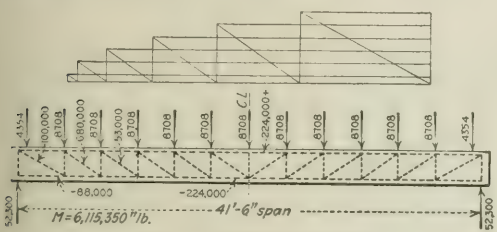


FIG. 1. STRESS DIAGRAM

The values shown in the stress diagram are slightly in excess of the actual stresses. The diagonal stresses in the middle half of the beam can safely be taken by the web.

Beams such as shown in Fig. 2 were designed and successfully built. They carry a dancing and drill floor. A heavy rain washed out the forms the night after these beams were poured, but a level failed to show any deflection the next day. Under full load the deflection was in the neighborhood of ⅛ in. No cracks have shown in five years that are discernible to the unaided eye. The beams were built with a camber of ⅛ in.

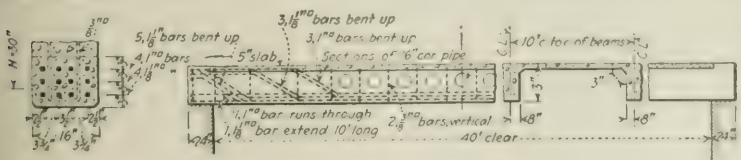


FIG. 2 BEAM DESIGN

It is recognized that the truss analysis does not apply rigidly to the beam. However, there are a large number of variables in such a beam, and also in any solution for same. The concrete itself may easily vary 5 per cent from its assumed value—or may vary that much in different beams. The load will never be exactly as assumed in the calculations, and, we have taken care of the variable effect of vibration by our "factor of doubt" (factor of safety).

We have also to consider that where a *simple* (approximate) method is used we may require a small additional amount of steel, or concrete, as the case may be, and we *save* the *value* of this on the drafting table and in the field. JOHN B. HUTCHINGS, JR.

Asheville, N. C., Dec. 10, 1920.

The Antioch Plan

Sir—In an article entitled "The Antioch Plan," by Arthur E. Morgan, appearing in *Engineering News-Record* Jan. 20, 1921, p. 108, the statement is made that Antioch, as far as known, was "the first non-sectarian, privately endowed college in the country."

The writer believes that the distinction of having been the first non-sectarian college in the country belongs to Union College, Schenectady, N. Y., Union having been chartered Feb. 25, 1795. The non-sectarian principle was clearly set forth in her charter, a portion of which provided among other things that no ordinance, rule, or order of the institution should ever "exclude any person of any religious denomination whatever from equal liberty and advantage of education, or from any of the degrees, liberties, privileges, benefits or immunities of the said college on account of his particular tenets in religion." The founders of the college also introduced a provision in the charter providing that a majority of the board of trustees should never belong to any one sect.

As to the private endowment, a portion of a recent communication from Dr. George Alexander, president ad interim, Union College, is to the point: "Before her (Union's) charter was granted citizens of three great counties, more than a thousand in number, presented petition after petition *backed by their personal subscriptions* for the founding of a college 'in the town of Schenectady as in every respect the most suitable and commodious site for a seminary of learning in this state, perhaps in America.'"

It may also be of interest to add that in 1845 the department of engineering was established at Union, which was the first engineering course in connection with an American college. EDGAR S. CLOSSON,

Montclair, N. J., Jan. 25. Consulting Engineer.

State Road Survey Methods and Costs

Sir—I read with much interest the article entitled "State Road Survey Methods and Costs in Missouri," which appeared in *Engineering News-Record* Jan. 13, p. 68, and my attention was particularly directed to the statement of the engineering cost policy. It is the opinion of the writer that there is a misdirected though widespread tendency on the part of engineers and legislative bodies to make a bugbear of engineering locating expense on highway projects.

I believe that highway engineers will in the future have to come to the more expensive and thorough method of projecting a location as is practiced by railroad engineers in all relocations, or at least in country that is difficult and in which construction will necessarily be heavy.

The writer is not aware of the type of country through which the surveys are made in Missouri, but if the country is inclined to be rough, broken or hilly, not to mention mountainous sections, the soundness of a carefully projected location must be apparent to any one who considers the construction cost of the work. As an example let us suppose that a projected location will cost $300 per mile as against a field location cost of $100 a mile. I certainly believe that all locating engineers will agree with me when I state that no matter how careful or experienced the chief of party may be there are many places in a field location that can be improved, particularly in rough country. Even the shifting of the alignment a few feet in either direction on side-hill work materially reduces the cost of earthwork, especially if the material is rock.

Assume, therefore, a projected location to cost $200 more per mile than a field located line. At the present time unit price bids on earth and rock excavation are uncertain, yet we will assume earth at 50c. per cubic yard and rock at 80c. per cubic yard. Using these figures it will only require 400 cu.yd. of earth or 250 cu.yd. of rock to reduce the two methods to equal final cost per mile. I do not believe I shall

be much in error in stating that many hundreds of dollars, and in some cases thousands of dollars, can be saved per mile on construction in broken country by using a carefully selected location, especially at this time when highway costs run from $8,000 to $12,000 per mile.

The means of reduction of first cost might be tabulated as follows: Straightening crooked alignment, shortening total distance, reduction of earthwork, compounding such curves as the topography and tangent lengths will permit, which saves materially in the cost of right-of-way markers, which in this state are constructed of reinforced concrete and are placed at every P.C. and P.T.

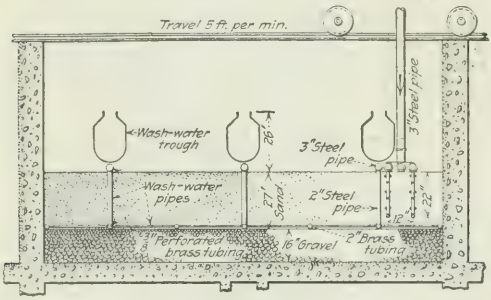
Aside from this reduction of first cost there must be considered the easier grades that result, and the decrease in cost of maintenance on the shortened length, not to speak of the satisfaction of being assured of having the best location possible, which will probably mean something in the future when highway traffic becomes heavy.

I am writing this in the hope that comment will be aroused and some attention directed to this important subject, and through such comment a better understanding of what real engineering economy is.

CHARLES M. NOBLE,
Decatur, Ala., Jan. 23. Alabama Highway Department.

Proposed Cure for Mud Balls in Filters by Rearrangement of Piping

Sir — On p. 985 of the Nov. 18, 1920, issue of the *Engineering News-Record,* Prof. Charles Gilman Hyde of Berkeley, Cal., suggested that the Blaisdell tractor washer in use at Yuma and Calexico, would prevent the formation of mud balls in mechanical filters, so I have developed the suggestion, as shown in the accompanying drawing, taking the new Toledo filters as a basis for arranging the piping for the use of the washer. It will certainly be a cure for all mud-ball and channeling troubles and the expense of operation will be nominal, for but 3 hp. will be required to give the rakes the reciprocating action. The machine will be electrically operated, the rakes making fifteen 6-in. strokes per minute. The forward motion of the car carrying the rakes will be 5 ft. per minute. An electric hoist will quickly lift the rakes over the troughs.



AUXILIARY MECHANICAL FILTER WASHER TO PREVENT CHANNELING AND MUD BALLS

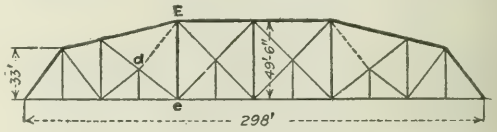
Water pressure for the rake-teeth jets will be taken from a filtered water pressure main, through a flexible hose which will drag behind the machine. The rake washer will be used in combination with the regular work, as often as may be required to keep the filters in first class condition. It will take 10 or 15 min. to wash a filter. One rake will do the work if it is not necessary to wash under the troughs. One washer will have sufficient capacity for almost any number of filters as it can be transferred from one row of filters to another on a transfer table.

A pair of 24-ft. rakes have been used to clean the Calexico municipal filters for five years with satisfactory results.

Los Angeles, Cal., Dec. 30, 1920. H. W. BLAISDELL.

Resistance to Secondary Stresses Saves Bridge With Member Missing

Sir—The article on "Secondary Stresses in Kenova Bridge" in your issue of Dec. 9, 1920, p. 1116, recalls a somewhat similar structure built in the early days of camelback trusses, about 1888, over the Big Warrior River near Cordova, Ala. At that time but little information was available regarding secondary stresses, and some of the venturesome designers were either overconfident through limited knowledge regarding primary stresses, or repeatedly careless. The structure carried a single track, was designed for a live load of two 171,000-lb. consolidation engines followed by a train load of 3,000 lb. per lin. ft., and weighed about 2,200 lb. per lin. ft. A diagram of the truss is submitted for the use of any readers who may be interested in determining how high secondary stresses may run without collapse.



SUB-HANGER ADDED TO RAILWAY BRIDGE

The structure had been completed and tested, and was in regular service, when the writer discovered that member *dE* should be added, as member *dc* consisted of two plain 5 x 1⅛-in. eyebars only. Considerable pressure was necessary to initiate an investigation because of the confidence in the reputation of the builders, the tests prior to acceptance, and the fact that the bridge was carrying the trains. Adequate haste followed the demonstration of the defect, and a rod 2 in. in diameter was added on the line *dE*.

Subsequent investigation of some other similar spans about 500 ft. long disclosed similar omissions, but all efforts of the writer to locate the responsibility for the blunders were unavailing. Unknown capacity to withstand secondary stresses has saved many structures. The credits and debits should be accurately computed rather than covered by a factor of safety or blanket percentage.

JAMES W. PEARL.
Chicago, Jan. 11.

Cold Patches with Sand Unsatisfactory in Ohio Road Maintenance

Sir—I wish to take decided exception to that part of an article in your issue of Dec. 16, 1920, p. 1168, entitled "Good and Bad Practice in Making Bituminous Patches," which Mr. Crandell styles, "Cold Patch (Mixed Method)." The Ohio State Highway Department has repeatedly tried sand as an ingredient in its cold-patch work and has never secured good results. We have found that a cold patch made with stone and sand almost invariably waves; whereas a patch made only with crushed stone uniformly gives good results where proper workmanship obtains. We have found that a mix of one part tar cut-back to thirteen or fourteen parts crushed stone (¼ in. to ¾ in.) when mixed by hand, or one part tar cut-back to sixteen or seventeen parts crushed stone when mixed by machine, gives approximately the correct proportion. We have found that, when mixed by hand, if the stone is completely coated after about six turns, the right amount of cut-back has been used.

One of the most valuable lessons we have learned in the use of the cold mix is the economy secured through using a small concrete mixer. We have in many of the counties in Ohio State highway maintenance gangs which are highly skilled in the use of the cold patch and get exceedingly good results in its use on practically all types of pavements.

H. S. PERRY,
Maintenance Engineer,
Columbus, Ohio, Jan. 7. Ohio State Highway Dept.

NEWS OF THE WEEK

New York, February 3, 1921

Good Roads Congress Next Week at Chicago

Program Contains a Dozen Technical Papers and Discussion by Specialists—Equipment Exhibit a Feature

The program for the eleventh annual Good Roads Congress, to be held at the Coliseum, Chicago, Feb. 9-12, under the auspices of the American Road Builders Association, presents twelve papers on highway topics to be followed by discussion by selected specialists and an announcement of the Good Roads Show, constituting an exposition of road-building machinery and paving materials by manufacturers. The annual banquet is scheduled for the evening of Feb. 10 at the Congress Hotel. The convention will be called to order by President M. J. Faherty at 10 a.m., Feb. 10. The main features of the program follow:

Feb. 10.—"Our National Road Problems," Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Washington, D. C.

"Relation of the Highway and Motor Transport Movement to Education," Prof. C. J. Tilden, national director of highway and highway transport education, Washington, D. C.

"Highway Improvements in New England," A. W. Dean, chief engineer, Division of Highways, Massachusetts Department of Public Works.

"The Local and National Importance of the Lee Highway," Dr. S. M. Johnson, manager Lee Highway Association, Roanoke, Va.

"The Highway's Part in the Development of Efficient Transportation," C. W. Reid, chairman transportation committee, Federal Highway Council, Washington, D. C.

"Subgrades," H. G. Shirley, secretary Federal Highway Council, Washington, D. C.

"Importance of Drainage in Road Construction," F. H. Eno, professor of engineering, Ohio State University.

"Types of Pavements," James H. MacDonald, former state highway commissioner of Connecticut, New Haven, Conn.

"Highway Researches and What the Results Indicate," A. T. Goldbeck, chief division of tests, U. S. Bureau of Public Roads, Washington, D. C.

Feb. 11.—"Recent Developments in Road Building," Edward N. Hines, chairman of board, county commissioners, Wayne County, Mich.

"Highway Finance," H. C. Sylvester, vice-president National City Co., N. Y.

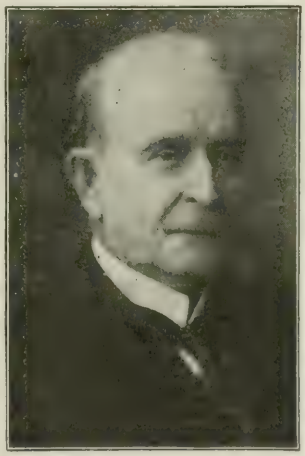
Feb. 12—"Relation Between Engineers and Contractors," W. A. Rogers, past-president Associated General Contractors.

General Contractors in Convention Approve Broad Plans for Association Activity

Meeting at New Orleans Last Week Indicates Great Progress in Crystallization of Aims and Methods

Settlement to a definite policy and assurance that the association will be a permanent and ever-increasing factor in the construction industry are the chief accomplishments of the convention of the Associated General Contractors of America which met in New Orleans last week. The convention lacked the dramatic. It listened to some prepared addresses, but its chief work was a quiet appraisal of what was done in the past year and an exchange of views on future policy. This was done more in the corridors than on the convention floor. At the beginning there was question whether the bigness of the plans proposed by the executive board were justified at the present stage of the organization's growth, but this feeling gave way during the meeting to the settled conviction that the plans of the executive board were the right ones. This attitude found expression in the acceptance, without objection, of all the committee reports, in the lack of dissent to the plans proposed for 1921, and in the hearty reception to the newly elected officers, all of them known to favor the program that had been laid before the convention.

New President of Associated General Contractors



W. O. WINSTON

At the final session amendments to the constitution were adopted providing for the increase of the number of vice-presidents from three to six, for the appointment of a general manager, and the establishment of the headquarters in Washington. The budget for the coming year, providing for the expenditure of the $119,000 now in sight and the allocation, if realized, of $40,000 more from prospective sources, was laid before the members at this session and approved. The proposal of the finance committee that dues be put on the basis of one-tenth of one per cent of the annual business done by the members was not put before the meeting by the executive board, and the dues for this year will be on the same basis as last. The membership report showed that, as of the end of last year, there were 760 members.

Past and Prospective Work

Most important was a broad plan prepared under the direction of the general manager, looking not merely to the year ahead but to the desirable work over a period of years. This included, among others, legislative and research divisions. The former would keep in touch with municipal, state and national

(Continued on p. 238)

W. O. Winston Heads Associated General Contractors

W. O. Winston, president of Winston Bros. Co., Minneapolis, who was elected president of the Associated General Contractors at the annual meeting of that organization in New Orleans last week, was born in Hanover County, Va., Feb. 6, 1853, and educated at private schools in Virginia. In 1872 he took up engineering in the service of the Chesapeake & Ohio R.R. Two years later he left the South, going to Minnesota with the United States Government as a member of engineering parties, 1874 and 1875.

He began the contracting business with his brothers, P. B. and F. G. Winston, in the winter of 1875-76, under the firm name of Winston Bros., at Minneapolis, Minn. Their business was incorporated in 1902 as Winston Bros. Co., and Winston-Dear Co. Mr. Winston served as vice-president of Winston Bros. Co. until 1914, since when he has been president. He has also been president of Winston-Dear Co. since its organization.

Subsitute Road Bill Reported by House Committee

A substitute for the McArthur road bill has been reported favorably by the committee on roads of the House of Representatives. The substitute carries an appropriation of $100,000,000 for federal aid in co-operative highway construction and $3,000,000 for roads and trails in forest reserves. As originally introduced this measure provided for a four-year program, but members of the committee were of the opinion that the incoming administration should be consulted before the program is authorized beyond the next fiscal year. The substitute measure will come up in the House on Feb. 7 under suspension of the rules. No doubt is expressed as to its passage.

The measure may meet with difficulties in the Senate. The bill will be referred to the committee on post offices and post roads, of which Senator Townsend of Michigan is chairman. Senator Townsend has a road bill of his own, but in the face of the nation-wide demand it is believed that the bill will be reported out by the Townsend committee, perhaps with amendments providing for the linking up of interstate roads.

The need for additional legislation, if the federal aid policy is to be pursued, is shown by the fact that no funds are available for new contracts in twelve states. In eight states the funds available would permit of contracts for less than 50 miles of road, while in ten states only enough is available to contract for 120 miles, or less, of new construction. The average annual program is figured as being 200 miles of new roadway.

Harlem River High Bridge to Remain

Retention of Harlem River High Bridge of the first Croton Aqueduct was decided upon by the Board of Estimate and Apportionment of New York City last week, when the opposing proposals (1) for demolition of the structure and (2) for its reconstruction with a large elliptical arch span to replace three of the present short spans across the river channel came up for final consideration. A full statement of the case was made in *Engineering News-Record* of July 29, 1920, p. 229, in which the plan presented by a joint committee of the American Institute of Consulting Engineers and the American Institute of Architects for constructing a large concrete arch over the river in place of three 80-ft. arches and removing two of the present piers was described and illustrated. The Department of Plants and Structures of New York City favored demolition of the bridge, but the Department of Water Supply desired to retain it as a supplementary water conduit, while residents of Bronx Borough desired the bridge as a future roadway crossing. The estimated cost of demolition was about $500,000, while estimates for constructing the large concrete arch of the joint committee ranged from $900,000 to $1,250,000. An appropriation of $900,000 has been made by the Board of Estimate to carry out this plan.

Army Engineers Report Against Ocean Ship Canal

In the river and harbor act of 1919 the Chief of Engineers, U. S. Army, was ordered to report on such routes between the Great Lakes and the Hudson River as may be considered practicable by him, with a view to securing a waterway admitting ocean-going vessels to the Great Lakes. In accordance with this order the Secretary of War has submitted as H.R. 890, 66th Congress, 3rd session, the endorsed report of the district engineer of Buffalo, Lt.-Col. Clarke S. Smith, Corps of Engineers, U. S. A. The recommendations in Colonel Smith's report are approved by the division engineer, Colonel J. G. Warren, by the Board of Engineers for Rivers and Harbors, and the Chief of Engineers, Major-General L. H. Beach.

The report calls attention to the fact that this same subject has been investigated a number of times since 1832, when the first report was made. Nevertheless the report details the possible location of such a ship canal, together with the physical status of the present waterways and the business which has been done upon them recently. There are stated all the arguments in favor of and against a canal, leaving aside advantages which may be gained by the concurrent development of water power. At the same time the proposed St. Lawrence waterway is not discussed because it is now being considered by another board of engineers. This leaves three practical locations between Lakes Erie and Ontario, namely the Welland Canal in Canada and two routes through the American Niagara peninsula, one from Tonawanda to Alcott, and the other from La Salle to Lewiston. To get from Ontario to the Hudson River there is the possibility of building a ship channel along the route of the present New York State Barge Canal from Oswego down to the Mohawk Valley and thence to the Hudson, or it might be possible to connect the St. Lawrence River with Lake Champlain, and thence by ship canal to the Hudson.

In the words of the Chief of Engineers the following is the conclusion of the report:

"In reference to the desirability of the proposed canal the district engineer states that this would depend chiefly upon how much of the hundred million tons or more of present through lake commerce would use the new canal or what saving of freight charges, if any, would be effected. It should be borne in mind, however, that the need for economical transportation with the present bulk of commerce of the Lakes is not the only need to be met. The great manufacturing cities of the Lakes now have a tremendous export of import traffic passing through Atlantic ports, chiefly New York. This traffic is now carried by rail and is subject to heavy charges for freight and terminal and transfer costs. As a result of his study of the subject the district engineer reaches the conclusion that it is not advisable for the United States to undertake the construction of a waterway connecting the Great Lakes with the Hudson River at the present time. The division engineer takes a similar view to the district engineer. The Board of Engineers for Rivers and Harbors states that if an adequate waterway were made available with suitable transfer facilities at the principal lake ports, a large amount of general merchandise, mostly grain, might be carried to the seaboard either in ocean-going vessels or in lake vessels transferring at New York. The completion of the New York State Barge Canal has been looked forward to for many years with the belief on the part of many that it would in a measure at least solve the difficulties of transportation and freight rates between the Great Lakes and the seaboard. It has been open for navigation but a short time, too short as yet for business interests to accommodate themselves to it, and it is still too early to determine definitely what its commercial influence will be. It has cost a very large sum and it will be practically all lost if a ship channel were constructed along the same route, even if only between Oswego and deep water in the Hudson. In view of the foregoing and of the investigation of the St. Lawrence River route now being made by the International Joint Commission the board concurs with the district and division engineers in the opinion that it is not advisable at this time for the United States to undertake the construction of a waterway for ocean-going vessels between the Great Lakes and the Hudson River."

Finally Colonel Smith states in his report: "It is my opinion that any improvement in line with the inquiry by Congress is not worthy of consideration at the present time and it is recommended that no such improvement be considered until the actual completion and use of the enlarged Welland Canal and actual demonstration of the adequacy or inadequacy of the New York State Barge Canal indicate a need therefor."

Start Manitoba Railroad Survey

The surveying for the proposed railway to the Flin Flon copper ore deposits in northern Manitoba has been commenced. Four miles of the line are already built as a spur from Mile 7 on the Hudson Bay Railway. The route lies from this point to Lake Athapapuskow, a distance of 53 miles, thence on the north side of the lake to Flin Flon. The survey is expected to be completed by March 1, 1921.

N. J. Engineers Urge Road Law Amendments

Association at Annual Meeting Proposes Many Changes—Traffic Committee Makes Final Report

Greater extension of traffic census work, involving the planning, now, for the future expansion of the state and the county highway systems, was recommended in a final report which the committee on present and future traffic conditions submitted to the annual meeting of the New Jersey State Association of County Engineers, held at Trenton, Jan. 25. Other features of the program were a discussion of proposed amendments to state road legislation and papers on laboratory control of highway work, bridges for state roads and motor-vehicle registration. F. A. Reimer, engineer of Essex County and vice-president of the association, presided.

While final action in approving proposed amendments to existing laws was deferred a number of suggestions were made and discussed. Opposition developed to the existing requirement for a year's maintenance by the contractor on a completed road. It was felt that any guarantee should cover only workmanship and materials, leaving the matter of maintenance to the individual counties. Such a change, it was contended, would result in better work and lower costs, for a contractor under obligation to maintain a road for a year after completion is sure to include in his bid prices for construction amounts amply sufficient to protect him in this feature of the work.

Pay for Materials Delivered

The proposal to pay contractors 80 per cent of the value of road-building materials delivered on the site of the work was generally endorsed, but no agreement was reached on the suggestion that a minimum width of 20 ft. for all pavements of materials better than macadam be specified by law.

The need for control of vehicles using county highways was recognized and it was recommended that each county engineer be made an inspector in the state's motor vehicle department. This proposal has the endorsement of Motor Vehicle Commissioner W. L. Dill.

Under existing rates of pay the county engineers have found it difficult to secure competent inspectors and sentiment was unanimous in favor of an increased salary for inspectors, with the provision, also, of inspection of materials at the source of manufacture in addition to the usual inspection of construction. Construction estimates, it was agreed, should not retain from the contractor more than 10 per cent of the value of the work in place. Another recommendation provided for the acceptance of completed work in units of one mile, paying for each unit in full when completed and accepted. Under present conditions the county retains 20 per cent of the value of a completed portion of road.

Greater importance must be attached to the provision of adequate bridges on state and county highways and the proposal to revise existing law so that the state would be required to pay to the counties a minimum of 40 per cent of the cost of bridge construction, instead of 20 as at present, met with general approval.

In the matter of detours it was recommended that the cost of making and maintaining them be included in the cost of road construction, allowing an issue of bonds for the expense of making and maintaining the detours.

Under present legislation counties are required to advertise for all work exceeding in cost $500; it was suggested that this amount be raised to $1,000.

For the protection of work under construction it is desirable to include in new legislation a provision making it a misdemeanor for any one to drive on work which is properly posted and barricaded.

Laboratory Control

R. B. Gage, chemist in charge of the State Highway Commission's laboratory at Trenton, read a paper on laboratory control of highway contracts. As a means of avoiding delays in construction and preventing the expense caused by the rejection of materials after they have arrived at their destination he endorsed the plan of dividing inspectors into two classes, the first dealing only with construction and the second with materials, the material inspectors to be assigned to the various points of manufacture or production. with powers of acceptance or rejection before shipment.

Charles A. Mead, bridge engineer, New Jersey Highway Commission, in a paper on bridges, made the startling statement that 80 per cent of existing bridges in the state were incapable of meeting the demands of modern traffic. He discussed the various factors entering into the design of bridges of different types and described the New Jersey Commission's practice of using a 20-ton truck as an assumed live load which would produce serviceable bridges. Considerable work is now being done in New Jersey in the reinforcement of old iron and steel trusses by incasing them in concrete and adding reinforcing material.

As a means of protecting New Jersey highways from damage by heavily loaded trucks, W. L. Dill, commissioner of the state motor vehicle department, announced that there are now being installed five road scales, each with a capacity of 50,000 lb., which will be used in checking up the weights of vehicles. The present truck load limit in New Jersey is 30,000 lb. New regulations are contemplated whereby the use of tires "suitable for carrying the loads" will be insisted upon, rather than a specific provision as to width or thickness.

A summary of the committee report on traffic conditions, which concluded the meeting, will be presented in an early issue.

Licensing Bill in Tennessee

Engineers and architects of Tennessee have agreed upon a joint bill for the registration of architects, engineers and land surveyors in Tennessee. The basis of the proposed bill is the uniform bill proposed by the Engineering Council, modified to suit local conditions.

The Engineering Association of Nashville, Engineers' Club of Memphis, the Nashville, Memphis and Chattanooga Chapters of the A. A. E. and the Tennessee Chapter of the American Institute of Architects co-operated in the drafting of the bill.

A subcommittee with Hunter McDonald representing the Engineers' Clubs, W. P. Butler, representing the A. A. E., George C. Norton representing the A. I. A. and B. H. Klyce as secretary made the final draft and will submit it to the Legislature.

Garbage Feeding Contract Given Up at Baltimore

The contract for the disposal of the garbage of Baltimore, Md., by feeding to hogs was abandoned by the American Feeeding Co. about the middle of January and the hogs were disposed of without previous notice to the city. The city immediately made a temporary contract with William H. Huse, a farmer of Baltimore County, under which he was to pay the city $45 a scow load for garbage delivered by the city, he to sell the garbage for use as a farm fertilizer. The Commissioners of Baltimore County immediately brought suit for an injunction against that means of garbage disposal on the ground that it would be a nuisance, but before the suit came to trial on its merits the city filed a general demurrer on the grounds of insufficiency.

The history of garbage disposal at Baltimore, together with the various attempts to let a new contract in 1918, the terms of the contract just abandoned, and an outline of the hog-feeding scheme, were presented in *Engineering News-Record* Feb. 6, 1920, p. 287, by Walter E. Lee, who served the city as engineer in its garbage disposal investigations.

In May, 1919, we are informed by Ezra B. Whitman, consulting engineer, Baltimore, Mr. Lee recommended to the incoming mayor that the city build a garbage reduction plant and invite bids for its operation, but no action on this advice was taken. Mr. Whitman also informs us that under the contract with the American Feeding Co. the city agreed to deliver the garbage at specified times and in a fresh condition, but that during severe winter weather in 1919-20 the garbage could not be delivered to the piggery, while in the following summer "the garbage reached the plant in such a putrid condition that it could not be fed to the hogs." As a result of the latter condition, "putrid and excess garbage were used for filling low ground around the plant," giving rise to complaints both as to odors and fly breeding.

General Contractors Convention

(Continued from p. 235)

legislation proposed or in process of enactment, and would study the effect and adequacy of existing laws affecting the contractor. The research division would have a statistical branch to tabulate data on labor, materials and other elements entering into construction. On labor, for example, the data would cover supply, demand, wages, efficiency, co-operative and welfare systems, etc.; on materials, such matters as prices, supply, production, manufacture, transportation, etc.

On the subject of contracts the past year's work included the preparation and publication of drafts of a cost-plus-fixed-sum contract, with and without a penalty and bonus clause, of a lump-sum contract and of a contract for the rental of equipment. Work is under way on a draft of a unit-price contract, while the program for the ensuing year includes study of contracts with sub-contractors, material men and equipment companies. In the work of perfecting the construction contracts the association has been assured the co-operation of other national organizations, including the American Society of Civil Engineers, the American Railway Engineering Association, Engineering Council, the National Association of Builders' Exchanges and the American Association of State Highway officials.

Quantity Surveys

Joint work during the year resulted in the formulation of a draft of a report on quantity surveying, which has gone to the three co-operating bodies—the American Institute of Architects, Engineering Council and the association—for their consideration. It endorses the quantity survey and urges all engineers, architects and contractors to use their efforts to have facilities established in their communities for making such surveys.

Study of estimating practice has resulted in the development of a standard estimating schedule, which is nearly completed; this schedule is designed, also, to be the basis for a cost-accounting system. A distribution summary sheet, resulting from this work, has already been published. An equipment rental schedule, published recently in *Engineering News-Record*, was prepared. Co-operation is under way with other associations on classification of compensation insurance risks. Though this work is still in the preliminary stage, data already furnished members have resulted in large savings in premiums. The preparation of a *manual* for contractors, containing the standard forms of contract, code of ethics, recommended practice and similar data, was approved by the executive board and by the convention.

The committee on labor prepared a set of "Fundamental Principles of Industrial Employment Relations" (founded on the referendum of the U. S. Chamber of Commerce), and has supplemented it with an elaboration under the title, "A Statute of Employment Relations Applied to the Construction Industry." (See p. 225.)

A tentative code of ethics has been prepared for discussion and criticism.

Legislation received attention in the support by the association of the bill for relief of Navy contractors (following the lines of enacted measures for relief of War Department and Treasury contractors), and in the presentation of facts to the congressional committees on immigration in connection with the Johnson bill. The association co-operated with the Calder committee and has collaborated with other national organizations in furnishing to Congress views of contracting organizations on matters of taxation. It has supported the proposal to organize a national department of public works and worked with the association advocating that proposal.

Transportation Work

On transportation it has worked with other bodies in securing modifications of the Interstate Commerce Commission orders restricting the use of equipment for moving construction materials and has co-operated in the setting up of special car-service committees to act as an intermediary between shipper and carrier in securing a fair allotment of available cars. The contractors' interests were also represented in rate hearings on construction materials. As a result of these efforts has come a new appreciation on the part of railroad and I. C. C. officials of the vital character of the construction industry.

A Contractors' Service Corporation has been organized to do a brokerage business in contractor surety bonds and to place, when the members desire, compensation insurance. Out of the corporation's 460 shares 450 are owned by the association, the other 10 by members of the association. The profits for the year were $7,000; the sum of $4,500 has been paid to the association in dividends.

Work for the coming year includes logical continuance and extension of the activities cited, and in addition, efforts on standardization of building codes and the formulation of specific procedure affecting general contractors for use in time of national emergency. These proposed elaborations and the new work were put before the members at the beginning of the convention, so as to direct their attention to the year's prospective activities, and each of the items on the program was subsequently gone over and explained.

Addresses

The set addresses included a lengthy paper by the Comptroller of the Treasury, W. W. Warwick, on the "Interpretation of Specifications," one by William B. King on "Minimizing Risks in Contracting" (see p. 227 of this issue), one by J. Waldo Smith, chief engineer of the New York Board of Water Supply, on "Co-operation of Co-ordinate Organizations of the Construction Industry," and one by Lawrence Mauran, of St. Louis, on "Building Contracts and Specifications."

Judge Warwick's address was chiefly an explanation of the machinery of the comptroller's office. Mr. King's plea was for the elimination of the risks due to indefinite and one-sided contracts, which precipitated a spirited discussion, in which Mr. King's position was heartily supported, though a number of engineer guests pointed out that the arbitrary clauses had been developed as a result of long experience and the necessity felt by the engineer, architect and lawyer for protecting the owner against the unscrupulous and incompetent contractor. Mr. Smith also presented the latter point of view in his paper, but pleaded for toleration and co-operation between engineers' and contractors' organizations to the end that present relations on construction may be improved—to the benefit of the owner, as well as of the engineer and the contractor.

There were papers, also, on various phases of compensation insurance, stressing the great reduction in premiums to the individual contractor through accident prevention methods and propaganda. E. M. Craig, of Chicago, put before the association the accomplishments of the National Board of Jurisdictional Awards in the Building Industry.

Resolutions

Resolutions adopted at the closing session were to the following effect:

Against discrimination in railroad rates on construction materials; in favor of the Calder bill exempting from income taxation the income on building mortgages; advocating allocation by the Federal Reserve Board of sufficient credits for needed construction; in favor of open markets, without discrimination between purchasers, for construction materials, and against restricting combinations of labor, contractors or material men; in favor of full gathering by the Department of Commerce of statistics regarding source, supply, manufacture and use of building materials; in favor of the national budget bill, of the establishment of a department of public works, and of prompt payments by the Government of its present indebtedness to the railroads; approving the Lockwood Committee investigation at New York and urging full punishment of the guilty in that and in similar situations elsewhere, if they exist; in favor of fair wages, and against taking advantage of unemployment to reduce them radically; urging a study by national, state and municipal officials of the relative efficiency of day labor work versus work by contract; favoring increases in salaries of the technical employees—engineers, architects and draftsmen—of the Federal government; endorsing the National Board of Jurisdictional Awards in the Building Industry and pledging support.

The following officers were elected for the ensuing year: President, W. O. Winston, of Minneapolis; vice-presidents, F. L. Cranford, Brooklyn, N. Y., Arthur Bent, Los Angeles, Daniel Breck, St. Louis, W. E. Wood, Detroit; treasurer, Lee Paschall, Richmond; directors, N. F. Hoggson and W. A. Starrett, of New York, G. O. Muhlfeld, Boston, J. R. Wiggins, Philadelphia, G. C. Mason, Portland, Ore., Richard McCarthy, New Orleans, A. E. Wells, Chicago, Charles Ffolliott, St. Paul.

The holdover officers are: Vice-presidents, J. W. Cowper, Buffalo, L. C. Wason, Boston; directors, H. B. Hanger, Richmond, Ky., E. J. Thomas, Memphis, George Watson, Dallas, M. D. Smith, Detroit. Past presidents D. A. Garber and W. A. Rogers are directors ex officio.

The members of the advisory board for 1921 are: R. B. Porter, Portland, Ore., T. T. Flagler, Atlanta, Thomas Bentley, Toledo, A. P. Greensfelder, St. Louis, Edward Haupt, Chicago, and E. F. Mullen, Cleveland.

Lumber Production, Shipment and Orders About Half of Normal

According to the recent barometer issued by the Southern Pine Association, the lumber production of 199 mills for December was 54 per cent of normal production, orders for the month were 57 per cent of normal, and shipments were 57 per cent. The stocks on hand Dec. 31 were a little more than twice the stock usually held. Shipments and demands for December were both more than double the production, though the shipments exceeded the demand by a slight margin. Stocks on hand December 31 aggregated 1,341,635,433 ft. b.m.

Building Congress Organizes Local Branch

The New York branch of the National Building and Construction Congress, organization of which was effected at Atlantic City last August, was established last week, when representatives of the building industry gathered at the Engineering Societies Building, New York City. The local branch is to operate as a part of a national movement to co-ordinate all elements in the building industry in an endeavor to eliminate factional disputes, promote general harmony, and increase the service to the public.

The organization hopes to be an all-inclusive one and the resolution, adoption of which initiated the local movement, includes on its organizing committee to establish a permanent local conference two each of the following: Architects, contractors, subcontractors, labor representatives, materials manufacturers, materials dealers, financiers, engineers, investing builders, and trade press representatives. If any other representatives of the building industry are not included in this list they are to be added as discovered.

The National Building and Construction Congress has as its aims: The thorough study of the relations of the various elements in the industries which enter into building and construction activities; elimination of various factors which have retarded necessary building and construction; a survey of building materials and building labor with a view to economical materials distribution, and establishment of wages which will take into account among other factors the hours lost through seasonal employment; and the study of the causes, with a view to their removal, of the progressive decline in the supply and quality of workers in the industry.

At the organizing meeting Clarence H. Kelsey, vice-president, Title Guaranty & Trust Co., New York City, asserted that there was plenty of money for building construction, but intimated that it would not be available until there had been a considerable recession in materials prices and until labor came to its senses.

The preliminary organization was effected with Robert D. Kohn as temporary chairman, and Sullivan W. Jones as secretary, of the executive board.

Lockwood Committee Denied Certain Increased Powers

The senate finance committee and the assembly ways and means committee of the New York Legislature on Jan. 25 reported upon the resolution designed to broaden the powers of the Lockwood committee, which recently made an investigation of building conditions in New York City, allowing it to investigate banking concerns in their relation to the building industry. An amended resolution, substituted for the original, gives the committee power to grant immunity though denying it the ability to requisition the records of state banking and state insurance departments. The committee had hoped, through such power now denied them, to show that mortage money could and should be obtained from the corporations who are favored by the state and federal tax laws, in whose hands interest on mortgage loans is exempt from taxation.

U. S. Chamber Urges Cheaper Building Materials

In the consideration of the housing problem at a two-day conference in Washington last week the national council of the United States Chamber of Commerce came to the conclusion that no great revival in construction was possible until there was a considerable reduction in building costs—both materials and labor. Resolutions were therefore passed urging: (1) the continuance of investigations of alleged illegal combinations in the building industry; (2) a study, on the part of each constituent member of the chamber, of the housing situation in its particular community with a view to stimulating a resumption of construction; 3) the performance by material dealers of a full share in meeting the public demand for cheaper building materials; and (4) an investigation by the Chamber of Commerce of the United States of the building industry such as will locate the responsibility for excessive costs. This last resolution sounded the keynote of the situation by declaring that "excessive costs constitutes the greatest single obstacle to a resumption of construction."

Senator William M. Calder, chairman of the Senate committee on reconstruction, warned the conference that unless every practical and economical facility was afforded to the active resumption of construction work the increasing housing shortage might bring about "paternalistic subsidy legislation."

To Vote on Spring Valley Purchase

A special city election will be held at San Francisco, Cal., on March 8 to vote on a bond issue of $38,000,000 to buy the property of the Spring Valley Water Co.

Reduction in Labor During 1920 Totals 3,437,466

As a result of a recent survey the employment service of the U. S. Department of Labor estimates that there are 3,473,466 fewer persons employed in industry now than at a corresponding time in 1920, a decrease of 36.9 per cent. This does not mean necessarily that there are that many unemployed, as a large percentage have probably turned to agricultural work. Following is the estimate of discharged men in industry in 15 principal cities: New York, 234,243; Detroit, 160 000; Chicago, 86,000; Cleveland, 81,000; Philadelphia, 70,000; St. Louis, 49.350; Newark, 41,000; Baltimore, 39,565; Boston, 25,000; Milwaukee, 24,330; Cincinnati, 24,000; Kansas City, 20,640; Scranton, 18,000; Jersey City, 15,000; Passaic, 12,000.

The service bases its calculations on "comparative information" from thirty-five states and the District of Columbia and on estimates of unemployment from the thirteen other states.

San Francisco Settles Building Disputes by Arbitration

Men engaged in the building trades in San Francisco, both employers and employees, have agreed to settle their differences by arbitration. A permanent arbitration agreement was recently signed by the building trades council, representing the workers, and the builders' exchange, representing the employers, and both sides have pledged themselves to be bound by the decisions of the board. The members of the Board are Archbishop E. J. Hanna, Max Shoss, ex associate justice of the Supreme Court of California, and George L. Bell, consultant in industrial relations and management. All disputes as to hours, wages and working conditions in the building trades are to be referred to the board for final settlement.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; seventh annual convention, Buffalo, N. Y., May 9, 10 and 11

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; Chicago, Feb. 9-12

The New England Water Works Association, at its meeting Feb. 9, will be addressed by Prof. George C. Whipple of the Harvard Engineering School on "The Need for Uniformity in Plumbing Regulations"; G. Wilbur Thompson, "Relations Between Plumbers and Water Works Superintendent"; and Gordon M. Fair, "The Hydraulics of the Flush Valve."

The American Society for Testing Materials will hold its annual meeting at the New Monterey Hotel, Asbury Park, N. J., in the week of June 20. Announcement of the exact date will be made later by the secretary, C. L. Warwick, Engineers' Club, Philadelphia, Pa.

The Engineers' Club of Baltimore has reorganized to include the former local branches of the chemical, civil, electrical and mechanical engineers. The officers elected are as follows: President, Ezra B. Whitman, first vice-president, Dr. Frank M. Boyles; second vice-president, Edward B. Passano; treasurer, W. W. Varney.

Personal Notes

EDWARD A. WEISMAN, formerly assistant superintendent on steel reinforcing of concrete buildings with the Buffalo, N. Y., branch of the Turner Construction Co., is now junior engineer, Southern Railway Co. at Washington, D. C., compiling reports on changes in and additions to the property of the Southern Ry. system.

JOHN N. CARLISLE, president of the Northern New York Utilities Inc., Watertown, N. Y., has been appointed by Governor Miller a member of the Black River Regulating Board.

RALPH S. HEATH, recently engineer in charge of concrete building construction for the M. J. Roche Construction Co., Cincinati, Ohio, has been employed as resident engineer on Lock 4 at Marseilles, Ill., for the State of Illinois, Department of Public Works and Buildings, Division of Waterways.

MAURICE A. LYNCH has resigned as district engineer at Smethport, Pa., Pennsylvania State Highway Department.

JOHN K. HARRIS has been appointed borough enginer of Sharon, Pa.

H. LEE WILSON, assistant city engineer, Johnstown, Pa., has been appointed city engineer to succeed J. R. Crissey, resigned.

JULIUS ADLER has been appointed deputy chief of the Division of Highways of the Bureau of Highways and Street Cleaning, Philadelphia, Pa.

EDWARD C. GAINES of the Mead Morrison Mfg. Co., Chicago, Ill., is now in Australia in charge of the erection of a large coal-handling plant and other interests of the company at Sydney.

GEORGE W. LEE of North Bay, Canada, acting chairman of the Temiskaming & Northern Ontario Ry. Commission since the resignation of J. L. Englehart, has been appointed chairman of the commission. He was formerly freight agent for the Temiskaming & Northern Ontario Ry. and was appointed a commissioner in 1914.

FRANCIS P. ADAMS, since 1911 city engineer of Chatham, Ont., Canada, with the exception of three years during which time he served in the World War, has been appointed city engineer of Brantford, Ont.

WILLIAM R. ELDEN, for fourteen years sales engineer of the Lidgerwood Mfg. Co., manufacturers of hoisting engines, has joined the organization of Sauerman Bros., Chicago, as engineer in charge of designing and specifying power equipment for Sauerman dragline cableway excavators and Sauerman bottomless power scrapers.

SQUIRE E. FITCH has been appointed division engineer, New York State Commission of Highways, Division 9, with headquarters at Buffalo, N. Y.

A. W. D. HALL, for the past five years city manager of Jackson, Mich., has been appointed city manager of Tampa, Fla.

WILLIAM J. DAVIS, JR., Pacific Coast engineer, General Electric Co., has been transferred to the International General Electric Co. and is en route from San Francisco to South Africa via London to make studies in connection with the proposed electrification of the government railroad between Cape Town and Pietermaritsburg, a distance of about 800 miles. This work is expected to require about a year.

MOTT X. CORCORAN, consulting and designing engineer of reinforced concrete construction, has opened an office in the Merrill Building, Wilwaukee, Wis.

Obituary

DR. WILLIAM T. SEDGWICK, professor of biology and public health at the Massachusetts Institute of Technology, widely known as a sanitarian and civic worker and a past-president of the New England Water Works Association, died in Boston Jan. 26. In next week's issue will be published a detailed sketch of Dr. Sedgwick's professional career.

ALFRED T. TOMLINSON, civil engineer, died at Toronto, Ont., Jan. 21. He was 62 years old. After graduation from the Royal Military College of Canada in 1882 he spent some time in bridge and railroad engineering in Canada. He then engaged for six years chiefly in Nebraska and Colorado on railroad location and construction. In 1891 he became connected with the Brooklyn Elevated Ry. Co., and three years later took charge of the extension of the Lake Street Elevated R.R. at Chicago. Later he became consulting engineer of the Boston (Mass.) Elevated Ry. and had immediate charge of a large part of the construction carried on by that company. In 1902 he joined the staff of J. G. White & Co., New York, and in 1905 he was sent to Montreal as Canadian engineer for that company. During the World War he was in charge of the inspection of small arms ammunition in Dominion arsenals.

JERRY O'SHAUGHNESSY, superintendent of water-works, Columbus, Ohio, died on Jan. 28. With three brief exceptions, due to changes in city administration, Mr. O'Shaughnessy was connected with the Columbus water-works for over fifty years, or since May 9, 1870, as noted in *Engineering News-Record* May 27, 1920.

ALFRED T. WHITE, engineer and philanthropist, was drowned Jan. 29 while skating on Forest Lake in Central Valley, N. Y. He was born in Brooklyn, 1846 and was graduated from Rensselaer Polytechnic Institute in 1865. In 1866 he began a mercantile career in Wall Street. He was interested in the housing conditions for the poor and in 1872 began a study of the housing problem in New York. In 1876 he constructed the first successful tenement houses in this country. In 1890 Harvard University bestowed on him the degree of Master of Arts in recognition of his work for housing reform. He was commissioner of city works, Brooklyn, 1894-1896, and a member of the Tenement House Commission, New York, 1900-1901. He was a founder of the Brooklyn Engineers Club.

ROY BULLEN, whose death was reported in these columns Jan. 13, was a former general agent with the Grand Trunk Ry. at Minneapolis and was not the engineer of the same name located at Logan, Utah, from whose professional record certain facts were erroneously taken.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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Partisan War Exploitation

In language more vigorous than polite Charles G. Dawes, the Chicago banker who as a brigadier general was the chief purchasing agent of the A. E. F., last week told a committee of the House of Representatives some plain truths that the whole body of politicians would do well to heed. The people of the United States are sick of the partisan exploitation of the war and the depreciation of the war-making activities. Honest criticism cannot be flouted, but criticism that is intended merely for political purposes, and which is based entirely on the principle that what we know now we should have known in 1917 and 1918, is beneath respect. Too much of it has been heard in and around the halls of Congress from the mouths of the now victorious Republicans. That one of the leading men in the ranks of that party, and one who has been prominently mentioned for high position within its gift, should so denounce the methods of the purely political wing is significant and deserving of commendation.

Cities and the Unemployed

As PART of the problem of the times there is now considerable talk of armies of unemployed in our cities and the duty of city governments to find them employment. In considering such proposals it should be remembered that "relief work" is notoriously inefficient, and that if provided the kind should be chosen and methods of control employed that are well designed to reduce this inefficiency to the lowest possible level. The reaction of "relief work" upon the already low efficiency of regular city employees, as well as upon their wages and on the great mass of taxpayers, many of whom may also be suffering from the combination of circumstances that throws large numbers out of work, should also be considered. Fortunately there seems no reason to expect that much justifiable "relief work" will be needed. A considerable amount of labor would be quickly absorbed through regular channels if it were offered at rates well below the present high figures but still well above starvation or even minimum living wages.

Conferences

EITHER as a barrier against the unwelcome caller or as an excuse for a prolonged luncheon, the "conference" is the greatest modern boon to business men. In the old days they used to talk things over once in awhile; today they go into "conference" at every opportunity. The world progresses. But this valuable business tool is being extended into the solution of public questions. Would you lessen the housing difficulty or reduce the income tax? Call a conference at some place where the hotels are elaborate and expensive. Invite to speak half a dozen congressmen, an officer, preferably the president, of the American Federation of Labor, the vice-president of a trust company (never forget the trust company man) the head of the certified accountants' association and the collector of internal revenue. Listen to them discourse at intervals through three days with a banquet, a round-table luncheon and a reception in between, and embalm the cream of their platitudes in some unanimously adopted resolutions. Then go home, forget about housing and get to work on your next year's income tax statement on the old basis of reckoning and prepare the program for the next group of annual conferences. Repeat ad lib. Some day some one will achieve fame by organizing a conference for the abolition of "conferences."

Ethics for the Contractor

TO THE engineer who, in the construction industry, has arrogated to himself the only professional status, it will come as a shock or as a cause for incredulous smiles to hear of the contractors discussing a code of ethics. Yet they are discussing one; they are doing it seriously and honestly, and not as a camouflage measure. They go so far as to put contracting into a professional class. They conceive of themselves as service organizations accepting obligations toward a client.

This attitude, too, has a solid foundation. They are not manufacturers merely putting before a prospective purchaser a finished product which he can examine and test, and determine, with the article in hand, whether it is worth the demanded price. No, they are manufacturers employed, or as their own language would have it, "retained," to produce in the future a certain structure. Documents attempt to tell what that structure is to be; many precautions are taken to assure delivery of an article conforming to the documentary descriptions, but despite documents and drawings and contract articles what the purchaser ultimately gets depends in large measure upon factors not definable, upon the "skill, integrity, and responsibility" of the contractor. Is it far fetched, then, to consider that the contractor has accepted a responsibility akin to the professional? We think not.

General appreciation by contractors of the character of that responsibility and serious acceptance generally of a professional code are not soon to be expected. There will be many lapses. There must be much educational work. But the attitude of engineers toward the contractors' new endeavors must be that of encouragement. It will be easy to poke fun and to cite the rascal who was caught skimping cement in the last sewer job. Such an attitude never helped anyone to higher levels.

The contractors, it is true, must prove the sincerity of their endeavors, but the number of sterling contractors who are putting their shoulder to the wheel to realize these aims warrants the faith and confidence, and the assistance, of the engineering profession.

Railroad Costs and Rates

ONLY COSTS of railroad operation that cannot be reduced will be accepted as the basis of justification for railroad rates, according to President Beatty of the Canadian Pacific Ry. in his address at the recent annual meeting of the Engineering Institute of Canada. President Beatty believes that real prosperity is that obtained by free traffic movement under moderate rates. Here certainly is a frank and liberal view of the difficult situation through which both this country and Canada are passing. Our experience has shown that rates must be made to yield a fair return above operating expenses and fixed charges in order to insure adequate development of transportation facilities through the stabilization of railroad credit. Canada at present is overbuilt with railroads; the United States is underbuilt. In Canada a cry went up immediately against the recent material increase in rates; in the United States there was but faint objection. But in spite of our need for expanding railroad facilities the carriers themselves do not look with favor upon further increases in rates, but rather toward a reduction in operating expenses. It appears that the first step is being made in current hearings before the Railway Labor Board. But will this be going far enough? Ten years have passed since Justice Brandeis, on the authority of Harrington Emerson, made the charge that the railroads of the country were wasting $1,000,000 a day. Then there was much protest from the railroads; now they are more ready to concede that there are large preventable wastes. Whatever they are they must be sought out and eliminated. The day when railroad presidents can rest easy in the assurance of steady net earnings is still very, very far away.

Immediate Relief for New York

DETAILS of the "measures for immediate" relief at the Port of New York were not given in the summary report of the New York-New Jersey Port and Harbor Development Commission, commented upon in these columns last week. As "measures for immediate relief" the commission proposes (a) consolidation of marine equipment and service, and (b) inauguration of voluntary store-door delivery by an organized motor-truck medium, and "urges that they be adopted at once." These columns have previously urged full consideration for a test in New York, necessarily in modified form, of the successfully established system of operation in Cincinnati employing motor trucks with demountable bodies for the interchange of less than carload freight between railroad main and sub stations. Thus almost all of the Manhattan railroad pier stations would be released to ocean shipping, as well as a good part of the New Jersey water front. But while urging efficiently co-ordinated trucking distribution as a measure for immediate relief—so far without detailed recommendations—the commission assents to the ultimate abandonment of the Hudson River ferry routes. Motor-truck distribution from New Jersey would depend directly on the ferry routes. Regardless of future tunnel construction, the fanlike distribution furnished by these ferries is a powerful argument against their abolishment to say nothing of resulting inconvenience to commuters. True, the commission's ultimate plan would not require the ferry routes for movement of railroad freight. Partial construction immediately of the proposed Manhattan freight terminals might well provide a means for reconsolidating less than truckload consignments. Without such zone distributing points it is estimated that only some 30 per cent of freight in and out of Manhattan is available for direct, 5-ton-truckload run between rail transfer and store door. Whatever the advantages of the commission's ambitious engineering plan, at best the relief promised is remote since negotiations and construction will necessarily consume years. An ultimate solution is, of course, necessary, but there is also needed now immediate relief and immediate action through evolutionary methods that will bring quick results with small capital outlay.

The Engineer's Relation to Contract Risks

MR. KING in his paper before the Associated General Contractors at New Orleans (see last issue, page 227) put much emphasis on indefinite specifications and the arbitrary power of the engineer as two major risks of contracting which should be reduced. Fair-minded engineers will readily agree with him that there is far too much of vague specification writing, but they will not so quickly nor fully acquiesce in his condemnation of the degree of power vested in the engineer.

Though it could well be discussed in elaborate detail, and certain limitations enlarged upon, the general thesis that specifications should be more definite is sound. Of course, there is much variation in specifications. Some engineers have a well-deserved reputation for the clarity, preciseness and fullness with which they explain what the contractor is to do. But where one deserves commendation there are five that merit adverse criticism. Obviously definition to the last degree is often difficult, and in many cases quite impossible, as when quality of workmanship is involved, but the ground for improvement on clearly definable features is very great. The contractors are right, then, in insisting that indefinite specifications are a risk of contracting that could be greatly reduced.

On theory Mr. King's second contention, for restriction of the engineer's power, is justified. The engineer should be an impartial judge, not a partisan wielder of arbitrary power. However, the authority given him under the general conditions of contracts has resulted from the experience of engineers—and lawyers—with contractors. They have found so many incompetent and dishonest contractors that they have felt it necessary to insert these clauses for the protection of their client's interests.

Despite the reason for this state of affairs, the ultimate interests of all purchasers of construction demand a wider use of arbitration provisions in contracts. But both parties have obligations; the engineers need to unbend to a certain extent, while organized contracting must raise the standards of its members.

Obviously the existing evils chase themselves around in circles. The indefinite specification causes loss to the contractor; the contractor endeavors to recoup himself by skimping; the engineer tries to prevent skimping by contract conditions that give him unlimited powers; these unlimited powers, as Mr. King truly says, encourage vagueness in specification writing. Thus we find ourselves back to where we began. The improvement can start at *any* point in this vicious circle; preferably it should start at *every* point simultaneously. In

the end, not merely will the contractor benefit, but also the owner, who, after all, is the most important factor in the whole process, for it is he that employs both engineer and contractor.

California's Highways

IN THIS issue is an extract from the report of the California Highway Commission which, though not so written, may be regarded as a partial reply to the criticisms of the California automobile clubs, summarized in the last issue of *Engineering News-Record*, page 207. Broadly there are two phases of the situation which warrant comment. The first relates to the fundamental character of the disagreement between the investigators and the commission; the second to the characteristics to be expected—and actually found—in a report coming from non-highway specialists.

The first phase is easily recognized by those familiar with highway work. It is merely a local manifestation of the old contest between those who want only the highest type of construction and those who favor a lower type in order that all parts of the community may get an acceptable highway service as soon as possible. The attitudes can be illustrated by the familiar example of the back-platform critic who can easily show the railroad engineer how a lot of the curves could have been eliminated, but who in his planning forgets the financial limits imposed on the engineer by a tight-fisted board of directors. Coming from the outside it is easy to set up ideals for high-class construction; it is quite different to take a state lacking an adequate system and so distribute the funds that the *best interests of the entire community* (an aim itself susceptible of widely varying definition) will be served.

There are, of course, two extremes. On the one hand would be an extremely limited highway system, but all of the highest type; on the other, a system in which the type was selected merely to be cheap enough to build into every portion of the state. Neither of the extremes is sound; nor do the investigators argue for the first, nor the commission for the second. Both recognize that between the extremes lies the correct solution; but that middle ground is very broad, and the investigators tend to go to one edge of it, the commission to the other. Either may be sound when subjected to economic tests. Neither of the brief reports available, however, gives a disinterested party sufficient data to come to a safe judgment. It is easy, though, to point out the essential identity of the controversy with that which is always found in highway circles.

The other feature referred to—the value of the non-highway engineer's opinion—is strongly emphasized in the summary of the investgators' report. They cut right through to the core of present deficiencies in our highway thinking. They are unhampered by tradition. At the same time they lack that sympathy which comes from knowing how and why these conditions have developed.

For example, they properly decry the lack of experimentation and research. They criticise the failure to enforce traffic laws. In both they are right, and the new emphasis they place on these and other shortcomings will be a benefit to highway constructors.

On the other hand they give no evidence, in their summary at least, that they appreciate how impossible it has been either to squeeze out of lay commissioners funds for research, or, in the terrific rush of recent highway expansion, to spare the men and time for the efficient organization of research work. The same factors have hampered the enforcement of traffic laws.

Moreover, these conditions obtain throughout the country. If the California engineers are to be damned on these grounds all highway engineers will go down in the same condemnation.

While specifically reporting on California's highways, the automobile clubs' investigators will help to awaken all highway engineers to the importance of certain neglected phases of their work. In so doing the investigators join their influence with that of other agencies, notably on research work, with Mr. McDonald, of the Bureau of Public Roads, and with the highway advisory board of the National Research Council. All such prodding is good, for the tremendous prospective expenditure in public roads warrants a great deal of experimentation and strong measures to conserve the roads once they are built.

Mr. Hirst's Resignation

A STRONG indictment of our narrow policies in the building of our highway organizations is brought against the public in the letter which A. R. Hirst has addressed to the people of Wisconsin in connection with the submission of his resignation as state highway engineer. He recognizes the serious responsibility of his great office, he realizes that the public's policy will not permit of its proper discharge, and he courageously abandons that which he had looked forward to as a life work—the building for the people of Wisconsin of an adequate highway system. He plays the part through in the spirit in which he has served the state, for he subordinates any personal interest he might have in an early relief from his duties by giving the authorities until the end of this year, if need be, to choose his successor.

The cause of his resignation is the impossibility of maintaining, under the pernicious policy of the public, an organization competent to secure the efficient expenditure of highway funds. Inadequate compensation and uncertain tenure of office make public service merely stepping stones to better positions with private agencies.

Unfortunately, taking the country as a whole, these conditions will long persist. In the New England States, with several hundred years of governmental organization, there has been time to develop a certain measure of maturity. There, more than elsewhere, the public official has an established status, and length and effectiveness of service are held in esteem. Even there the compensation is not what it ought to be.

In Wisconsin, Mr. Hirst's words should have a good effect. Let us hope that his warning will be the beginning of a broader policy in that state.

But the message should be considered as addressed to the country as a whole. It is ammunition and encouragement for such organizations as the former committee on compensation and classification of Engineering Council and the American Association of Engineers. But it should equally be material upon which such agencies as the American Society of Civil Engineers and the Associated General Contractors should work. They, like the first named bodies, have obligations to the public which, of course, they fully recognize. Obligations, though, must be translated into action— educational, if not otherwise—if there are to be results.

Snow Surveying for the Forecasting of Stream Flow

Methods, Factors and Results in Making Spring Predictions of Summer Water Supply for Irrigation and Power in Streams Fed by Mountain Snows

By J. E. Church, Jr.
Nevada Co-operative Snow Surveys, Reno, Nev.

Part I—Relative Value of Different Methods—Variable Factors Affecting Run-Off

An increasing interest shown by engineers in the problem of forecasting water supplies from winter snows has led to the preparation of two articles representative of the main phases of this problem, as follows: (1) The relative value of snow surveying as compared with other methods; (2) the effect of weather upon run-off; (3) forecasting supply from large areas; (4) methods of inaugurating a snow survey. Earlier articles on this subject include the following: "Snow Surveys for Predicting Steam Flows," *Engineering News*, May 29, 1913, p. 110; "Snow Survey for Forecast of Watershed's Yield," *Engineering Record*, April 17, 1915, p. 494; "Determination of Water Supply from Snow Fields," *Engineering News-Record*, Oct. 23, 1919, p. 766; "California-Nevada Co-operative Snow Survey," Jan. 8, 1920, p. 109; "Snow and Water Relations in Nevada," Sept. 9, 1920, p. 492. A view of the Mount Rose Observatory near Reno, Nev., at an altitude of 10,800 ft., is given in Fig. 1.

> **SNOW SURVEYS**
>
> Snow surveying is a special phase of hydraulic engineering developed for regions where mountain snows are the source of streams and rivers and where it is highly important to determine the water content and conditions of the snow fields in order to predict or forecast annually the summer flow that will be available for power, irrigation and other purposes. Snow survey methods have been developed most extensively by the States of Nevada and California, and in Switzerland in the study of glacier movements.
>
> In view of the increasing importance and interest of this work, a comprehensive article on snow surveying with reference to the forecasting of stream flow has been prepared for *Engineering News-Record* by Prof. J. E. Church, Jr., of the University of Nevada, who with Major P. M. Norboe, chief assistant State engineer of California, and H. F. Alpas, meteorologist of the U. S. Weather Bureau, is in charge of the Nevada-California co-operative snow surveys, and who has charge also of the Mount Rose meteorological observatory, which was established partly for this purpose near Reno, Nev.—*Editor.*

TABLE I. SIMILARITY OF SNOW COVER IN TAHOE BASIN AS DETERMINED BY PERCENTAGE METHOD AND RISE OF LAKE TAHOE AFTER APRIL 1, IN YEARS OF APPROXIMATELY NORMAL PRECIPITATION DURING RUN-OFF (PER CENT OF NORMAL)

	1910-11	1911-12	1912-13	1913-14	1914-15	1916-17
Snow cover (average of six courses)	170.4	49.7	58.2	153.8	88.2	115.6
Actual rise of lake after April 1	172.3	64.5	69.3	150.6	89.8	125.9
Variation between methods	—1.9	—14.8	11.1	+ 3.2	1.6	10.3

Snow surveying comprehends the determination of the water content of the snow cover by means of sampling apparatus, being unlike the measurement of snowfall by means of catch basins or snow stakes. Two methods have been developed: the percentage method and the method of areas. The former method is simple, being merely the determination of the percentage relationship of the seasonal snow cover of any given basin or region to its normal, with the assumption that such percentage is indicative of the coming seasonal run-off in the streams below. The latter method endeavors to determine the acre-feet of water in the snow fields and the probable net amount that will find its way into the streams.

The difference between the two methods is fundamental. The percentage method is based upon the fact that the "big storms" which furnish the bulk of the winter snow are comparatively uniform in intensity over considerable areas, thus lacking the spotted character of the lighter summer rains. Therefore it is possible to select from four to six snow survey courses distributed over characteristic parts of a basin and, by averaging their individual seasonal percentages, to obtain a close seasonal percentage for the entire basin. The only requirement is that the snow courses should be fixed and fairly long, such as 40 measurements 50 to 100 ft. apart; they must be located at a sufficient altitude to prevent distortion of the measurements by winter melting. A safe altitude in the Sierra Nevada has been found to be approximately 7,000 ft. Sites for snow courses should be selected, where possible, in protected flats or in timber, where the snow cover does not suffer oscillation by the wind. A part of the region included in the Sierra Nevada snow surveys is shown in the photograph, Fig. 2.

The method of areas is beset by two serious difficulties: (1) The large variation in the snow cover (even of individual basins) with elevation and distance from the crest of its watershed; (2) the difficulty of determining the normal seepage and evaporation losses of the region. The close agreement, when the precipitation during the period of run-off is fairly normal, between the snow cover and the run-off as determined by the percentage method is shown by Table I. The apparently wide divergence where the area method is used is shown in Table II.

TABLE II. DIVERGENCE BETWEEN METHOD OF AREAS AND PERCENTAGE METHOD. (RISE OF LAKE TAHOE AFTER APRIL 1)

Season	Estimated Rise: Method of Areas (Corrected for normal losses by evaporation from snow and surface of lake and by absorption by the soil)		Estimated Rise: Percentage method (No corrections for normal losses necessary)		Actual Rise		Divergence Between Estimated and actual Rise per Cent of Normal Rise	
	Ft.	Per Cent of Normal	Ft.	Per Cent of Normal	Ft.	Per Cent of Normal	Method of Areas	Percentage Method
1914-15	0.08	5.1	1.46	88.2	1.49	89.8	—84.7	—1.6
1915-16	1.73	104.0	2.52	151.9	2.48*	149.4*	45.4	+2.5

* Corrected by 50 per cent for abnormal deficiency in precipitation during rise (see paragraph on "Factors Affecting Run-Off"). Actual rise only 1.65 ft.

It is unfortunate that the long series of snow surveys conducted under the method of areas in Big Cottonwood Canyon, Utah, since 1911-12 by Salt Lake City, in co-operation with the U. S. Weather Bureau, is confused by the fact that only two-thirds of the watershed is surveyed, the remainder being considered as possessing but little snow. Moreover, no attempt is made to correct the forecast for normal losses by evaporation and absorption by the soil. With possibly one exception, other experiments with this method have gradually been abandoned. Consequently, in the following comparison of methods the percentage method alone will be employed as a standard.

Three methods of forecasting based upon seasonal percentage but not upon snow surveying have entered or may enter into competition with the latter, because of their ease or inexpensiveness. These are the methods of accumulated snowfall, the winter rise of open lakes, and the depth of snow on the ground. The basis for choice between these methods and snow surveying is accuracy modified only by the question of expense.

Accumulated Snowfall—The inherent weakness of this method is the variation in the density of the snow, not only from storm to storm but even from season to season. This is particularly true where the snow stake, only, is employed and the water content of the snow cannot be determined because of distance of station from observer or magnitude of the snowfall. In comparative measurements made in the Tahoe basin by the Mount Rose Observatory and the U. S. Weather Bureau the divergence between this method and snow surveying varied between 20 and 55 per cent for five seasons in a total of eight. Although this method is moderate in cost its excessive latent inaccuracy makes it undesirable.

Winter Rise of Open Lakes—The winter rise of lakes, such as Lake Tahoe, which never freeze, should be apparently a safer standard for measuring the snowfall upon the adjacent watershed than the method of accumulated snowfall, as the snow falling upon the lake is reduced to water. The reverse is true, however, for the advantage of an inelastic standard, such as water is overcome by the variable factors of winter run-off from the watershed into the lake and the evaporation from its surface. In fact, a 9-year record shows that with a single exception the method of accumulated snowfall is from 5 to 40 per cent more accurate.

TABLE III COMPARISON OF METHODS OF DEPTH OF SNOW ON THE GROUND AND WATER CONTENT ANNUAL SNOW SURVEY IN TAHOE BASIN, APRIL 1

(Seasonal Percentage)

	New on						
Method	1909 10	1910 11	1911 12	1912 13	1913 14	1914 15	1915 16
Depth of snow	80 0	165 1	59 4	66 5	141 9	93 6	145 5
Water content	82 7	170 4	49 7	58 2	153 8	88 2	151 9
Variation	2 7	5 3	+9 7	+ 8 3	11 9	5 4	—6 4

Depth of Snow on the Ground—Of the three methods in competition with snow surveying the depth of snow on the ground at the beginning of the season of run-off is by far the most accurate, and if handled carefully it is a close rival of snow surveying. The prime essentials are that courses equal in fixity and length to those used in snow surveying must be maintained and that the measurements of depth must be made only when the new snow has settled approximately to the density of the snow beneath. Fewer measurements, as at occasional snow stakes, or measurements immediately after a storm, would cause corresponding distortion in the results.

Whatever divergence occurs beyond the distortion due to the above factors is caused by the seasonal density attained during the ripening of the snow. This density will vary with the winter weather, particularly the temperature and the wind, but the maximum variation between seasons is rarely greater than 10 per cent. This is graphically shown in Table III, based upon snow surveys in the Tahoe basin, in which both the depth of snow on the ground and the water content were determined over the same courses. Since the surveys were made without reference to the date of the previous storm the actual variation between the two methods should be less than shown in the table.

The gain over snow surveying is merely in saving the moderate expense for snow samplers. Aside from this the expense for field operations would be identical, without the satisfaction of certainty regarding the data obtained. However, the question of exact cost, which depends upon the area and number of the basins included, will be discussed in the concluding part of the article.

FIG. 1 MOUNT ROSE OBSERVATORY IN THE SIERRA NEVADA; ALTITUDE 10,800 FT.

Factors Affecting Run-Off

Shrinkage and acceleration of run-off beyond normal conditions occur occasionally and are factors which must be taken into account in predicting the run-off or stream flow of an approaching season.

Shrinkage of Estimated Run-Off—In forecasting the summer flow from winter snows the chief problem is the anticipation and prediction of the abnormal shrinkage that infrequently occurs in the seasonal percentage indicated by the April survey. In the eleven annual surveys made since 1909 in the Sierra Nevada this shrinkage has occurred to an extreme degree three times and to a moderate extent twice. The maximum shrinkage has been 50 per cent of normal for lakes and 25 per cent for rivers.

Precipitation During Run-Off—The major factor in the phenomenon of shrinkage of run-off is lack of precipitation during the period of run-off, rather than late snowfall or dryness of the watershed. This is plainly indicated by the divergence between the maximum shrinkage in lakes and in rivers. Lakes are susceptible to variable precipitation in whatever amount, but streams, because of the preponderating land area of their basins, may be from 80 to 90 per cent immune to such influence when the soil is driest. In fact, the disparity between the susceptible water areas of lake and river basins, as in the case of Lake Tahoe

and the Carson River, may be as great as 50 to 1.

Evaporation being the complement of precipitation and intensifying its lack, the theoretical probability of apparently so small a cause as lack of late spring and summer rainfall producing so marked an effect on the run-off becomes more understandable. No other weather factors could have caused the divergence. For the Tahoe basin this precipitation amounts normally to 22.8 per cent of the snow cover. In April, when the snow cover is most extensive, it is 10.6 per cent, and in May 9.5 per cent additional.

FIG. 2. SNOW SURVEY REGION—HAGAN'S MEADOWS IN THE SIERRA NEVADA

Despite this fact an effectiveness of 25 per cent seems at first anomalous in face of the further fact that occasional summer precipitation in the semi-arid West is almost negligible as compared with a field of snow, because of the small proportion of the former that finds its way into the streams. However, at the time when the spring precipitation is heaviest the snow cover is most extensive, coming at times almost as low down as the gaging station, so that whatever precipitation falls at this period finds lodgment upon the snow surface and obtains a relatively untaxed passage to the streams.

TABLE IV. RATIO OF DECREASE IN RUN-OFF WITH DECREASE IN SEASONAL PERCENTAGE OF THE SNOW: TAHOE BASIN

Snow Cover — Per Cent	In.	Absorption, In.	Run-Off — In.	Per Cent of Normal	Ratio of Decrease Per Cent of Normal Run-Off
100 (normal)	22 7	8 6	14 1	100	0
75	8 6	8 6	8 4	59 5	15 5
50	11 4	8 6	2 8	19 9	36 1
25	5 7	8 6	2 9	20 5	[illegible]

The relation of this fact to the April snow survey may be stated as follows: The equality between the seasonal percentage of the snow field, as measured April 1, and the succeeding run-off of April-July is dependent upon the normality of all factors that influence the run-off, for the very normal upon which the seasonal percentage is based is merely the average of many seasons, and presumably so many that any abnormality of the weather has faded into the general average.

Minor Factors in Reduced Run-Off—Lack of autumn rains, snowfall less than normal, and shrinkage in run-off below diversion points are contributory but minor factors in the phenomenon of occasional shrinkage of run-off. The absence of autumn rains in the semi-arid West seems to have little or no effect upon the amount of moisture necessary to prime the soil in the spring, and its effect even upon the winter run-off is not plainly discernible in the presence of other factors. Indeed, the effect of the heaviest snow covers in the Tahoe basin, which have a cumulative effect far in excess of rain, does not persist beyond October, or four months beyond its peak. This is due to the steep mountain slopes and a surface material sufficiently porous to permit a rapid run-off. Meadows and other retarding media are small in area as compared with the entire watershed, so that even the heavier rains are drained off before the time of melting has arrived. Conversely, the freezing of the surface soil, so effective on priming in the East, is entirely lacking, for the surface has been drained dry before the freezing temperatures of winter occur.

The effect of subnormal snowfall in shrinking the computed seasonal percentage of run-off may be clouded by excess or deficiency of precipitation during run-off, but it can be determined mathematically if the initial factors are known. Since the amount of moisture necessary to prime mountain soil in semi-arid regions is practically unaffected by

TABLE V. EFFECT OF WEATHER UPON SEASONAL RUN-OFF

(1) Seasons of Abnormal Shrinkage in Run-Off (per Cent of Normal)

Year	Water Content of Snow Cover	Priming of soil as shown by excess and deficiency of autumn rains and winter run-off: Autumn Rains	Winter Run-Off	Excess and deficiency of precipitation and evaporation: Precipitation	Evaporation	Run-Off — Seasonal Percentage	Variation Between Snow Cover and Run-Off
A. Carson River Basin							
1909 10	82 7[1]	+165 41	+38 31	29 2		64 14	−18 6
1915 16	151 9[1]	−69 55	+49 59	−70 4		125 71	−26 2
1917 18	9[illegible] 4	−25 19	29 51	57 2	+27 7[2]	61 31[3]	−35 13
1918 19	96 8	+100 0	−44 52	0 8	−36 2[2]	66 58	30 2
B. Tahoe Lake Basin							
1909 10	82 7[1]	−140 18	+38 31[4]	85 9		61 45	21 2
1915 16	151 9	−42 83	+49 59[4]	82 9		99 40	52 5
1917 18	95 0	−71 96	−29 51[4]	63 0	−27 7	53 61	41 4
1918 19	103 0	+113 69	44 52[4]	63 5	−36 2	72 89[5]	30 1[5]

(2) Seasons Without Abnormal Shrinkage in Run-Off (per Cent Normal)

Year	Water Content of Snow Cover	Autumn Rains	Winter Run-Off	Precipitation	Evaporation	Seasonal Percentage	Variation Between Snow Cover and Run-Off
A. Carson River Basin							
1[illegible] 11	170 4[3]	−18 80	− 7 36	−26 8		176 70	+ 6 3
1[illegible] 12	49 7[3]	−40 98	40 75	− 51 0		42 43	− 7 4
1[illegible] 13	58 2[3]	−22 18	57 30	−72 4		57 18	1 0
1[illegible] 14	153 8[3]	−16 92	−81 89	− 3 5		162 95	− 9 2
1[illegible] 15	88 2[3]	48 50	17 35	0 4		93 33	− 5 1
1[illegible] 17	115 6[3]	−30 08	−19 08	− 0 4	− 6 0[2]	128 65	−13 1
B. Tahoe Lake Basin							
1910 11	170 4	−12 80	− 7 36[4]	+ 3 27		172 29	− 1 9
1911 12	49 7	−60 26	−40 75[4]	−63 48		64 46	+14 8
1912 13	58 2	−27 15	−57 33[4]	−12 59		69 28	+11 1
1913 14	153 8	− 6 8	−81 89[4]	4 53		150 60	− 3 2
1914 15	88 2	56 73	17 35[4]	−11 84		89 76	− 1 6
1916 17	115 6	−13 02	+19 08[4]	23 43	− 6 0[2]	125 90	−10 5

[1] Substituted from Tahoe Basin because of lack of snow surveys.
[2] From floating pan at Tahoe City.
[3] At Genoa, 20 miles below Empire. Probable correction, 5 per cent, seasonal, or 31 as of variation, 30 1.
[4] Interpolated from Carson River.
[5] Maximum ri e accelerated three weeks by high temperatures. If corrected for evaporation to normal date of maximum rise seasonal percentage of run-off would be 60 89 and variation 42.1.

TABLE VI. SHRINKAGE IN EXPECTED RUN-OFF BELOW DIVERSIONS: APRIL-JULY, 1920 (CARSON BASIN WITH TAHOE AND WEST WALKER BASINS AS CHECK)

Basin	Expected Run-Off: Normal (Acre-Ft. or Feet Rise)	Expected Run-Off: Seasonal 1919-20 Per Cent	Expected Run-Off: Seasonal 1919-20 Acre-Ft. or Feet Rise	Diversions (Acres of Land)	Actual Run-Off: Acre-Ft. or Feet Rise	Actual Run-Off: Per Cent of Normal	Diminution (Per Cent of Normal)
Carson (Empire)	246,412 a.-ft.	70.0	172,488 a.-ft.	27,000	97,496 a.-ft.	39.6	—30.4
Tahoe	1.66 ft.	50.2	0.83 ft.	None	0.89 ft.	53.6	+3.4
West Walker	190,366 a.-ft.	74.8	142,394 a.-ft.	Small	164,100 a.-ft.	86.2	+11.4

weather, and hence may be considered a fixed quantity for its particular basin, it becomes a factor of increasing effect as the snow cover exceeds or falls below its normal.

For example, the normal snow cover of the Tahoe basin estimated quantitatively by the method of areas is 22.7 in. water content and the amount of absorption in priming the soil theoretically determined is 8.6 in., or 37.9 per cent. On this basis the ratio of increase in deficiency is as shown in Table IV. The converse should be true also when the seasonal percentage of the snow cover is above normal. However, when compared with the run-off of seasons of deficient and excessive snow cover (see Table V) this ratio seems too large and should be applied with caution.

Shrinkage in the expected flow below diversions is similar in effect to sub-normal snow, for not only is the ratio of decrease progressive but the land is thirstier because of the general dryness of the season. In years of heavy precipitation the diversions have but little effect upon the seasonal percentage, as based upon the snow fields. One of the experiences of the present season is shown in Table VI.

This shrinkage is shown conspicuously in the increased ratio of use of water in the Truckee meadows, which consist of approximately 14,000 acres of irrigated and swamp land around Reno, Nev. According to a table prepared for water users by C. A. Norcross, University of Nevada, the average difference in the flow of the Truckee River above this diversion for five years of sub-normal snow was 99,587 acre-ft.; but for four years which were over-normal in snow and one which had copious summer rains the difference was only 54,746 acre-ft., the ratio of "overuse" being thus 81.9 per cent. A portion of this "overuse" is probably only apparent, for part of the supply of the meadows, estimated at a normal of 22,000 acre-ft., comes from sources other than the Truckee.

This shrinkage shows the need of testing estimates of seasonal run-off by obtaining data above all diversions. But it demonstrates more particularly the need of special forecasts for each section that is handicapped by large upstream diversions.

Most of the factors mentioned in the above discussion are illustrated in Table V, based upon four seasons of deficient precipitation during run-off, with six check seasons of normal spring and summer rainfall. A lake and a river basin adjoining each other, and consequently having similar weather, are represented to show the divergence between the types.

In that table the dominant and consistent correlation is the precipitation, the river basin being less affected by extremes than the lake basin. The priming of the soil by autumn rains or winter run-off presents constant contradictions. The effect of the extremely sub-normal years of 1911-12 and 1912-13 is clouded by excess precipitation, and shrinkage below diversions during these years does not appear, possibly also because of the summer rainfall. During the season of 1919-20, in which the snow forecast was approximately 20 per cent below normal, and the summer rains, except for two heavy showers, were entirely lacking, the diminution seems to have been as high as 30 per cent.

April Precipitation—The precipitation factor in Table V is made more obvious by the preponderance of the April or April-May precipitation over the remaining precipitation in the seasons of 1913-14, 1914-15 and 1916-17. Thus, in the Tahoe basin in 1913-14, with an April normal of 1.78 in., 2.29 in. fell in a total of 3.79 in.; in 1916-17, 2.32 in. out of a total of 3.04 in. In 1914-15, although only 0.54 in. out of 4.44 in. fell in April, this was supplemented in May by 3.70 in., an amount 132 per cent in excess of the May normal.

In the Tahoe basin the normal April precipitation is estimated at 10.6 per cent and the May precipitation at 9.5 per cent of the normal winter snow cover, while the precipitation for June is only 2.7 per cent and that for July 1-15 is negligible. Thus, in view of the continuous melting of the snow fields after March 15 and the increasing area of exposed soil, the precipitation for April should indicate the probability of normality or shrinkage in the seasonal run-off. It is possible, however, that the May precipitation at times may become the deciding factor, or that concentrated rain, as in the present season, may complete the monthly or seasonal normal and leave bright skies to accelerate the evaporation. But this latter effect is only partial as compared with total lack of rain.

Acceleration of Run-Off—Acceleration or even retardation of snow melting does not necessarily mean abnormal increase or decrease in the relative seasonal run-off, for the melting when once begun is almost continuous. Consequently, the soil has no opportunity to dry out and the total variation in run-off is probably less than 8 per cent.

It is a striking fact that in all of the seasons of abnormal shrinkage in run-off shown in Table V the seasonal temperature during run-off was from 0.7 to 4.2 deg. F. in excess of normal. This temperature was 2.5, 0.7, 3.0 and 4.2 for the seasons of 1909-10, 1915-16, 1917-18 and 1918-19 respectively. Its principal effect

TABLE VII. EFFECT OF TEMPERATURE IN CAUSING PREMATURE RUN-OFF WITHOUT COMPENSATING CHANGE IN SEASONAL ESTIMATE
(Run-Off Carson River, 1918-19. Temperature at Reno)

Snow Cover Apr. 1 (per Cent of Normal)	April: Excess Temp. (Deg. F.)	April: Run-Off (per Cent of Normal)	May: Excess Temp. (Deg. F.)	May: Run-Off (per Cent of Normal)	June: Excess Temp. (Deg. F.)	June: Run-Off (per Cent of Normal)	July: Excess Temp. (Deg. F.)	July: Run-Off (per Cent of Normal)	April-July: Excess Temp. (Deg. F.)	April-July: Run-Off (per Cent of Normal)	Variation Between Run-Off and Snow Cover (per Cent of Normal)
36.8	+2.1	86.44	+7.2	115.24	+1.8	27.36	+3.7	[illegible]	+4.2	66.58	—30.2

TABLE VIII LACK OF CORRELATION BETWEEN LIGHT DENSITY OF SNOW COVER AND EARLY MAXIMUM RUN-OFF. (CARSON RIVER BASIN)

Year	Snow Cover in Tahoe Basin (per Cent of Normal)	Excess or Deficiency in Density of Snow (per Cent)	Excess or Deficiency Temp. from March to Month of Maximum Acceleration Inclusive (Deg. F.)	Month of Maximum Run-Off (Normal Month May)	Percentage of Monthly Normal Run-Off to Show Acceleration (Maximum Acceleration Underscored)					
					March	April	May	June	July	August
1909-10	83.3	+3.3	+7.5	May	134.43	127.66	74.54	34.18	19.01	.....
1910-11	167.5	+2.4	+0.7	June	142.01	135.63	113.05	236.24	258.36	161.10
1911-12	49.9	—9.5	—1.2	June	37.0	7.62	52.78	61.83	12.61	
1912-13	58.3	—8.2	+0.6	May	44.35	57.09	92.35	36.26	14.0	..
1913-14	154.1	+12.2	+4.2	May	162.10	163.29	178.65	148.95	156.06	141.37
1914-15	88.4	—5.2	+2.0	June	71.40	95.23	83.11	108.69	77.16	....
1915-16	152.2	+6.7	+4.4	May	134.39	161.95	121.58	118.52	101.40	.

was to run the moisture from the snow fields prematurely, without noticeably increasing the total seasonal flow, as shown in Table VII.

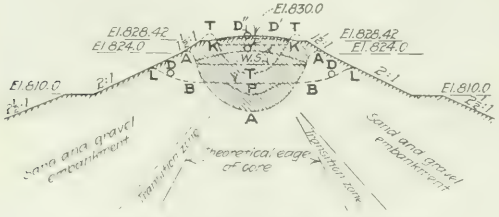
Although the May flow is 18.4 per cent above that of the snow cover, the June flow falls to a deficiency of 69.2 per cent, while the July flow is negligible. The total seasonal loss of 30.2 per cent, due to lack of rains, is so large that little compensation can have come from the accelerated melting, but it is possible that the increased ratio of shrinkage below diversions accompanying sub-normal run-off may have clouded the result.

Light Density of Late Snows—That mountain snows have a tendency to run off prematurely is not proved by data so far gathered. The fact rather is that these snows pass through a process of accelerated ripening due to the alternation of thawing and freezing that occurs normally in April above the elevation of 7,000 ft. For example, at Summit Station, California, in 1917-18, the relative density of the snow field for its entire depth was only 36.6 per cent on March 24, but on April 15 this density had increased to 49.2 per cent with a loss of only 3.3 in. above the current precipitation in a total snow cover of 32.8 in.

It is true that snow of light density at the beginning of the time of melting, before losing its water, fails to attain the density of snow of higher initial density. But the maximum seasonal variation in density for the Tahoe basin as a whole is under 13 per cent, and no marked effect from light densities appears in the run-off. This is shown in Table VIII by the lack of correlation between light density and the advancement of the month of maximum run-off or even of acceleration in the melting, due mainly to excess of temperature.

Method of Capping Hydraulic Fill Germantown Dam

A PUDDLE crown completes the hydraulic fill embankment of the Germantown Dam. This crown was placed during September and October of last year by hydraulic filling in connection with dragline excavating. Approximately 95,000 cu.yd. of puddle were placed, completing an embankment of 797,907 cu.yd., and, except for minor finishing operations, the first of the large retarding basin dams of the Miami River valley flood protection works.



METHOD OF CAPPING OUT GERMANTOWN DAM EMBANKMENT

To about El. 815 the embankment was completed by the regular hydraulic fill process described in *Engineering New-Record* Sept. 23, 1920, p. 600. At this level the top of the fill displayed the characteristic parallel levees and beaches, with the core pool in the center, as indicated on the accompanying sketch by the line *LBPBL*. Here the distinction between fine core and outside embankments of coarser material was abandoned and a full width cap of fine and coarse material puddled together was substituted. The reasons for this change were that as the fill narrowed it was difficult to maintain distinctive beaches and core by hydraulic fill; that above this level the heads of water at extreme flood level will be insignificant and the mixed material is sufficiently impervious to resist them; and that a top to the embankment was desired which would become immediately solid for the roadway along the crest.

With the top at *LBPBL*, a dragline excavator was run along the beaches scooping out the pool and building up the levees to about the line *AAA*. With a single dredge discharge pipe line at *D'* the excavation was filled with mixed coarse and fine material to the line *KK*. The dragline then scooped out the trench *TTT*, which was in turn filled by the dredge pipe at *D''* to the crest level of the embankment. The remaining work was merely a finishing operation. The dragline trenching besides serving the construction purpose described also served the structural purpose of securing a well-mixed top material for the dam.

The construction of the Germantown Dam was under the direction of the Miami Conservency District, Arthur E. Morgan, chief engineer; Charles H. Paul, assistant chief engineer, and C. H. Locher, construction manager. A. H. Pauls was division engineer in immediate charge of construction.

Iowa Prohibits Stockpiles on Subgrade

The placing of loads or piles of aggregate on the subgrade or shoulders to be wheeled, shoveled or conveyed directly to the mixer is not permitted in the 1921 specifications for concrete road of the Iowa State Highway Commission.

The Sewage Treatment Plant at Newton, Kansas

Sludge from Secondary Settling Tank and Effluent from Sludge Bed Returned to Inlet of Imhoff Tank

By Ivan S. Siegrist

Assistant Engineer with Black & Veatch, Consulting Engineers Kansas City, Mo.

A SEWAGE treatment plant has recently been completed for Newton, Kan., which has several distinctive minor features, especially the means of protecting the plant from floods, and of returning to the incoming sewage the sludge from the secondary settling tank and also the effluent from the sludge filter. The plant comprises a small pumping station with Imhoff tanks, a dosing tank, sprinkling filter, final settling basin and flood-control manhole.

Newton has a population of 8,000 and the sewage to be treated is practically all residential. Sand Creek, into which the sewage is discharged, has an intermittent flow, at times so small as to afford almost no dilution. A considerable degree of purification is therefore required.

The former plant consisted of a one-story septic tank that was in bad condition and yielded unsatisfactory effluent. It had been proposed to use this tank as part of the new plant, but on account of its condition and the difficulty of fitting it into a plant having secondary treatment it was decided to build a complete new plant, on an adjacent site, keeping the old tank in service through the construction period.

On account of the low elevation of the outfall sewer the sewage must be pumped. The flow passes through an inclined bar screen of 1-in. clear opening, into a reinforced-concrete wet well with a capacity of approximately 3,000 gal. Two 300-gal. per minute vertical centrifugal pumps, direct-connected to electric motors, are automatically controlled by floats in the wet well. There is a conection from the pumps direct to the outfall sewer for use in case of extreme high water.

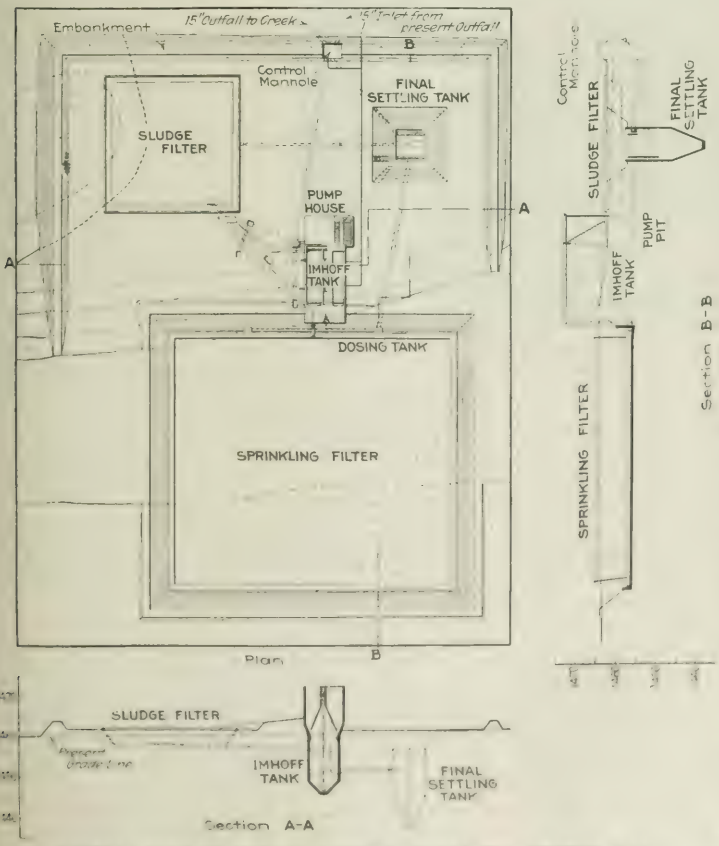
The sewage passes from the pumps to the rectangular horizontal-flow Imhoff tank, an end of which forms one wall for the pump pit and house. This structure projects some distance above the ground, due to the rather flat topography of the site and the head required for the sprinkling filters.

The two settling compartments are designed for a 1-hr. detention of the maximum flow. No inlet weir is used, thus eliminating deposit of sediment. The effluent falls directly into the dosing tank over a weir in the outlet end. No other baffles are used than scum baffles at each end of the tank. The slot leading to the sludge compartment is 6 in. wide with 6 in. lap. The sludge compartment is designed for five months' detention of deposits and may be flushed from rings of lead pipe.

Sludge from the Imhoff tank is discharged onto a 60 x 60-ft. sludge drying bed built of crushed stone (a 6-in. layer ¾ to ⅞ in. and an 8-in. layer ¾ to 2 in.) covered with 4 in. of sand. The underdrain laterals are lines of 6-in. tile laid with open joints, 6 ft. 5½ in. c. to c. They connect with an 8-in. central collector. The sloping sides of the filter are paved with concrete.

The effluent from the sludge filter, instead of being discharged into the stream, flows into the line which leads to the pumps and is retreated. Thus nothing but the settled effluent from the sprinkling filter reaches the stream.

A reinforced-concrete dosing tank, which receives directly the effluent from the Imhoff tank, is designed to have a capacity equal to 12½-min. flow at the average daily rate. It is shaped to give a uniform dose, and contains a 14-in. siphon.



GENERAL PLAN OF SEWAGE DISPOSAL WORKS FOR NEWTON, KAN.

The sprinkling filter material is crushed rock, having an average depth of 7 ft. The bottom is paved with concrete and a dry stone wall extends around the filter. The distribution system is of 6-in. tile encased in concrete, with wrought-iron risers. Worcester $\frac{3}{16}$-in. nozzles are used, located at the corners of equilateral triangles 12 ft. on a side. The underdrains are of 8-in. split tile, 2 ft. c. to c., draining to covered gutters. Both gutters and split tile are carried through the outer wall at their upper ends for flushing.

In designing the sprinkling filter it was assumed that 11 grams of nitrogen is produced per day per capita, and that each cubic foot of filtering material can take care of 0.75 gram. This gives a loading of 2,970 population per acre per foot of filtering material.

Following the sprinkling filter is a final settling basin, designed for 1-hr. detention of the average flow. This basin is of reinforced concrete, with a hopper bottom, and is 19 ft. deep. It has a deep inlet baffle and a shallow outlet baffle. The sludge may be blown out of the bottom through cast-iron pipes and a bell mouthpiece, in the same way as from the Imhoff tank. On account of the probable difficulty of handling the sludge, it is not piped to the sludge bed, but is emptied into the incoming sewage. This arrangement was adopted not only because of the advantage in operation, but also because it gave a simpler and more economical layout than any other scheme for handling the sludge. From the final settling tank the treated sewage flows into the second compartment of the control manhole and thence to the creek. On the line into the plant which passes through the first compartment is a hydraulic gate valve. A float in the second chamber controls this valve through a pilot valve, and cuts off the flow to the pumps when the water in the creek reaches a point where backwater might damage the plant. The sewage then rises in the first compartment and flows into the second compartment through a flap valve. Another flap valve prevents water backing into the plant. The lower part of the grounds is protected by a dike.

SPRINKLING FILTER BEFORE FILLING WITH DRY WALLS THROUGH WHICH UNDERDRAINS EXTEND

The plant was designed and construction was supervised by Black & Veatch, consulting engineers, Kansas City, Mo. Ralph B. Reeves was their resident engineer. The Chanute Construction Co., Chanute, Kan., was the general contractor.

Denies Further Extension of New York Piers

Secretary of War Orders City To Put Hudson River Piers in Chelsea Section of Manhattan Back to Original Line

UNDER date of Jan. 17, 1921, Secretary of War Baker wrote to Murray Hulbert, Commissioner of Docks, New York City, refusing to make permanent the temporary order of 1911 permitting the city to extend three piers in the Chelsea district of the Hudson River. By order of the secretary these three piers must be shortened to the established pierhead line before May 21, 1921. The major parts of the secretary's letter are as follows:

Referring to the application of Jan. 28, 1920, on behalf of the authorities of the City of New York for an extension channelward of the North River pierhead line between Perry St. and West 72d St., in order to legalize the extension of the Chelsea piers and to provide for extensions elsewhere, I have to say that the statements and arguments presented at hearings given in my office on Nov. 8, 1920, to the interests you represent, and on Dec. 11, 1920, to representatives of the Board of Commerce and Navigation of the State of New Jersey, have been fully weighed and considered. I have also visited New York and personally inspected the locality. In view of those proceedings and of the public hearing held by the New York Harbor Line Board on March 4, 1920, I feel that all interests have had full opportunity to present their views concerning the questions involved and that with the additional information afforded by the comprehensive reports of the board and the Chief of Engineers all information needful for the decision of the matter is now before me.

I find that your application is a repetition of others made to the Department from time to time since 1903, all of which were made the subject of hearings and reports by the New York Harbor Line Board and which were decided after a thorough consideration by different Chiefs of Engineers and by five different Secretaries of War.

It appears that those decisions were based upon evidence that there has been a serious encroachment upon the waterway at the point in question, reducing the channel width below the minimum considered necessary for the safety of navigation, thus creating an increase of about 60 per cent in tidal velocity, and showing a tendency to interfere with the river action necessary to preserve navigation facilities in other reaches. It also appears that the necessity of providing long slips on the Manhattan shore for the berthing of large steamers was recognized in connection with the requests referred to, and that a change of the pierhead line was permitted between the Battery and the foot of Gansevoort St. which would enable the city to construct piers over 1,000 ft. without further narrowing the Chelsea gorge.

At the hearing held by me on Dec. 11, 1920, the representatives of the New Jersey Board of Commerce and Navigation directed attention especially to the change below Gansevoort St., stating that the action was in accordance with an agreement between commissions of the States of New York and New Jersey and the Federal Government, and they expressed, in effect, the feeling that the matter of the proposed extension at Chelsea having been settled at that time, the State of New Jersey should not again be put to the trouble of objecting to it.

They also called attention to the greater physical difficulties of obtaining long slips on the New Jersey side on account of the adjacent high land and to the slight advance which has been made channelward of the New Jersey harbor line as compared with that on the New York shore. They stated that plans are in hand for the construction of extensive terminals for the berthing of large ships on the New Jersey side immediately opposite Chelsea, and that notwithstanding the physical difficulties referred to the construction will be such that vessels lying in the terminal slips will be entirely shoreward of the harbor lines. The traffic at those terminals will undoubtedly increase the congestion of the waterway in the Chelsea section.

The reports of the New York Harbor Line Board and the Chief of Engineers give data confirming the statements regarding harbor line concessions made to enable the City of New York to construct elsewhere than at Chelsea piers necessary for the berthing of large ships, and show that in view of an explicit understanding and assurances that the city would take such action the Secretary of War authorized as a temporary expedient; namely, the extensions which you now wish made permanent. They also confirm the statements concerning the narrowing of the river at the locality and adhere to the views that the existing width of the waterway at Chelsea is less than is considered essential for the safety of navigation; also that the increase in tidal velocity caused by the contraction in width is objectionable, and that the encroachment has shown a tendency to interfere with the navigable condition of the river in other reaches.

I find nothing in your application or in your presentation of the matter which would justify the granting of your request, either on legal or equitable grounds. So far as the equities of the case are concerned it would seem that if any further advance of harbor lines at the locality is to be permitted the privilege should certainly be given to the State of New Jersey and not to the City of New York. My decision, however, must be based not upon the equities, but upon the law governing the matter found in Section 11 of the River and Harbor Act of March 3, 1899, which provides that harbor lines may be established where it is made manifest to the Secretary of War that such action "is essential to the preservation and protection of harbors." It is my view that in applying that law it is my duty to consider not merely the requirements of a particular limited section of waterfront and the needs of the immediate present, but rather the interests of the entire waterway affected and the probable demands of the future. The evidence before me is, so far as the present is concerned, that the encroachment at Chelsea, instead of preserving and protecting the harbor is a damage and a menace to it and to other sections of the waterway. It further develops that the City of New York has ample space for providing berths for large ships elsewhere on the Hudson front as well as at other points in the harbor.

So far as concerns the future, it appears highly improbable that commercial developments above Chelsea have reached their ultimate limit and that navigation yet feels the full burden of the contraction of the waterway at that locality. From the standpoint both of the present and the future, therefore, I cannot consent to a longer continuance of the temporary encroachments now existing and could not assent to a permanent narrowing of the channel to its present limits at that point were that matter now before me as a new proposition.

I am consequently constrained to deny your application and to direct that immediate steps be taken to remove the temporary piers, the work to be completed not later than May 1, 1921. I will give the Chief of Engineers instructions to defer commencing any legal action until that date, provided assurances are received from you in the near future that the work of removal will be undertaken in accordance with this notice.

Road Grading Methods and Costs in Nebraska

Ten-Ton Tractors Operating Elevating Graders Show Decided Economy Over Team-Operated Grader Outfits

By George E. Johnson
Secretary, Department of Public Works and State Engineer, Nebraska

STATE road construction in Nebraska has been largely a task of producing permanent road beds. On the theory that a perfect earth-road grade is the first essential in constructing a permanent paved road, the grading and drainage of earth roads has been prosecuted intensively. As the work has advanced, team grading, tractor grading and dragline grading are the three leading methods which have been developed. A comparison of these methods, based on a wide range of conditions and giving representative costs, is instructive.

With 80,000 mi. of earth roads it is impossible to

TEAM-OPERATED ELEVATING GRADER OUTFIT

pave any appreciable mileage without first a large amount of grade development. Grade is the initial step toward permanent construction. The state highway department has acted upon this theory and has undertaken, ahead of all other work, to grade, straighten and drain the 4,500 mi. of earth roads which compose the state system. The program was started in 1917. To date the state has under construction 1,311.57 mi. of road classified as follows: Earth road, 1,215.51 mi.; hard surface road, 17.33 mi.; sand-clay road, 55.7 mi.; and gravel road, 23.03 mi. This work, under contract, will cost $6,359,359.

A program of this character is not sacrificing funds for "temporary earth roads" but is making for permanent highways by preparing a perfect road bed for surfacing that is to follow when supplementary funds will permit.

Of the 4,500 mi., which constitute the state highway system, nearly 3,000 mi., are of earth construction and no two roads are of the same character. There are known to be ninety-three kinds of soil ranging from sticky gumbo to pure blow sand. Because of this diversity of soil texture variety in methods of grading and a multiplicity of equipment are required.

There are three distinct methods under which all grading work in the state is classified: (1) Team grading; (2) tractor grading; and (3) dragline grading.

The excavating tools and grading procedure are sub-

stantially identical in team grading and in tractor grading. The major tool is the elevating grader for the larger cuts and fills. For lighter excavation, blade graders are used and for short-haul (under 300 ft.) earth movements the Fresno scraper is economical. The standard earth road section is 24 ft. wide with a 6-in. crown from the shoulders; the ditches have 1 on 1½ back slopes and 1 on 3 front slopes.

Ordinarily, sixteen horses and three men constitute an elevating grader equipment with from three to nine teams hauling dump wagons. On one job with heavy cuts and a long haul a fourteen-wagon outfit was required to handle the grader output. With tractor haulage the wagon outfit is increased to handle the increased output. Tractor operations are gaining in favor. Generally speaking, Nebraska road contractors are convinced that with tractors labor is saved, the quantity of earth moved is increased, greater ease of operation is secured and costs are reduced.

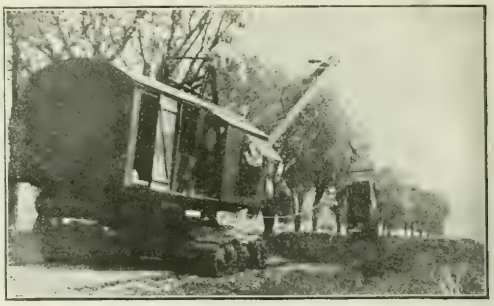
A tractor-drawn outfit has an advantage over a team-drawn outfit; first, because the contractor, with the stock he has on hand necessary to operate his team-drawn outfit, can, by the addition of a tractor and an increased number of wagons, practically double the output of material. The horses released by the tractor

TRACTOR OPERATED ELEVATING GRADER OUTFIT

work can be used for the actual placing of the earth. In the majority of cases, from twelve to sixteen horses are released. Again, where there are three men required to operate the horse-drawn outfit, but two are required on the tractor work, one for the elevator and one for the tractor. With this outfit, the work progresses more steadily, as it is not necessary to stop and rest the horses. The tractor can turn easier and in less space than is necessary for a team-drawn outfit.

The experience of this department has been that for the past two seasons the 10-ton caterpillar tractor has been very successful as a motive power for elevating graders. The work of maneuvering the elevating grader in the narrow cuts is facilitated where the tractor is used. Breakdowns have been very infrequent. In one instance, the tractor worked the entire season continuously and was held up for repairs but one day in the late fall of that year. However, this factor is almost entirely under the control of the mechanic whose duty it is to keep the tractor in perfect working order. One contractor, within the past month, has ordered eleven 10-ton tractors, and another has ordered five 10-ton tractors.

A cost comparison of team-drawn and tractor-drawn grading outfits is impossible because of the wide variation in the condition of the soil, weather and labor. This conclusion is arrived at after a complete analysis of roads built by both types of outfit. Taking projects that are considered fairly representative of the two



DRAGLINE ROAD GRADING OUTFIT

methods of work, I have attempted to compare them for a period of three months, with respect to cost per cubic yard, contract price, yardage moved and profit. These figures are submitted in Table I as proof that it is impossible to analyze or actually compare the earth construction work in the state, because yardage which is the basis of grading operations, is dependent upon seven factors: (1) Condition of the soil, (2) depth of cut or fill, (3) length of haul, (4) type of equipment, (5) weather, (6) labor, and (7) management.

As a general indication of the range of costs, figures selected from a number of operations run as follows in cents per cubic yard for team-drawn elevating graders: 37.6, 37, 51, 51.2, 36.5, 37, 38.5, 38.6 and 31.9. For tractor-drawn graders the figures are: 41, 35, 29.6 and 38.6c.

One of the largest contractors in the state recently stated that he had found it much cheaper to work with tractors pulling grading machines than with teams. He said: "On one project I have two twenty-team outfits, two grading machines and twenty wagons. The cost of operating these two outfits per month is $13,400, which is $6,700 per month for each twenty-team outfit. I have several tractor outfits working in different places. The expense of these outfits averages about $5,250 per month, thus making the tractor expense $1,450 a month less than the team outfit."

Finishing Methods

Before taking up the third type of equipment used in road construction in Nebraska attention will be called to the question of the proper finish. This is the most important matter in the construction of earth roads. After the work has been brought to grade, finishing stakes are set by the engineer and the contractor blades his road continuously until a smooth, compact surface is secured as indicated by the stakes.

Finishing the back slopes raises the question whether hand dressing is required. If a contractor is careful, he can slope his cuts in such a way that the terraces made by his disc are so slight that the action of the weather will soon put them in satisfactory shape, and when the weather is not favorable, a once-over with the mormon will show a workmanlike job. Some contractors are careless and butcher their work in such a way that a mattock is the only tool that will correct the rough work on the back slopes. Usually the type of finishing is governed by the depth of the cut; on shallow work finishing is not necessary. As a rule the department does not require handwork on back slopes. There are several attachments for an elevating grader

which will cut back slopes and it is possible to cut slopes as high as 6 ft. with a blade grader.

The finish of the road is important, for the verdict passed by the traveling public, whether a road is good or bad, is based entirely upon how it rides and how it looks.

Dragline Grading Operations

The third type of equipment used in building roads in this state is the drag-line excavator. There are several of these in operation in the state, but as a general rule the machine is not in common usage except where unusual conditions exist. Where there are long fills taken from low wet places the drag-line excavator is unexcelled. Ordinarily, tractor- or team-drawn outfits are impracticable under such conditions and often quite impossible. The equipment consists of a dragline excavator, equipped with a shovel and provided with widespread traction wheels or the caterpillar type of tread; and of two teams, a fresno, a mormon and a blade grader. The contractor's force consists of a superintendent and four men, two of whom operate the dragline. The operation is simple: The boom swings out, lowering the bucket at the end of the cable to the material, fills, swings back, and deposits the excavated earth on the fill. In order to get earth across a creek bottom for construction on one project, 8 mi. in length, it was necessary to dig deep side ditches on both sides of the road. At three different times the work was completely under water, but construction was not hampered. Herein lies the advantage of dragline excavator. On this particular piece of work the grade was raised 3 ft. and the entire surrounding country was level. This proved to be the most economical method, as there was no earth to be hauled since the excavated material from the ditches formed the grade. However, here again enter the factors of soil conditions, labor and yardage placed. The economy of the operation is mainly dependent upon a proportioned combination of existing conditions, power and capacity of the machine, and the brains and experience of the operator.

TABLE I. COMPARISON OF ROAD GRADING OPERATIONS WITH RESPECT TO CONDITIONS EFFECTING YARDAGE

Item:	1	2
Soil	Loose	Loose clay
Weather, rained, days	2	6
Number of men, average	48	23
Lost man-hours	514	1,166
Lost team hours	8,348	2,761
Lost tractor hours		121
Yards moved	58,368	67,571

Eight miles of an average 3-ft. fill were built across a creek bottom by an excavator, equipped with 1-yd. dragline in a reasonable length of time. Two men operated the machine and with an uninterrupted run of ten hours it placed 500 cu.yd. of earth. It goes without saying that there was considerable finishing work.

Strong Railing for Highway Bridges

Railings of highway bridges should be designed so as to be capable of withstanding the impact from unmanageable vehicles, according to the view of the New Jersey Highway Department. To this end monolithic concrete railings with reinforcement and anchorage to bridge decks have been designed. It is stated that such a railing can be produced at a cost about equal to that of heavy galvanized pipe railing, and is vastly superior to it in strength, endurance and appearance.

Federal Reserve Board's Report on Building Activities

IN ANALYZING the reports of its member banks on building activities during December, 1920, the Federal Reserve Board makes the following statement:

For the first time in some months an increase in the value of permits issued is shown in some districts in December. The number of permits issued, however, with the exception of scattered centers, has continued the decrease characteristic of preceding months. The building contracts awarded in New York State and northern New Jersey, District No. 2 (New York), according to the reports of the F. W. Dodge Company, were 616 projects at a cost of $17,000,000 for December, while in November there were 694 projects at a cost of $29,500,000. In District No. 3 (Philadelphia) the decrease was largest, being from $2,303,445 to $1,443,715.

In District No. 4 (Cleveland) the number of permits issued decreased, but there was a very large increase in value, this being $8,976,700 in December as against $5,901,026 in November. The value of permits issued in Cleveland alone increased from $2,402,100 in November to $6,391,994 in December. During December a decrease was shown in practically every city in District No. 5 (Richmond) when compared with the same month a year ago, the value being only about 40 per cent. In District No. 6 (Atlanta) large decreases were noted in the leading cities, while some increases were noted in some of the smaller cities.

It is reported in District No. 8 (St. Louis) that "a heavy slump in number of building permits and dollar values involved is shown in reports of leading cities of the district for December. Virtually nothing in the way of new construction is being undertaken at the moment." In District No. 9 (Minneapolis) December building operations, when measured by number of permits, decreased one-third from the November figures, but the valuation increased 21 per cent, due entirely to Duluth and Superior operations, which cities alone showed an increase in valuation. Minnesota alone showed an increase in the number of permits issued.

District No. 10 (Kansas City) states that "the showing made by the December reports on building was somewhat better than anticipated." There was a decrease in every leading city of District No. 11 (Dallas), with the exception of Shreveport, La., as compared with the previous month. When compared with the closing month of 1919 there was a decrease of 66.8 per cent for the nine leading cities, Austin and Beaumont being the only cities showing increases. District No. 12 (San Francisco) reports that "Building activity in this district during December, 1920, was 5.8 per cent greater than that of November. Each of the principal centers except Los Angeles, where a decline of 39.3 per cent in the value of permits occurred, reported an increase in value but a decrease in the number of permits issued.

The decline in operations in Los Angeles is attributable to the high record attained during November.

Jamestown Municipal Milk Plant Delayed

Construction of the proposed municipal milk bottling, pasteurizing, and distrubuting plant for the city of Jamestown, N. Y., noted in *Engineering News-Record*, Oct. 21, 1920, p. 792, has been delayed by difficulty in selling the $150,000 of city bonds voted for the purpose in August, 1920. A bond house whose bid for the bonds the city accepted subsequently refused to take the bonds, giving as its reason a question as to the legality of the city going into the milk business. We are informed by Lyman P. Hapgood, the superintendent of the city water and light plant at Jamestown, that the city now proposes to try to dispose of the bonds at private sale.

Build Bridge Across the Colorado in Grand Canyon

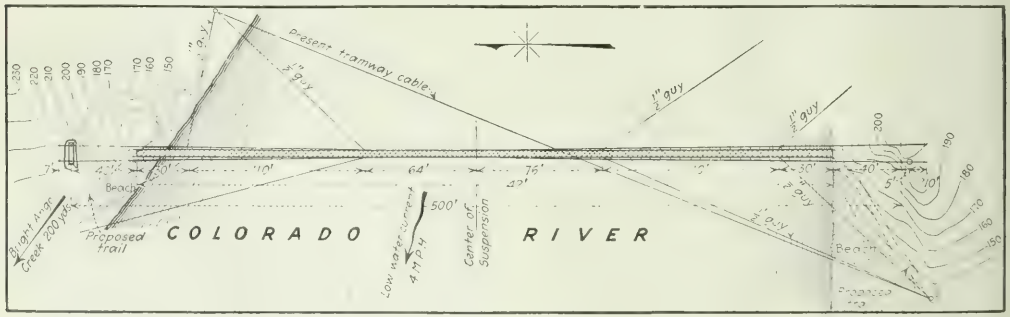
Material for Only Crossing Above the California Line Has to Be Packed Down Canyon Trail

AT THE bottom of the Grand Canyon of the Colorado—nearly 5,000 ft. below the rim at El Tovar—the United States through the National Park Service is now building a suspension bridge across the Colorado River, the only bridge crossing of that river above Needles, Cal., which is over 500 miles below where the Grand and the Green join to form the Colorado. The bridge is for mule trains and foot passengers and is of the simplest design, not only because of the light loading but also because all of the material and construction equipment have to be packed by mule trains down the narrow and steep trails of the canyon.

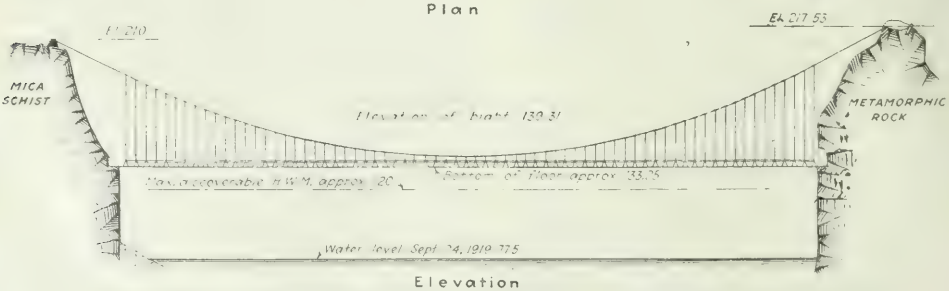
Access to the Grand Canyon is confined practically entirely to the railroad leading up from Williams, Ariz., which reaches the south rim at El Tovar, and by highways from Williams and Flagstaff, Ariz. From there tourists may be sent into the canyon by foot or on muleback on two or three separate trails. The north rim of the canyon has heretofore been difficult of access, although there is a camp opposite El Tovar which is reached by horseback from railroad points in Utah many miles north. This north rim is about 1,500 ft. higher than the south rim and presents a view entirely different from what is usually seen. For this reason the Park Service, which has only recently taken over the Grand Canyon, has decided to build the bridge across the river and extend the trail up by Angel Creek on the north side of the canyon to the north rim, thereby making available a new scenic trip for tourists.

SWIMMING HORSES ACROSS COLORADO RIVER

The site selected for the bridge is just above the mouth of Bright Angel Creek, a distance perhaps of 9 or 10 miles by trail from Grand Canyon station at El Tovar. It is a narrow rock gorge having quite

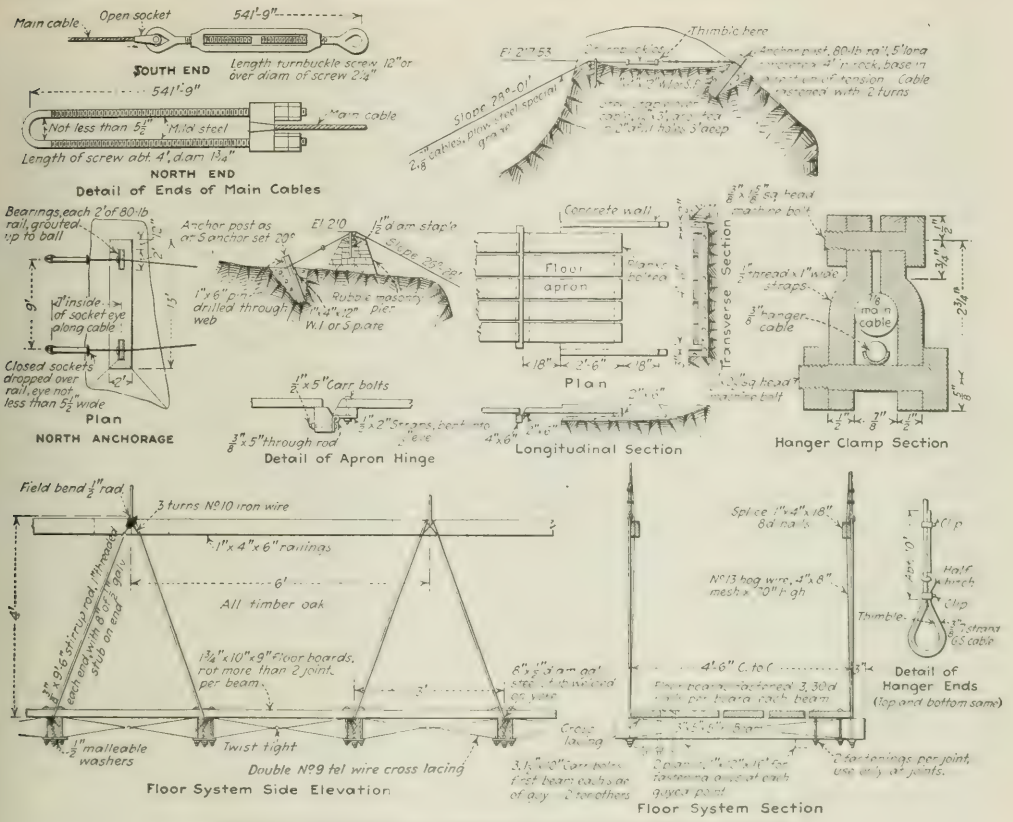


Plan



Elevation

PLAN AND ELEVATION OF BRIGHT ANGEL SUSPENSION BRIDGE ACROSS COLORADO RIVER IN GRAND CANYON



DETAILS OF DESIGN OF COLORADO RIVER SUSPENSION BRIDGE

precipitous sides about 400 ft. apart. There is located here at present a two-line cable which has been used for a tramway crossing. The trail on either side of the river at present, however, is not easily traveled nor is there any way of reaching the bridge on either side except by the excavation of a new trail along the rock side of the bluff. The floor of the bridge is located at a height about 13 ft. above the highest known water and 60 ft. above normal water.

The bridge itself is a wire cable suspension bridge with approximately 500 ft. span from center to center of bearings, and about 420 ft. along the roadway. It has two main ⅞-in. plow-steel cables, placed approximately 10 ft. apart, anchored about 80 ft. above the floor level on the sides of the rock canyon. These cables carry the wood floor by ⅜-in. galvanized-steel cables spaced 6 ft. center to center, through the medium of spread iron rods 4 ft. deep.

The hangers are clamped to the main cables by bolted clamps, shown in the detail herewith, on the bottom bolt of which the hanger cable is looped with a clip and half-hitch connection as shown. A similar loop at the bottom of the hanger carries the inverted V-shaped ⅜-in. steel rods which are bent at the bottom to pass through the wooden floor beams. The floor itself is composed of 3 x 5 in. floor beams with 1⅞-in. floor plank laid longitudinally fastened to the beams with 30 d. nails. In addition the floors are held down at the ends of the floor-beams with clamp fastenings as shown. These floor-beams are crossbraced by twisted No. 9 telephone wire as transverse X-bracing. In addition the bridge is stiffened by being guyed back to the rock face with ½-in. galvanized steel cables. As a protection for the passing animals and pedestrians, 4 x 8-in. mesh No. 13 hog wire 7 ft. high is attached along the sides of the inverted V iron-rod hangers.

The main suspension cables are ⅞ in. diameter plow steel extra galvanized special span wire, having a strength of approximately 90,000 lb. The two anchorages are designed differently on account of the difference in rock condition and exigencies of construction. On the south side, from which the construction will be started, a trough is excavated out of the rock and the cable anchored around a diagonal anchor post made up of 50 ft. 80 lb. rail concreted 4 ft. into the rock base. Turnbuckles are provided for adjustment between this anchorage and the bearing which is formed of 80-lb. old rail concreted into the rock up to the road. The cable is further held in place by staples grouted into the rock. On the north side the anchorage is a similar diagonally placed rail, but the cable passes over a mound of rubble masonry with the bearings made up of two 80-lb. rails grouted up to the head. At this end the closed sockets form a fixed anchorage.

Expansion in the floor is provided at either end by an apron, as in the detail shown on the drawing, with

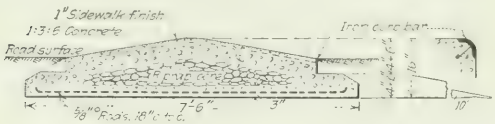
an extension apron reaching out from the concreted trail which runs along the side of the bluff.

It was necessary in the design to have the units of such size and weight that they could be packed by mules on the trail. The main cables weigh at least 700 or 800 lb., so it will be necessary to divide them into four pairs of coils, one pair being placed on each of the four mules in the train with an intervening length of cable about 20 to 30 ft. Each mule will be in charge of a packer and the intermediate men will in addition to leading the mules control the slack of about 20 to 30 ft. of cable so that they can successfully negotiate the switchback in the trail. There will be in all about 15 tons of material to take down to the site, which, as stated, is some 10 miles from the head of the trail. About 150 lb. per animal can be allowed, which means about 200 mule trips. Pack trains go down with from twelve to fourteen head of mules.

The packing as well as the material for the concrete will be furnished by the government. All the other material and the work itself will be done by the Monarch Engineering Co., of Denver, to whom a contract has been awarded. The bridge is designed by George C. Goodwin of the National Park Service, and the construction will be supervised by D. L. Reaburn, who is superintendent of the Grand Canyon National Park, also an engineer of long experience. It is expected the bridge will cost in the neighborhood of $13,000 and will be in service before the end of 1921 summer season.

Highway Humps at Railway Crossings

REDUCTION of accidents by providing humps in highway approaches to railway crossings at grade is contemplated by a bill which will be introduced this winter in the Tennessee Legislature. The proposed legislation, which has been initiated by the Nashville, Chattanooga & St. Louis Ry., specifies the construction and location; includes a requirement for sign posts, makes unlawful the use of X-signs for other purposes than to denote railway track; and places the obligation

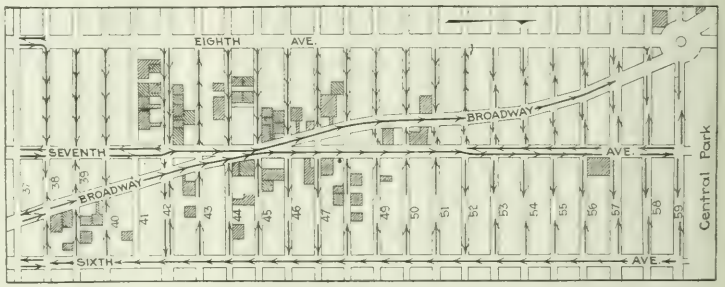


CROSS-SECTION OF PROPOSED HUMP

and cost of hump construction on the state and county highway departments. A concrete hump designed according to the law is illustrated by the sketch. This hump must be placed between 50 and 100 ft. from the track center on each side of the crossing and must extend the full width of the roadway. The time limit for the construction of humps is 90 days, with an extension, in extreme instance, to 18 months. The hump design illustrated is suggested by Hunter McDonald, chief engineer, Nashville, Chattanooga & St. Louis Ry.

Traffic Regulations Make Broadway a One-Way Street

IN AN EFFORT to expedite the movement of vehicles in the theater zone of New York City the Police Department, through Dr. John A. Harriss, special deputy commissioner in charge of traffic, has put into effect radical traffic regulations which make Broadway and other streets one-way thoroughfares from 7 p.m. until midnight, daily, except Sundays, and between the hours of 1 and 6 p.m. on Saturdays. The accompanying map, on which the principal theaters are shown by cross-hatching, indicates by means of arrows the direction which traffic must take between the hours noted. The



HOW VEHICULAR TRAFFIC MOVES IN NEW YORK CITY'S THEATER ZONE DURING EVENING HOURS
Theaters are indicated by cross-watching.

new regulation became effective Jan. 5 of this year.

Traffic is permitted to move in both directions on Broadway north of 57th Street.

Parking of vehicles on any thoroughfare included in the territory bounded by 59th St., Sixth Ave., 37th St. and Eighth Ave., inclusive, is prohibited.

The territory contained in the above boundaries is known as the "east theater zone" and the "west theater zone," respectively, Broadway being the dividing line.

Vehicles conveying patrons to theaters in the east zone are permitted to park on the same street on which a theater is situated, east of Sixth Ave. Those conveying patrons to theaters in the west zone are permitted to park on the same street on which a theater is situated, west of Eighth Ave.

Sight-seeing vehicles are prohibited from standing on any thoroughfare within the above zones, except for the purpose of loading and unloading passengers, and then not to exceed a period of 15 minutes. Sight-seeing vehicles are prohibited from "cruising" on any thoroughfare within the theater zones.

The foregoing regulations do not apply to the following vehicles: United States mail, police, fire, fire patrol, bureau of buildings, emergency repair of public service corporations, ambulances, military, and those which run only on rails or tracks.

Imports and Exports During 1920

According to a recent bulletin issued by the Bureau of Foreign and Domestic Commerce the exports of the United States in the calendar year 1920 were $8,228,000,000, an increase of 4 per cent over those of 1919 and three and one-third times the exports during the calendar year 1913. Imports in 1920 amounted to $5,279,000,000 a 35 per cent increase over the calendar year 1919.

Proposed Code of Ethics for Contractors

Submitted at New Orleans Convention for Consideration of the Members of the Associated General Contractors

AT THE New Orleans convention of the Associated General Contractors, Jan. 25, the committee on ethics submitted a tentative draft of a code of ethics or practice for criticism of the members, with the expectation when perfected of recommending it for adoption by the association. The code defines certain *unprofessional* practices, sets up certain standards, and provides machinery for its enforcement.

The tentative draft on which criticism has been invited, is as follows:

Article I—Purpose

The purpose of the code is to define briefly the rules of professional conduct and ethics for the members of The Associated General Contractors of America.

Article II—Improper Practice

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of The Associated General Contractors of America

1. To act for his clients in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than (a) that stipulated in the contract or (b) his customary charges for similar professional services to other clients.

2. To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business of another general contractor.

4. To alter a prepared bid after being informed of the bid of a competitor.

4. To lend his name to any questionable enterprise.

5. To engage in any movement which is obviously contrary to law or public welfare.

6. To engage in undignified, sensational or misleading advertising.

7. To submit bids on a basis other than that requested unless a bid on the basis requested is submitted for comparative or other purposes.

8. To accept a contract at the price submitted by the lowest but disqualified competitive bidder.

9. To seek information concerning the bid of a competitor and make use of the knowledge thus obtained for his own gain or for the competitor's detriment.

10. To collect money for making an estimate, where plans for securing payment for estimating are in force, without the knowledge of the owner or his representative.

Article III—Skill, Integrity and Responsibility

"Skill, Integrity and Responsibility," our slogan, requires

1. That in all their relations, our members shall be guided by the highest principles of honor.

2. That the dignity of the construction industry be upheld to the public at all times and its members protected against misrepresentation.

3. That a personal helpfulness and fraternity be maintained among our members and toward the profession generally.

4. That sensationalism, exaggeration and unwarranted statements be avoided and discouraged.

5. That clients be frankly advised when projects are undertaken which our members from former experience have found to be unprofitable.

6. Conservatism in all estimates, reports, testimony, etc., especially in connection with the promotion of business enterprises.

7. That when one of our members undertakes for a client work in connection with which he may make improvements, inventions, plans, designs or other records, he shall preferably enter into a written agreement regarding their ownership.

8. That a member cannot honorably accept remuneration, financial or otherwise, from more than one interested party. "No man can serve two masters."

9. That when a member is called upon to decide on the use of inventions, equipment, methods, etc., in which he has a financial interest, he should make his status in the matter clearly understood before engagement.

10. That credit be given where credit is due.

11. That where bids are requested an effort should be made to have them opened publicly at a specified time and place, known to all bidders.

12. That bona fide bids carefully prepared be submitted whenever solicited or the reasons for the inability or unwillingness to comply be stated—frankness in these matters will establish the obviously fair principle that all solicited bids are entitled to consideration and the bid thus solicited which is most favorable to the owner should be accepted.

13. That consistent pressure be exerted to have all bidders notified whenever it is the intention to request bids for the same or part of the same work from both subcontractors and general contractors.

14. That when a limited number of general contractors are requested to bid, the names of those invited to bid should be made known to all those who are so invited.

15. That all general contractors expose without fear or favor before the proper tribunals, corrupt or dishonest conduct in the profession and accept without hesitation employment against a member who has wronged his client.

16. That where perjury concerning professional matters is indulged in, the matter be publicly brought to the attention of the prosecuting authorities.

17. That all members guard the association against the admission to its membership of candidates unfit or unqualified because deficient in either moral character or professional ability.

18. That competitors and their work be treated with fairness whenever clients discuss them with general contractors.

19. That all work be so creditably performed that the seal of the Association will continue to symbolize the highest professional ideals.

20. That when any member is charged publicly with using questionable methods, he should voluntarily present all facts to the Committee on Ethics.

21. That the honor of every member be defended when wrongfully accused.

22. That all fraudulent misrepresentations be exposed as a duty to the public and the profession.

23. That work shall not be contracted for at less than cost with the hope or intention of finding enough "extras" to take care of the profit.

24. That existing agreements between general contractors and labor, architects, engineers or others be respected whenever work is done in the locality affected by said agreements. Should extenuating circumstances prevent adherence to these agreements the general contractor should confer with the general contractors who are parties to the local agreements, in order to work out the best substitute or else he should publicly announce his intention to disregard the agreements, and give his reasons for so doing.

25. That general contractors work loyally for the success of measures brought forward to benefit their industry, regardless of their immediate interest or lack of interest in such measures.

26. That the public welfare be promoted at all times and particularly in matters in which the general contractors' experience qualify them to act, giving freely of their counsel and support and holding themselves in readiness to assume responsibilities when called upon, bearing in mind that the public welfare is paramount and that the cus-

tomary villification practiced by those who have been thwarted in controlling such matters or finding berths for henchmen has no effect upon any unbiased mind.

ARTICLE IV—OWNER OR CLIENT

The proper relationship of the general contractor to the owner (or client) requires:

1. That no contract should be undertaken which the contractor is unable economically and efficiently to complete.

2. That the owner be intelligently advised of all things which may promote his interests in the successful prosecution of the project.

3. That advice should not be given to owners on subjects concerning which the general contractor is not qualified to advise.

4. That controversies with owners concerning compensation are to be avoided so far as shall be compatible with self-respect and with his right to receive his contractual or reasonable compensation for his services; and lawsuits with owners should be resorted to only to prevent injustice, imposition or fraud.

5. That members keep constantly in mind that the results of their labor are permanent assets, having a definite economic and taxable value, in contradistinction to consumable or materialistic products, and that laxity in execution may in after years reflect discredit on the profession.

ARTICLE V—ADMINISTRATION

1. Administration of this code of ethics shall be performed by a Committee on Ethics consisting of five members appointed by the president holding office at the time of the adoption of the code. One committee member shall be appointed for five years, another for four years, another for three years, another for two years, another for one year, and thereafter, the President then holding office shall appoint one member annually to serve for five years and also fill such vacancies as may occur for an unexpired term. All of these members shall be over forty years of age. The committee shall select its own chairman. The Committee on Ethics shall investigate all complaints submitted to it bearing upon the professional conduct of any member, and after a fair opportunity to be heard has been given to the member involved, shall report its findings to the executive board, whose action shall be final.

2. Discipline for violation of this code shall be determined by the executive board, after the facts have been reported by the Committee on Ethics.

Or

(The following paragraph is submitted as an alternative.)

2. Upon specific complaint made by or through one member against another, of violation of the code of ethics, such complaint shall be referred to the Committee on Ethics, which shall promptly give the complaint full and fair investigation in such manner as it shall deem proper, save that the accused must be given an opportunity to be heard in his own defense. The findings of the Committee on Ethics shall be transmitted to the executive board for action. If the accused member is found guilty of the charges preferred it is the duty of the executive board to discipline him, either by censure, suspension for a period not to exceed one year, fine not to exceed Two Hundred ($200.00) Dollars, or expulsion; the action of the executive board to be final and its action published or otherwise to be brought officially to the notice of all members.

ARTICLE VI—AMENDMENTS

Upon thirty (30) days' notice stating the change proposed, this code of ethics may be amended by a two-thirds vote of the entire executive board or by a majority vote of the association voting in convention or by letter ballot.

Density of Road Bridges in New Jersey

On the state road system of New Jersey, the number of miles of road per bridge varies from ½ on route 16 to 8:1 on route 14.

A Further Study in the Economics of Garbage Reduction

Operations at Columbus and Washington Compared —Outlay for More Tankage at Washington Would Pay But Not for Grease

By F. S. Besson

Major, Corps of Engineers, U. S. A., Assistant to the Engineer Commissioner of the District of Columbia

VALUABLE deductions may be drawn from the garbage reduction records of Columbus, Ohio, and Washington, D. C. The details of nine years' operation of the Columbus works were given in an article by James W. Follin in *Engineering News-Record,* Nov. 18, 1920, p. 991. Results at Washington for the fiscal year 1919-20 were reviewed by the present writer in the same journal for Dec. 2, 1920, p. 1072. This article will compare some of the Columbus and Washington figures and will show that the Washington plant, which is old and not up to date, might advantageously be made to produce more revenue from tankage but that under existing conditions, including the low price of grease, the installation of a percolator to recover additional grease would cost more for capital, coal and gasoline than the added grease would be worth.

It is not unusual for garbage samples to show 75 per cent moisture content, 5 per cent ether extract and a residue of 20 per cent. Based undoubtedly on such tests are those reports of engineers that assume a production of 4½ per cent grease and 20 per cent tankage from the reduction of city garbage. The average selling prices shown during a year by Columbus and Washington are 8.2 c. per pound for grease and $13.90 per ton for tankage. Based upon a production of 4½ per cent grease and 20 per cent tankage these prices would give $10.16 as the value of a ton of green garbage. Such an estimate of the value of a ton of garbage has led to much disappointment and has discredited many reduction systems.

Following are listed for comparison the important figures relating to Columbus and Washington:

COMPARISON OF THE COLUMBUS REDUCTION PLANT WITH THAT OF WASHINGTON, D. C.

	Columbus	Washington
1. Population	237,000	437,500
2. Tons garbage collected per year	18,126	52,800
3. Pounds per capita	153	241
4. Average tons reduced per day (year of 313 days)	58	169
5. Average tons reduced per day (max. month)	80	234
6. Average tons reduced per day (min. month)	42	136
7. Tons grease extracted	352	927
8. Per cent grease extracted	1.942	1.76
9. Value of grease per 100 lb	$6.729	$9.7
10. Total value of grease	$47,372.00	$179,668.00
11. Tons tankage produced	1,558	3,048
12. Per cent tankage produced	8.6	5.8
13. Value of tankage per ton	$15.65	$12.11
14. Total value of tankage	$24,336.00	$36,922.00
15. Total value of production	$73,248.00	$216,590.00
16. Value of production per ton of garbage	$4.05	$4.10
17. Tons of fuel consumed per ton of garbage	0.378	0.091
18. Cost of one ton of fuel	$2.87	$6.64
19. Gallons of gasoline consumed per ton of garbage	1.647	No percolation
20. Cost of labor for reduction	$37,703.00	$95,000.00
21. Per ton cost of labor	$2.08	$1.79
22. Total cost of plant operation	$106,438.00	$176,100.00
23. Per ton cost of operation	$5.87	$3.33
24. Plant charges	$19,216.00	$13,000.00
25. Per ton plant charges	$1.06	$0.25
26. Total reduction cost	$125,654.00	$189,100.00
27. Total per ton reduction cost	$6.93	$3.58
28. Status (receipts—costs)	—$52,406.00	+$27,490.00
29. Per ton status	—$2.89	+$0.52
30. Per capita status	—$0.22	+$0.06

Item 8 of the table gives a grease extraction for one city of 1.942 per cent and for the other 1.76 per cent. Item 12 shows tankage percentages of 8.6 and 5.8, and the per ton values of green garbage are shown by item 16 to be $4.05 and $4.10. These figures, taken from practical operating data, are far from the theoretical

ones of 4½ per cent grease, 20 per cent tankage and $10.16 per ton value of green garbage. A recovery of $10.16 may be obtainable but its economy is a matter of relative expenditures and receipts. For instance, it may be noted from item 17 that Columbus used four times as much coal per ton of garbage as did Washington and, in addition, used 1.647 gal of gasoline solvent per ton of garbage, whereas Washington used no solvent. As for coal, it may readily be seen that Columbus with a cost of $2.87 could afford to expend more coal in an effort to increase production than could Washington with a cost of $6.64 per ton.

The salvage from Washington's garbage of but 5.8 per cent tankage and 1.76 per cent grease is very low. With the assistance of Mr. Hacker, supervisor of city refuse, and Mr. Crane, superintendent of the Reduction Plant, a study has been made as to possible increases in these items. It is estimated that a mill for grinding tailings and that settling basins for recovering sediment in tank water would increase the tankage to about 11 per cent of the amount of green garbage; of which increase about two-thirds would be due to grinding and one-third to recovery of the sediment. The value, however, of the sediment is several times that of ground tankage and the average value would be increased from about $12 to $14 per ton, so that on a basis of 52,800 tons of garbage there would be produced 5,808 tons of tankage worth $81,312. No increase in labor cost would be entailed, as at present considerable labor is required to get rid of the tailings which are now wasted. The cost of the equipment required for grinding tankage and recovering the stick would be as follows:

1—9-ft. diam. dry pan mill installed	$3,750
1—400-hp. engine for driving mill, dryer and conveyors	3,000
Necessary shafting, bearings, conveyors, belting, etc.	750
Building for mill	2,500
Magnetic separator	3,000
Settling basins for recovering the stick	10,000
Total	$23,000

The cost of operation would be as follows:

6 per cent interest on $23,000	$1,380
10 per cent depreciation on $23,000	2,300
750 tons coal at $9	6,750
General supplies	3,600
Total	$14,030

Increase in receipts from tankage:

$81,312 — $36,922 (present receipts)	$44,390
Expenses as above	14,030
Profit from mill and stick	$30,360

It thus appears that an investment for increasing tankage as described would be one of the best that could be made. The use of evaporating pans would recover a much higher percentage of stick from the tank water than can be obtained by the use of settling basins but the value of the fuel used would exceed that of the product obtained.

An essential difference in the Columbus and Washington plants lies in the fact that the former percolates its press cake; that is, uses gasoline as a solvent in order to extract a maximum of grease, while the latter makes no use of solvent. At today's writing, with coal in the District of Columbia above $10 per ton, gasoline above 25 c. per gallon, and grease selling for less than 3 c. a pound, it is manifest that much discretion must be exercised in any attempt to increase production. However, it should be realized that less than 3 c. per pound for grease is an abnormally low figure. In the long run there is a rather definite relationship between commodity prices. With labor wages as at present, coal estimated at $9 per ton, and gasoline at 25 c. per gallon, 7 c. per pound is a conservative value to place on grease.

The installation and operation of a percolation plant may accordingly be estimated as follows:

Equipment:	
2 Percolators, approx. 9 ft. diam. x 19 ft. long, installed	$16,000
1 Direct heat dryer, 4 ft., 9 in. diam. x 32 ft. long, installed	10,000
1 Stoker for dryer furnace, installed	2,000
2 Gasoline storage tanks, installed	1,600
2 Condensers, 4½ x 8 x 38 ft., installed	4,000
2 Vaporizing and treating tanks, 6 x 26 ft., installed	2,000
1 Gasoline separating tank, 6 x 20 ft., installed	1,000
2 Grease storage tanks, 10 x 20 ft., installed	2,400
3—150-hp. return tubular boilers, installed	15,000
3 Stokers for above boilers, installed	6,000
1 Engine for driving percolator, dryer, conveyors, etc.	5,000
3 Pumps for gasoline, treating and grease, installed	2,000
Shafting, piping, valves, conveyors, belting, pulleys, hangers, etc.	10,000
1 Tankage, storage bin	5,000
Percolator building	15,000
Dryer building	10,000
Boiler house	7,000
Coal unloading equipment	5,000
Sundries	6,000
Total equipment	$125,000
Labor, operation:	
1 Foreman percolating plant	$1,450
1 Fireman boiler house	1,650
2 Fireman boiler house (night)	2,600
1 Fireman dry house	1,450
1 Engineer	1,650
8 Skilled laborers	10,400
Total labor	$19,200
Supplies:	
4,840 tons coal at $9 per ton, delivered	$43,560
79,200 gal. gasoline at $0.25	19,800
Miscellaneous	15,000
Total supplies	$78,360
Operating account:	
Interest on investment—5 per cent on $125,000	$6,250
Depreciation, 10 per cent on $125,000	12,500
Labor	19,200
Supplies	78,360
Total expense	$116,310
Receipts, 1 per cent grease (528 tons) at $140	73,920
Loss on operation of percolating plant	$42,39

The remarkable point to be noted in the above estimate is that, not considering the plant and equipment necessary for percolation nor the labor necessary for working out the grease, it is shown that the value of the supplies used exceeds that of the grease obtained. Furthermore, the supplies used consist mostly of coal and gasoline, two items of much importance today. It is obviously poor policy to exchange coal and gasoline for an equivalent value of grease for which, at the best, it is difficult to obtain a market.

A prime essential in the disposal of the garbage of a municipality is to give satisfactory service to the citizens. Probable profits from by-products of the disposal, while commanding regard, should be of secondary consideration. Entirely satisfactory results can be obtained only when it is realized fully by the public that getting rid of the garbage of a city is a function in a class with the disposal of its sewage. If this had been realized years ago, the history of the garbage disposal in the first cities of the land would have shown fewer failures and less disappointment.

Machine Tamped Base for Brick Pavement

A machine tamped base is required for monolithic brick pavement by the 1921 specifications of the Kansas Highway Commission. At least three trips of the tamping machine are required and it is specified that the tamped surface "shall show sufficient surplus of mortar to produce adhesion between the bottom surface of the brick and the concrete base." The bricks are laid directly on the tamped base. Experiment last year with this type of construction was described in *Engineering News-Record* Jan. 6, 1921, p. 27.

Concrete Oil Reservoir with Flat-Slab Roof and Floor

In Order to Insure Strength and Tightness Concrete for Tanks at Three Rivers, Que., Is Mixed by Weight —Special Joints for Expansion

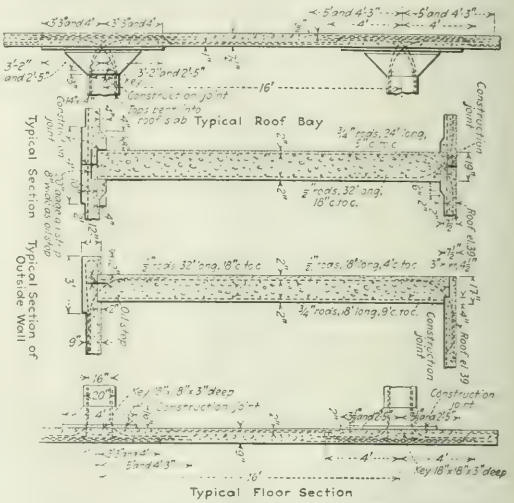
By EUGENE E. HALMOS
Designing Engineer, Parsons, Klapp, Brinckerhoff & Douglas, Consulting Engineers, New York City

ONE of the largest reinforced-concrete underground fuel-oil reservoirs in existence was built at Three Rivers, Que., last summer for the St. Maurice Lumber Co. The structure is approximately rectangular in plan with girderless roof slabs supported on columns resting on a similarly designed floor slab and with sides reinforced to resist earth pressure from without and oil within. The connections of the walls to roof and slab were detailed so as to take care of movements due to temperature or to filling and unfilling. A special feature in construction was the proportioning of the concrete by weight in a semi-automatic device in order to insure a uniformly strong concrete.

The plant is located between the St. Maurice and St. Lawrence Rivers near their junction, on a peninsula forming a plateau about 45 ft. above low water, having a rather steep slope toward the St. Maurice River, and a gentler slope toward the St. Lawrence. The whole peninsula is of alluvial sand peculiar to the rolling country adjacent to the north shore of the St. Lawrence River. This sand hill was excavated to receive the oil reservoir here described.

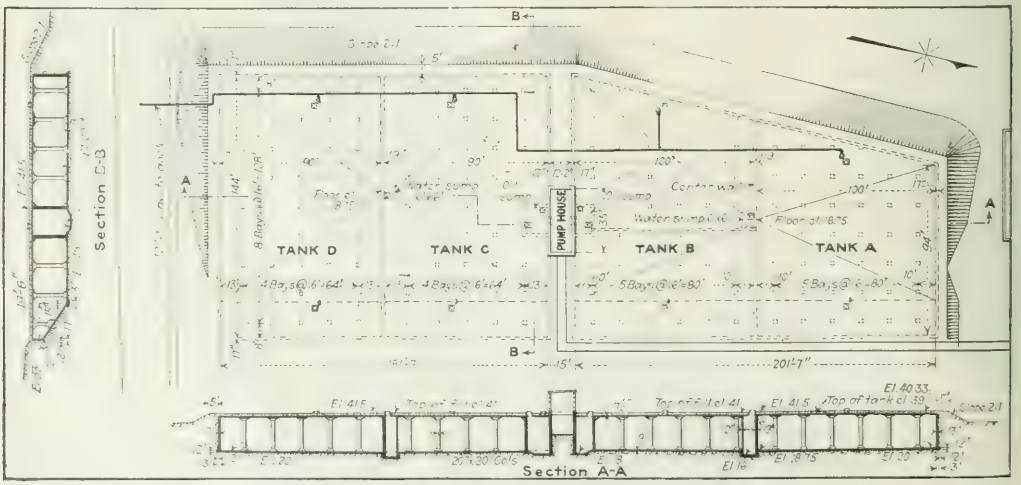
The reservoir has a capacity of about 160,000 bbl. and is intended to store fuel for use in the operation of the company's new paper mill which is now under construction. The tankers land at the company's dock about 400 ft. from the reservoir into which the oil is pumped by the ship's pumps through a 12-in. pipe at a temperature of from 120 deg. to 150 deg. F. depending on the season of the year. The boilers of the paper mill will be supplied with fuel from a service tank into which the oil stored in the reservoir will be pumped at the rate needed.

The main plan herewith shows the general plan of the reservoir, which consists of two sets of twin tanks and a centrally located pump house. One oil sump and one water sump are provided for each set of tanks. These

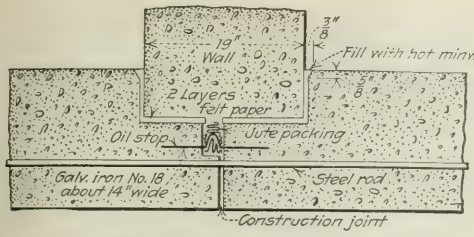


DETAILS OF FLOOR, ROOF AND COLUMN AND WALL CONNECTIONS

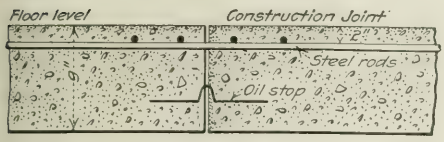
sumps are supplied with the necessary piping and valves to permit both oil and residual water to be pumped from each tank, independently.



GENERAL LAYOUT OF OIL RESERVOIR AT THREE RIVERS, QUE.



Oil Stop at Bottom of Wall



Oil Stop at Construction Joint

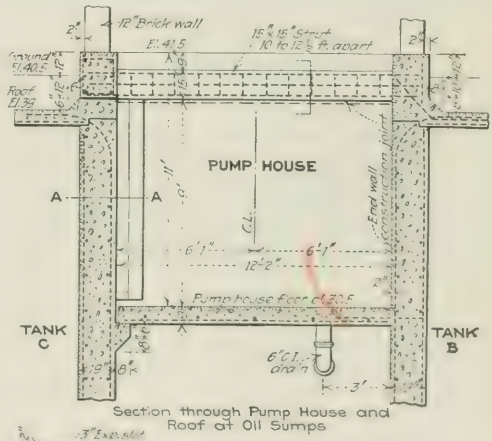
DETAILS OF OIL STOPS

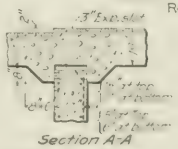
It will be noted that the structure is comparatively shallow and consequently has a large superficial area; also, that the floor along the east wall is built on a slope of 1 on 1½, and that, while tanks *C* and *D* are rectangular in plan, tanks *A* and *B* are trapezoidal. These features were adopted after a study made with a view to produce the required capacity with the least expense and with due regard to conditions determined by the elevation of the ground water, by the limits of the company's property and by the necessity of harmonizing the reservoir layout with the present and proposed other structures of the plant.

The roof of the tanks is of the two-way drop panel flat-slab type and it is supported on square columns, the span being generally 16 ft. The roof is designed for a total load of 400 lb. per square foot, including the weight of the insulating earth fill and of a possible snow cover of 6 or 7 ft. The floor is practically an inverted replica of the roof except as to the omission of the drop panel; moreover, a slight slope is given to the floor toward the water sump for drainage, and that part near the east wall is constructed with an inclination 1 on 1½ as already mentioned.

The walls are treated as slabs hinged on the top and the bottom and are reinforced for the most unfavorable conditions of loading. They are placed in grooves formed in the floor slab permitting of a slight angular displacement which is expected to occur under the influence of the loads and the temperature variations. The top of the walls is tied to the roof by reinforcing bars. It will be noted that the walls are reinforced on both faces. This, of course, must be so at the interior walls which may receive unbalanced load from either side. At the exterior walls, the reinforcement on the inner face takes care of the active earth pressure when the tank is empty. When the tank is full with oil, the oil pressure on the inside is about twice as large as the active earth pressure on the outside. It was found by a close analysis that the elastic deformation of the wall under this load will not produce enough passive resistance in the surrounding fill to counterbalance the surpressure of the oil, and the outside face of the walls was correspondingly reinforced. A specially designed oil stop prevents leakage at the junction of the walls and the floor slab. Typical details are shown in the accompanying drawings.

No expansion joints were provided in any part of the roof and floor slabs nor in the walls, all structural parts being properly reinforced to safely take the stresses induced by the expected considerable temperature changes. Construction joints were made along lines of zero shear, and oilstops, similar to those at the bottom of the walls, were placed across these joints. The only expansion joint in the whole structure is at the pump house, the brick superstructure of which would seriously suffer due to the movement of the reservoir walls, upon the coping of which the house is built. This joint is formed in the following manner and is shown in one of the drawings. The coping under the south wall of the pump house is integral with the reservoir wall, while the coping under the north wall lies on a horizontal sliding joint. This latter coping is properly reinforced and rigidly connected by means of struts to the opposite solid coping. The cross walls under the east and west walls of the pump house can slide in vertical grooves





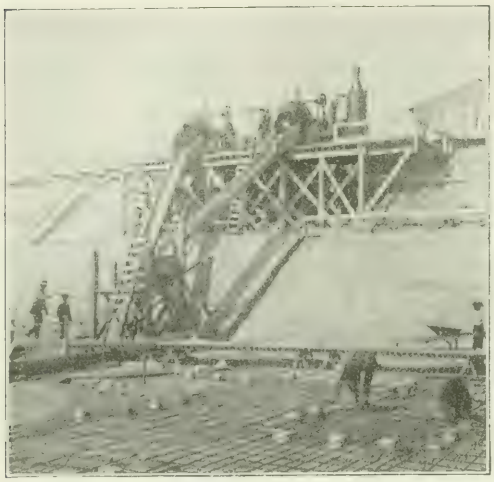
Expansion Joint at Pump House

EXPANSION CONNECTIONS AT PUMP HOUSE WALLS AND ROOF

provided on the face of the south wall of tank *B*. It can be seen that through this arrangement both sets of tanks may expand or contract without affecting the pump-house superstructure.

By far the most important problem in the construction of the reservoir was properly to determine the concrete mix with the given aggregates. It was mandatory to use a minimum amount of cement, and to produce an oil-proof, non-porous concrete of high compressive strength, unaffected by a possible temperature variation of perhaps 100 deg. F. Additional importance to this matter was given by the requirement that each tank was expected to take oil not later than four weeks after its completion. A careful study of all conditions led to specifying a concrete having compressive strength of 3,000 lb. per square inch in twenty-eight days.

Nathan C. Johnson, of New York, was asked to advise on the subject of proper mix. He reported that the sand and the ballast available were clean and of



PLANT FOR WEIGHING AND MIXING CONCRETE AGGREGATES

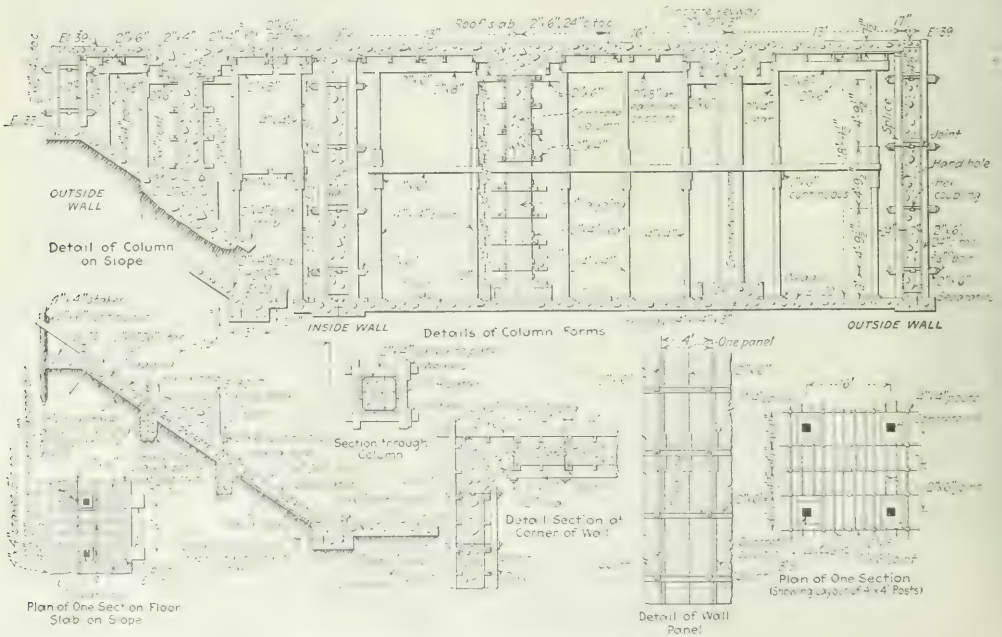
excellent quality but difficult of combination. The stone was coarse trap, only a small percentage of which would pass a 1½-in. ring, with sizes up to 4 in. occurring in patches. The sand, which was obtained from the excavation of the site, was very fine and of substantially two size grains, 32 per cent passing through No. 65 sieve and 95 per cent through No. 20 sieve. It was found that the surface area of the sand was 3,200 sq.ft. per 100 lb. weight. The volume of the sand varied considerably with varying moisture content and thus led to the decision of proportioning the aggregates by weight. A ½-cu.yd. batch consisted of 3 bags cement, sand weighing 5.04 bags and stone weighing 10.85 bags of cement; expressed in volume, the mix was substantially 1 : 1⅔ : 3. Considering the specified requirements and the character of the aggregate, a water ratio of 0.6 was recommended by Mr. Johnson. This mixture worked well and gave practically a full ½ cu.yd. yield.

The concreting plant consisted of two batch mixers, one electrically and one steam operated, placed on a platform midway between the two sets of tanks, on the east side of the excavated slope and about 6 ft. above the elevation of the roof. The mix was then carried in chutes to the proper elevation for distribution by means of hand carts. The stone and sand bins were located behind the mixers.

Counterbalanced weighing hoppers were provided under the sand and stone bin gates and by means of these the side loader slips were charged with definite and unvarying quantities of the aggregate. With a fixed and constant quantity of cement, sand, stone and water entering into each batch, the consistency chosen became automatically duplicated throughout all the batches from both mixers. With careful placing, this certainly found reflection in smooth castings, free from laitance or honey comb, giving each section as poured a true tightness and a true monolithic character not often found.

Furthermore, since the composition and character of the concrete was thus made dependable, forms could safely be pulled at a definite and predetermined time and earlier than customary procedures would make permissible.

Samples made in the field, when tested in the laboratory, showed a compressive strength of 2,960 lb. per



FORMS USED IN THREE RIVERS OIL RESERVOIR

square inch in 28 days. To test the oil proofing quality of the concrete, a test box, 3 ft. cube, with side walls 9 in. thick, was poured on the first day of making concrete. This box, 30 days after pouring, was filled with oil and subjected for five days to a pressure equivalent to 27 ft. head or 50 per cent more than that possible in the reservoir. After the box was broken up, it showed no appreciable trace of permeation, so that the originally contemplated coating of the inside of the tanks with sodium silicate was abandoned as unnecessary.

Special Forms Used

On account of the short time available for the construction of the reservoir it was necessary to have the wall and roof forms ready in advance and of such design that they would be easily stripped and re-erected. A drawing herewith shows typical details of the forms indicating the method of sectional division and the connections used. The wales and joists were calculated with due regard to the progress of the predetermined daily work. No failure of forms of any sort occurred throughout the whole job.

Difficulty was expected at the concreting of the sloping tank bottoms along the east wall. It was feared that the rather loose sand subsoil would be dislocated during the placing of the concrete and make a poor job. To avoid this possibility, a mat of ½-in. wire mesh was placed on the slope and plastered with cement mortar. In this way a solid bottom was created and the slope could be poured without reducing the quality of the work at these places.

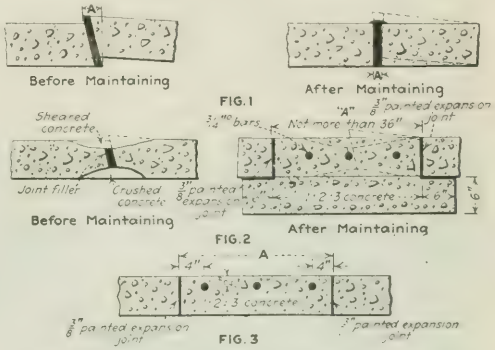
The reservoir was designed by the engineering staff of the International Paper Company, A. H. White, chief engineer, and the plans were reported upon by Parsons, Klapp, Brinckerhoff & Douglas, consulting engineers. The contract was awarded to the Parklap Construction Corporation, of New York, the construction organization of the consulting engineers. Work was executed under the direction of W. J. Douglas, president of the Parklap Construction Corporation. E. A. Little had charge in the field, F. A. Morgan assisting. The writer had charge of matters pertaining to the design and of the general supervision of the work. The contract was awarded on July 17, 1920, and tank *D* was filled on Oct. 4, 1920.

Curves of 10 Degrees Reduced to 1½ Degrees

Realignment which substituted one long curve of 1½ deg. for a series of sharp curves at the lower end of a four-mile tangent on a grade of 1.4 per cent has materially reduced maintenance expenses at this point, which is on the Southern Pacific Ry. between Chamiso and Benson, Arizona. In the original location across the San Pedro valley, curves were used freely to avoid heavy cuts and fills in a dry sandy clay which is subjected to rapid erosion by the heavy rains. In a stretch of 1.3 miles of line there were four curves of 10 deg., one of 6 deg. and one of 2½ deg. compounded to 9 deg., the total curvature amounting to 388 deg. 22 min. There were also three pile trestles with a total length of 32 ft. In the new location the total curvature is only 139 deg. 47 min. About 123,000 cu.yd. of grading were required for the relocation, two concrete arch culverts and some concrete pipe culverts.

Replacing Concrete Slabs at Joints

IMPERFECT, heaved, sheared or crushed slabs at joints in concrete pavement are successfully repaired in Pennsylvania by the methods indicated by the three accompanying sketches. (1) Heaving or riding of the slab due to improper placing of the bituminous joint filler is repaired, when *A* does not exceed 2 in., by cutting out the joint with a cold chisel and refilling the opening with joint filler and coarse sand or ⅝-in. stone. (2) Concrete crushed or sheared because of the use of short or narrow bituminous strips of joint filler, is



METHODS OF REPLACING CONCRETE PAVEMENT

repaired by cutting out the damaged part not exceeding 3 ft., constructing a sub-base slab and refilling the cut-out portion with concrete reinforced. (3) When the crushed or sheared section involves the replacement of more than 18 in. of each adjacent slab or wherever the pavement slab is cracked within 5 or 6 ft. of a high, heaved or imperfect joint, the section between cracks is removed, the slabs chiselled carefully and the section entirely replaced with new concrete. The standard slab is used in the replacement and is reinforced with round rods spaced on 12-in. centers.

Panama Canal Traffic Highest in 1920

TRAFFIC through the Panama Canal during 1920 reached a new high record. The commercial ships numbered 2,814, as compared with 2,478 during the fiscal year ending June 30, 1920, and 2,134 during the calendar year 1919. The gain was 13.56 per cent in ships over the fiscal year 1920 and 31.87 per cent over the calendar year 1919. The net tonnage of the commercial vessels in the calendar year 1920 aggregated 10,378,265 tons as compared with 8,546,044 net tons in the fiscal year 1920 and 6,919,149 net tons in the calendar year 1919. The gain was 21.44 per cent, over the fiscal year; and 50 per cent over the calendar year 1919. The tolls levied during the year aggregated $10,295,329.96, as compared with $8,513,933.15 in the fiscal year ended June 30, 1920, and $6,992,218.39 in the calendar year 1919. This was a gain of 20.92 per cent over the fiscal year 1920 and 47.24 per cent over the calendar year 1919. The cargo carried by commercial vessels aggregated 11,236,119 long tons. The cargo in the fiscal year 1920 was 9,374,499 tons, and in the calendar year 1919 it was 7,468,167 tons. The gain was 19.86 per cent over the fiscal year 1920, and 50.47 per cent over the calendar year 1919.

Pier of Dayton Arch Bridge Split and Listed

INVESTIGATIONS of the failure of the Third St. concrete arch bridge over the Miami River in Dayton, Ohio, have not yet brought to light the cause of the failure. As reported in our news pages of Jan. 27, p. 187, the failure of the bridge occurred abruptly, two automobiles and a pedestrian being thrown into the river. The vehicles may be seen in the view Fig. 2 herewith, which shows the condition of the up-stream or north end of the pier supporting the two spans involved in the failure, as is more generally shown in Fig. 1.

FIG. 1. WRECKED ARCHES OF THIRD ST. BRIDGE OVER MIAMI RIVER, DAYTON, OHIO

The suddenness of the arch failure indicates that the failure of the pier below preceded, and subjected the arches above to excessive stress. The piers of this bridge are founded on gravel about 9 ft. below original river bottom, according to William Mueser of the Concrete Steel Engineering Co., who designed the bridge and followed its construction closely. During the sixteen years of service of the bridge (it was built in 1904-1905) no weakness or trouble has developed, and the structure went through the catastrophal flood of 1913 without apparent injury, although its arches were flowing full and under head.

Channel improvement carried on by the Miami Conservancy District during the past two years has involved some widening and deepening of the river. However, Charles H. Paul, assistant chief engineer, advises us that no excavation has been made within 45 ft. of the pier in question, and no excavation under the bridge within the limits of the two spans which failed. Soundings show depths ranging from below 712 to 714 in the channel, one span west, pier bottom being 713.13.

The pier between the two arches that failed is split vertically a little upstream of the longitudinal center line of the bridge, and the upstream portion has moved about a foot up-stream and has listed to the north and west. The arches, of the Melan type, show a separation tending to follow longitudinal vertical planes, possibly construction joints. A large part of the face of one arch is formed by one of the reinforcing frames embedded in the concrete. The indications from the position of the pier and the wreckage is that the easterly arch failed in tension and dropped, while the westerly arch was crushed, when the pier broke in two and listed to the west. There is nothing to indicate how long a dangerous condition existed.

Harrington, Howard and Ash of Kansas City are conducting an investigation of the bridge for the city.

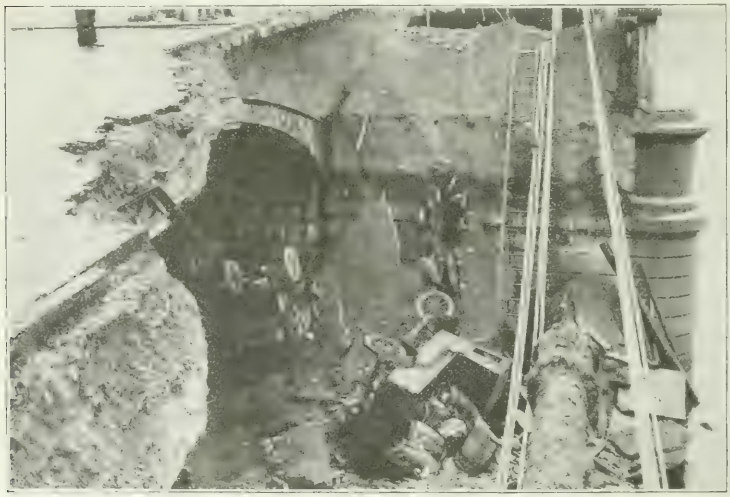


FIG. 2. UPSTREAM HALF OF PIER BROKEN AWAY
Note [illegible] of arch concrete on line of reinforcing frame

Inadequate Organization Policy Causes Hirst's Resignation

State Highway Engineer of Wisconsin Unwilling to Shoulder Heavy Responsibility with Underpaid Staff

AS ANNOUNCED *in the news section of this issue, A. R. Hirst, state highway engineer of Wisconsin, has tendered his resignation to take effect not later than Dec. 31 of this year and has issued to the people of Wisconsin a statement setting forth the reason for his action. It is, in brief, that he is not willing longer to assume the heavy responsibility of state highway engineer with the inadequate organization allowed under the narrow policy characteristic of public service in this country.*

Mr. Hirst's statement, in full, follows:

"THE filing of my resignation as state highway engineer, effective not later than Dec. 31 of this year, or earlier, at the pleasure of the State Highway Commission, has occasioned considerable comment and some speculation as to my reasons for taking the step, especially in view of the fact that the present salary attached to the position, $7,500 per annum, is one of the largest paid in the state service. It is only fair to those people of the state who have so loyally and freely supported our efforts for the betterment of highways in Wisconsin that I should at this time give some of the reasons for taking the step which has been announced.

"I wish to state at the outset that there is and has been nothing in my relations with the State Highway Commission, with any past or present state official, or with the present legislature, to impel me to resign. My personal and business relations with all of these persons and bodies have been of the pleasantest, and, I have every reason to believe, would so continue as long as I felt able to remain in the state service.

"It is nearly fourteen years since I entered the highway service of Wisconsin. In that time, under the impetus of the state-aid (1911) and federal-aid (1917) highway laws, the highway program in Wisconsin has reached tremendous proportions. There have been built 8,500 miles of all types of highway and 1,700 bridges at a total cost of $40,000,000. For the planning and execution of this work, I, as the chief engineer and executive officer of the State Highway Commission, have been personally responsible.

"For 1921 there is available a total of over $20,000,000. (Please note this total in comparison with the above total for 1912 to 1920 inclusive), for federal, state and county-aid construction of roads and bridges in Wisconsin, exclusive of the amounts available for strictly town, village and city construction. This sum will not and should not all be spent, because we are not organized to spend it properly, but probably well over 2,000 miles of all types of highway will be built. The years that have gone since 1907 have seen Wisconsin placed in the foremost rank as a state which is building roads as fast as sound business judgment warrants, and as a state which, in the meanwhile, has maintained a highway system of which most of her citizens are proud.

"I give these matters of record, not in a spirit of boastfulness, but simply in order that something of the magnitude of this great enterprise may be realized. In these accomplishments, through nearly fourteen years of service I have played my part. I am proud to have been connected with the state and with its highway work. The fact that no shadow of suspicion of crookedness or graft has ever fallen on any part of this great expenditure will always be one of my proudest memories.

State Salaries Inadequate

"I have been content to serve because I loved the work and it was my one ambition to help to give Wisconsin a system of highways worthy, if possible, of the state and of its citizenry. It has not been profitable work, in terms of money, it has been hard work and, at times, extremely trying. Nevertheless, I should gladly have continued for the rest of my active life had I felt reasonable assurance that public sentiment would support the legislature, the highway commission and the county boards in the payment of salaries adequate to maintain organizations of the proper capacity to handle with efficiency the tremendous expenditures ahead.

"Salary has been considered the only unimportant part of public office. Given any salary, any place could be filled. There would be hundreds of applicants for the position of state highway engineer if the salary were $2,500 instead of $7,500 per annum. As long as the public is willing to accept any kind of service, it can fill all of its places at any given salary. As examples of public opinion of the value of public service, Wisconsin pays its Governor $5,000 a year, its secretary of state, its treasurer, and its attorney general the same amount. She pays the members of her legislature $500 for two years' service, not enough to pay their board in Madison and their railroad fares to and from Madison, while they spend at least six months in the state's service away from their businesses, homes, and families. All of these places and many hundreds of other elective positions in state, county and all other units of government, are and will always be filled and generally well filled, because the honor, prestige and experience are worth a personal sacrifice for a limited period. However, few of these offices are the life work of the incumbent. They are either stepping stones to other things, or are the contribution to the public welfare of men who have made their stake and can afford the sacrifice. The expediency of this public policy for even this type of public service is a grave question.

"Certainly, a business undertaking of the first magnitude, such as is Wisconsin's program of highway construction, cannot be picked up and laid down by any citizen, or group of citizens, at will. It is worthy of, and must have, the service of a high class, continuing organization of the best business brains and the best engineering and administrative talent that the market affords, if the state and the counties are to expend to advantage the millions which are available and which will continue to be available for all the years to come. Hundreds of dollars can be saved or wasted at every step and millions can be made or lost by a mistaken state-wide construction or administrative policy.

"A proper organization to control this kind of construction enterprise cannot be political, it cannot suffer too great annual changes in personnel. It must be an organization able to meet on an even footing of brains, training and experience, the best organizations that the manufacturers of road machinery and materials can buy. It must be able to stand knee to knee with the best and worst contractors and get for its clients, the people of Wisconsin, good construction at a fair price. The

public must equip itself with eminently fitted representatives in this struggle, or the losses in poor roads and unjustified prices will be appalling.

"I had hoped to build up such an organization for Wisconsin. Until the public mind grasps the situation and supports a proper scale of salaries in the public service I am convinced that I cannot succeed. As fast as we train men, the best are picked for service in the commercial field. In 1920 the commission lost 27 per cent of its principal employees, and indications are that the losses in 1921 will be even greater. This will continue to be the case until the public realizes that it must protect itself by paying more nearly the market price for highway training, business experience, brains and energy.

Situation is Serious

"The situation facing the state highway organizations is serious, but the situation in the county highway organizations is infinitely worse. The salary paid the county highway commissioner in most of the counties does not attract, or if it does attract, cannot long hold in the service the type of men who should and must fill these important executive positions. In a large fraction of the counties the clerical organizations charged with the accounting for expenditures often reaching into the hundreds of thousands of dollars is not as adequate as would be required to operate properly a not too busy corner grocery store. Despite all that the commission has preached and sought to teach, the last few years have seen but little improvement in the average standard of the county organizations, while the expenditures have mounted apace.

"There is little that I can sense in the present public attitude toward public service to make it possible to hope for any great improvement in the situation. Petty savings to be made by reducing the compensation of already and always underpaid public servants are dragged forth constantly in all units of government as the panacea for all tax evils. Waste at the bunghole is lost sight of, while a pin prick through the head of the barrel is magnified into a geyser. The people cry for efficiency in public expenditures and then strangle it, still-born, by ill conceived and shortsighted financing of the supervision of those expenditures. It seems impossible to make the people, as a whole, realize that if the entire expense of all national, state, county and local legislative, executive, and clerical staffs were eliminated from their tax bills, they would sense no appreciable difference in their individual taxes. So much attention has been centered on the mole hill of public service expenditures that little regard has been paid to the mountain of public waste resulting from inadequate and ill-paid staffs of public servants.

"The consequences of this general public attitude is not so serious when only routine clerical public business is concerned, but when the states come into contact with an open competitive market for skilled service in a great construction enterprise, where the public buys hundreds of millions of dollars worth of machinery, materials, roads, and bridges from corporations, firms, and individuals who equip themselves with the best brains and experience that the market affords, the only possible ultimate result is disaster to the public and to the public purse.

"As I look into the probable future, I am unwilling to continue to take the responsibility for the proper expenditure of the tremendous funds now available longer than is necessary for the State Highway Commission and the state chief engineer to select my successor. I shall relinquish the work with the most profound regret. One does not easily surrender an almost lifetime ambition unfulfilled.

Public Awakening the Only Cure

"However, until there is a general public awakening, it must be obvious that the financial measurement by the public of the value of my services must vary so greatly from the value of these services to myself and family in the commercial field, that no other course is open for me. If, by continuing my connection with the work, I could prevent the coming disaster, it would be my duty to stay. But I, or no other one man, can stem the tide. The public must sense the danger and urge its representatives to act, if any worth while action is to be secured.

"If the whole public service cannot be properly organized, at least the public's highway organization must be put on a business basis. I cannot afford to be longer connected with it unless it is so put. Lacking that basis, both the elements of personal progress and the element of protecting my reputation as a highway engineer must impel the relinquishment of a position both unprofitable and fraught with danger to my future career.

"It may naturally be said, 'Is this not a cry of wolf, wolf? Wisconsin has done pretty well and is recognized as one of the leading states in highway construction and maintenance. There is no reason why it should not continue to do so. Hirst is an alarmist.'

"It is true that Wisconsin has done pretty well. The results have been probably 75 per cent of what they could have been made with adequate public support. Wisconsin and her counties have been lucky and have gotten better service than they paid for. But we are entering a new era. The expenditures of past years are as nothing compared to those proposed for the years to come. The competition for brains and experience of superior value in planning and building highways and for talent in all the fields allied to highway construction is keen and intense. Unless Wisconsin acts, unless her counties act, the price for self-satisfaction will be exacted. This is not a cry of 'wolf, wolf'—it is the expression of a mathematical certainty."

Kansas Governor for State-Made Cement

Governor Allen, of Kansas, in his 1921 message to the Legislature, advocates the state construction of cement mills and brick-making plants in the following words:

I believe the state could render valuable aid to road building by going into the manufacture of cement and brick to be used on state roads. For some years we have been making building brick at the penitentiary plant, and many thousands of dollars have been saved annually in the construction of state buildings by this product. Recently a scientific test was made of some shale at the penitentiary, and the assurance is obtained that we could make there a paving brick which would pass as high a test as any paving brick now on the market. It would not cost much to add to our brick plant, already established, sufficient machinery for making pavers. The presence of this product would be useful in the state's road building; it might also affect the unreasonable price now charged for brick. In addition to this the state could doubtless save much money by operating a cement plant for its own roads. If the first $1,000,000 collected from the vehicle licenses were used to start a cement plant the state could then contribute its aid to counties which were building cement roads in the form of cement at cost. In a year, with an $8,000,000 program, the saving on the cost of cement would go far toward paying for the plant. It would cost the taxpayer nothing and it would in the course of a few years save millions. The objection that this would place the state in competition with private business is not tenable because the state product would be utilized for public business only. Incidentally the indirect effect might help th general public in securing relief from one of the most harmful monopolies of the day—the cement trust.

Use of Rammed Earth as "Masonry" in Building Construction

By Thomas Crane Young
Eames and Young, Architects, St. Louis

BECAUSE of the interest exhibited in the possibility of using earth as a building material, the writer made several experiments which throw light on the utility of rammed earth for small buildings. At first thought it seems highly improbable that earth could be compacted by hand sufficiently to stand in a wall. However, some briquets made with dry earth were seasoned and tested in a manner customarily followed in testing cement. The briquet specimen developed a tensile strength of from 80 lb. to 125 lb. per square inch after six days of seasoning in the form. A test for compression developed a strength of 125 lb. per square inch. Later on a small cube of earth used in the building herewith illustrated failed under compression at 475 lb. per square inch after forty-two hours of seasoning. These two tests are of little scientific value, but may serve to indicate the desirability of a more thorough investigation by qualified experts of the physical properties of compressed earth.

FIG. 1. ISOMETRIC VIEW OF FORMS FOR 18-IN. WALL

The building herewith illustrated was built for the David Rankin, Jr., School of Mechanical Trades, St. Louis, for the storage of oil and gasoline. While the building was to be only 10 x 13 ft. in plan, it had to be roofed and provided with a door and a window, and so it possessed most of the elements of a larger house.

The experiments have convinced the writer that earth may be used successfully for the walls of small dwellings, for farm buildings, for fences and garden walls, for similar purposes. It is also possible that it may be used for army cantonments. The application of this or any new system of construction to actual use will doubtless entail considerable preliminary study of building processes and may require some slight modification of the usual forms of architectural detail.

FIG. 2. RAMMED EARTH BUILDING, UNFINISHED

In the case of the building illustrated herewith a foundation of concrete extending about 8 in. above the surface of the ground was used. It is probable that an earth foundation would answer as well if thoroughly waterproofed. The earth used in the building was obtained in grading and from foundation trenches. Best results were obtained from a mixture of yellow clay and top soil in an approximate proportion of one part clay and two parts loam.

The earth should be free from roots, twigs or vegetable substances and should contain no lumps of clay or gravel larger than that which will pass through a 1¼-in. screen. In the gables, earth passing a ¼-in. mesh was used, the result being a smoother wall. When placed in the form the earth should be only slightly damp, and until used it should be protected from rain. It should be placed in the forms in layers not exceeding 4 in., pressed down, then rammed with a wooden device until solid. The end of each section of wall should be tamped to a slope which will form the joint with the next one added horizontally. Great force is not needed in tamping. A quick sharp stroke is the most effective. Wood blocks may be placed in the forms and tamped into the earth to serve as bases for the attachment of frames, wainscoting, etc. If the top of one course is dry when a second course is laid, it should be slightly sprinkled with water to insure adhesion.

As indicated in the accompanying detail sketch, the lower ties are first placed at proper distances on the wall, then the side pieces are lifted on and the top yoke

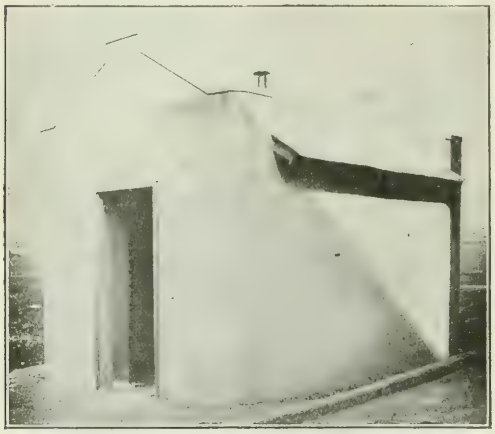


FIG. 3. EARTH BUILDING AFTER APPLICATION OF PLASTER

pressed into place. The steel plates on the yoke are slotted and halved with the iron lugs screwed to the side pieces so they hold the top of the form rigidly in place. A block, screwed to the top of the tie, holds the lower part of the boxing on one side and a similar block on the other end of the tie is hinged in order to prevent obstruction on extracting the tie from the wall. For the same purpose the tie is tapered and made in two parts, wedged apart at one end. On removing the wedge the parts come together sufficiently to permit easier passage of the tie through the hole. No doubt this device may be improved. Taking out the ties is the only difficult part of the whole process. When the wall is completed the holes may easily be filled with dry earth tamped in with a hammer or mallet, a little water being first sprinkled around the edge of the hole. Small defects arising from accidents may be repaired in the same way.

No doubt with a suitable apparatus and more experienced labor, much greater speed in building may be accomplished than we secured. It took two laborers eleven working days to lay 460 cu.ft. of earth, or the equivalent of 10,000 bricks, and by applying the local price of each type of labor one may form his own conclusion as to the comparative cost. It is almost useless at this time to attempt accurate estimates, but it seems probable that earth walls, plastered, can be built at from 35 to 50 per cent of the price of common-brick walls laid without plaster.

In this little building the author has experimented with various forms of water-proofing — with coal tar products applied directly to the exterior surface of the earth, with paint and with waterproofing material in the finishing coat of plaster. Time will determine the necessity of using any of the materials or their relative usefulness.

Alcohol from Wood Waste

Under present conditions an alcohol plant with a daily supply of 180 tons of wood waste can produce 3,600 gal. of alcohol at approximately a cost of 25c. per gallon, according to the Forest Products Laboratory. Soft-wood waste can be made to yield from 20 to 25 gal. per ton and hardwood waste only one-half as much.

California Highway Commission Defends Its Policy

Biennial Report Discusses Thickness of Concrete Slabs Criticized by Automobile Associations' Report

PORTIONS of the second biennial report of the California Highway Commission, which has just been made public, deal with questions of policy about which a controversy has been raised by the report of the board of engineers which investigated the subject for two of the local automobile associations, as summarized in *Engineering News-Record*, Feb. 3, p. 207. One of the points at issue—the thickness and width of the concrete road slab constructed—is covered by the Highway Commission report as follows:

The third outstanding feature of early road construction was the adoption of what may be termed the unit plan in road building. This plan enables a highway to be constructed which can be thickened and widened to meet larger traffic demands without the loss of the original investment. The 4-in., 15-ft. highway was sufficient for the travel for which it was built, and has taken care of an increase in traffic unthought of ten years ago. Even under the more intensive travel of today, this road is still meeting traffic needs over at least 90 per cent of the highway system. Under the stimulus of good roads, however, traffic near the large centers of population has now developed to the point that one of the pressing problems before California is that of thickening and widening these sections.

Under the unit plan of road construction, this can be accomplished without the loss of the original investment or the destruction of the original highway. The old road is included in and made an integral part of the wider and thicker highway.

This policy has resulted in giving to California a mileage in improved highways that could never have been built had roads been originally constructed to meet traffic demands of the far future, were it humanly possible to estimate either the extent or the character of such traffic. The added mileage thus secured has given to communities and counties all over California a good roads service, the value of which it is safe to say runs into millions of dollars.

Not only has this added mileage justified the commission's construction policy, but it is further justified by the fact that the alternative policy of building completed roads would have cost the state millions of dollars without due return. Huge sums would have been tied up for years in an investment, which in large part would lie idle. The interest charge upon such idle investment would in itself amount to a huge sum.

Added to all this, is the undoubted fact that the good roads mileage built by the state has been the largest single factor in stimulating counties into campaigns for the improvement of local roads.

In accordance with the early determined policy of the Highway Commission, i.e., to make construction take care of present traffic and to reasonably anticipate future traffic growth, the Highway Commission has increased its minimum specifications from four inches of unreinforced concrete to five inches of reinforced concrete. Practically all construction under the $40,000,000 bond issue has been in accordance with these new specifications.

In this connection, it should be noted that the steel used in reinforcement and the extra inch of concrete have made a very material increase in the cost of constructing roads. We believe, however, that there can be no question of the wisdom of this expenditure.

The desirability of including in the specifications provision for a road of a minimum width from 18 to 20 ft. has been given very serious consideration by the commission. It is the opinion of the commission that to adopt a uniformly wider pavement than the 15 ft. slab would reduce mileage to an extent not warranted by the service that the

increased road width would give. It is the further belief of the commission that the better plan for new construction is to build the wider pavement where the need for a wider road either now exists or will soon exist.

The plan that has been followed by the commission in widening and thickening the pavement has been twofold in character. In some places a second concrete slab has been placed over the original slab. In other places concrete shoulders have been built 1½ in. higher than the original slab and the trough filled with asphaltic surfacing.

At the present time the commission is building a 5-in. oiled macadam road using the original concrete slab as a foundation on certain sections in the rice growing district, where, owing to inundation of the road bed from adjacent rice fields, disintegration occasioned by alkali salts carried in solution in this water and the excessive loads hauled on the roads, the concrete slab has been broken into fragments.

The commission urges more stringent regulations for the protection of the highway system and that legislation be enacted to require rice growers to keep drainage water from their fields off the highway right of way. In certain sections the highway has been converted into a veritable marsh by such water. No type of hard surface road, it is claimed, can be maintained under such conditions. This practice has cost the state hundreds of thousands of dollars. The present law which provides for recovery after the damage has been done has proved inadequate to deal with the abuse. It is time, the commission believes, that action is taken to stop the flooding of state highways, and their consequent destruction.

Overloading of trucks and reckless speeding by drivers of loaded trucks is also endangering the state highways, according to the report. The remedy is more adequate policing of state highways, and legislation to secure this is necessary. Experience in the enforcement of traffic laws convinces the commission that best results can be obtained by the enforcement of traffic laws on state highways by a state police, the members of which are independent of local control and local influence.

San Francisco Garbage Rates Revision

A sub-committee of the San Francisco Board of Health is conducting hearings on rates for garbage collection in that city. Until recently the arrangement of rates and routes has been in the hands of the scavengers themselves under the so-called license system which calls for only nominal supervision by the Board of Health. The rates in effect vary from 50 cents per month for small households to $30 per month for some apartments. An endeavor is being made to establish a fair basis for classifying these rates. The collection routes at first crossed and re-crossed. Later the scavengers formed combinations, pooling their trade and organizing routes for systematic collection. This reduced the number of wagons to about 25 per cent of the original requirement. Except for certain hotels that sell their swill to hog raisers at $3 to $5 per ton, no segregation is attempted in San Francisco. About 380 to 400 tons of garbage is now collected and delivered daily to the old refuse destructor of the Thackeray type. (This destructor was described in *Engineering News*, May 17, 1900, p. 318; it was built under a private franchise, operated privately for some years, and bought by the city in 1909). The garbage is weighed on delivery at the destructor and the scavengers pay $1 per ton for its destruction. This charge is designed to cover maintenance and operating costs at the destructor, which is now owned by the city.

Reconstruction Needed on New York State Highways

Annual Report for 1920 of Commissioner Greene Reviews Year's Work and Urges Definite Highway System

WITHIN the next three years 1,204 miles of New York State highways will need reconstruction or resurfacing. This is the "note of warning" sounded in the annual report for 1920 of Frederick Stuart Greene, state commissioner of highways, which has just been made public. The report points out that the New York State highway system has reached a point where reconstruction is more important than is new construction. It reviews the work of the year and makes a plea for the establishment of a definite and fixed highway system which cannot be altered continually in the interests of political expediency. A summary of the report follows:

At the height of the season of 1920 there were under operation at one time 184 contracts for the construction and reconstruction of 803 miles of highways. Due to the high prices of materials and the difficulty of securing competition among contract bidders, the commission, on April 24, discontinued lettings. Results have proved, Commissioner Greene states, that this action was for the best interests of the state, economically, and saved it from having a number of abandoned and unfinished contracts.

During 1920 contracts for construction, reconstruction and improvement were awarded as follows:

New Construction and Completion Contracts	
1 project (Rondout Creek Bridge)	$657,241 60
43 projects for 170 88 miles	5,419,078 00
Reconstruction	
41 projects for 99 45 miles	2,950,547 86
Surface Treatment	
5 projects for 133.95 miles	110,190.30
Total, 90 projects, 404.28 miles	$9,137,057 30

The necessity for reconstruction is greater now than it was twelve months ago, according to the report, for many lightly built highways which still have some value in their pavements will lose that value unless they are promptly reconstructed. Many miles of road are said to have reached the elastic limit and are in a condition where further patching is not only uneconomical but a waste of money. In reports received from the commission's nine division engineers the following mileage of highways for reconstruction or resurfacing within the next three years is certified: Cement-concrete restruction (542.82 miles; bituminous macadam reconstruction, 527.54 miles; bituminous macadam resurfacing, 133.30 miles; total, 1,203.66 miles. If, owing to lack of contractors, it is found impracticable to carry on both construction and reconstruction, the building of new highways, the report emphasizes, should be deferred until the state can complete the necessary reconstruction.

Mileage Policy Bad

New York State, it is claimed, is suffering today from the mistaken policy pursued in former years of trying to secure the greatest possible mileage for the least possible money. All other states now carrying on extensive highway improvement, profiting by the experience of New York State, are building 90 per cent of their improved road mileage of the most durable types

In these days of the motor truck and heavy roads Commissioner Greene is of the opinion that "it is indisputably the sounder business policy to build roads for a longer yearage rather than for a longer mileage."

The Federal appropriation of $3,237,630 was met by the legislature for 1920 construction. In order to secure the Federal aid apportionment due in 1921, amounting to $4,727,117, it is requested that the state appropriate $5,250,000 to match the Federal appropriation and to cover the costs of making preliminary surveys and plans. At present plans for new Federal-aid projects which have been submitted to and approved by the government cover a total of 200.45 miles, of which 115.64 miles are to be built on designated state routes and 84.81 miles on routes not so designated. The commission is in sympathy with the policy of utilizing prison labor to perform the preliminary work on roads where heavy grading is necessary. Prison labor has been found to be more efficient on this type of work than on building a finished road.

Gang System Favored

The report comes out emphatically in favor of the "gang" system as against the patrol system for road maintenance. In one division, during 1920, no patrolmen were employed, all work being done by gangs. For patching, painting of guard rails and similar light work, small gangs of from two to four men were employed, while for the heavy reconstruction work gangs running as high as twenty men were used. The division engineer reports as follows:

"The gang system in this division has demonstrated that there is no comparison with the patrol system in any phase or feature of the work. The gang system, which is more mobile, always concentrates its efforts on the sections of highways which need repairs; this is not true of patrolmen, for the reason that they were appointed to local beats."

The report requests a change in the highway law which would permit the purchase by the state of materials used in highway construction. Substantial savings could thus be effected, it is claimed.

Definite System Needed

The report deplores the fact that the state has no definite and fixed highway system. Three classes of improved roads—state routes, state-and-county highways, and Federal-aid roads—are being built wholly or in part from state funds. The only fixed locations are for those highways built as state routes; state and county highways are subject to change by boards of supervisors and Federal-aid roads by the New York State Highway Commission. On this general subject the report comments as follows:

"This is manifestly a bad policy, and in the interest of the taxpayers it is essential that the location of the roads of our highway system should be definitely determined by law, so that they may be built where they will serve the greatest number and not be subject to changes in the interests of any one person or group of persons. A striking evil of permitting modifications and changes in road location is the temptation to use such changes to have surveys made on roads when there is no real intention of construction.

"A study of the map of the highways already completed by the state shows that there are isolated, disconnected stretches in practically every county in the state; also that at many points roads have been built closely paralleling others, while in other parts of the same county large areas exist where no highway improvement has been undertaken. These conditions indisputably show that many roads have been constructed in the past, not with the view of serving the majority, but to accommodate favored persons or communities.

"To put a stop to these evils and to prevent opportunity for using the construction of highways for selfish purposes, this commission has had prepared a map showing a connected and completed system for the state."

The map shows a total of approximately 12,880 miles of approved routes.

The report concludes with a recommendation that the state law be so drawn that the Highway Commission would not have power to survey, advertise or award a contract for any road which did not connect with some portion of the already completed highway system, or a state highway being constructed, except where the proposed new highway would connect with a street within the limits of an incorporated village or city.

Steady Progress on Hetch Hetchy Mountain Division

CONSTRUCTION is progressing all along the mountain division of the Hetch Hetchy project, says M. M. O'Shaughnessy, city engineer of San Francisco, who made the following report after a recent inspection tour of the work:

At the site of the main dam the excavation for foundation has been carried 20 ft. below river bottom. Very little water has been encountered. A force of 175 men is working in three 8-hour shifts on this part of the project. Two steam shovels are excavating in the unwatered area, delivering to dump cars which haul the spoil to a dump downstream. The Utah Construction Co., contractor on the dam, has installed about $1,000,000 worth of equipment at the site and is preparing to pour concrete at the rate of 1500 cu.yd. per day as soon as the foundations are ready.

On the 18-mile tunnel about four miles have been excavated and the six headings are now being advanced daily at the following rates: Priest, 14 ft.; Big Creek east, 7 ft., Big Creek west, 7 ft.; South Fork east, 9 ft.; South Fork west, 12 ft.; Early Intake, 10 ft. Within two months four new headings will be opened and the work is then expected to progress at the rate of 3,000 ft. per month.

Plans for the earth fill dam at Priest, to contain about 825,000 cu.yd., have been completed and a call for bids is to be advertised within a few months. This structure is estimated to cost approximately $1,000,000. Plans for Moccasin Creek power house, the first installation in which is to be for 66,000 hp., are well under way and contracts are to be let in ample time to have the plant ready for service as soon as water could be delivered to it.

The city's sawmill will be kept in operation this year throughout the winter season. This is the first time in the history of the project that the extent of work under way has made this necessary.

Few Water Supplies in Czecho-Slovakia

Municipal water supplies exist in only 16 per cent of the cities of over 4,000 population in Czecho-Slovakia and the Carpathian district of Russia, according to a report by Colonel F. F. Longley, chief of the department of sanitation of the League of Red Cross Societies, as published in the *Bulletin* of the League for October, 1920. The water systems of the large cities are said to be in general well built and designed to assure a safe supply. In most of the towns, villages and rural districts, says Colonel Longley, one sees very commonly the dug well with its long sweep. The water level is usually not far below the surface of the ground, from 10 or 12 ft. to 30 ft.

Belt Line Plan Recommended for Port of New York

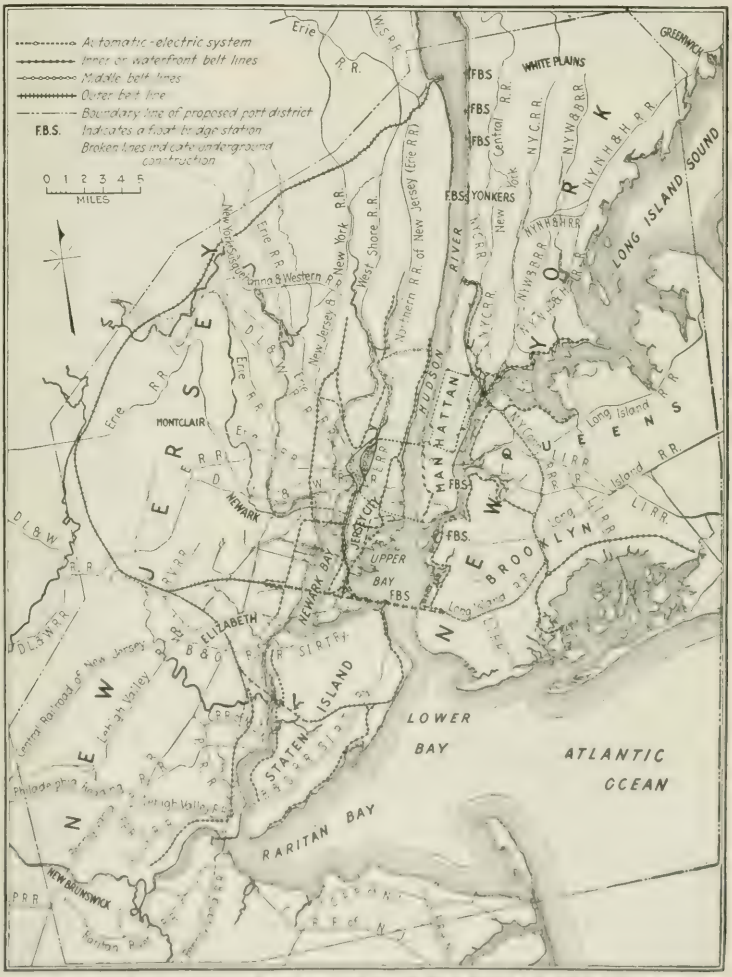
THE SYSTEM of belt lines, spurs and marginal railroads to bring direct rail connection to the greater part of the water front of New York Harbor, except Manhattan Island, as recommended in the report of the New York-New Jersey Port and Harbor Development Commission is shown in the accompanying map. The summary of the commission's report, made public Jan. 24, 1921, was reported in *Engineering News-Record*, Jan. 27, 1921, p. 182, and included the recommendation for building an underground "automatic-electric" freight subway loop system for Manhattan distribution and collection.

The recommended surface belt-line system includes joint marginal surface belt lines and spurs to serve navigable water fronts of the port for the development of steamship terminals and industrial enterprises. The outer belt line extends from Piermont above the Palisades to Bayonne, Staten Island and Perth Amboy, passing west of Paterson and the Orange Mountains. Connection between the New York and New Jersey systems is proposed first by car ferry across, and ultimately by tunnel under the Upper Bay. Brooklyn and the East River section of Queens would be served by the Long Island-New York Connecting R.R. from Bay Ridge to Hell Gate, and by marginal lines, not necessarily continuous, but reached by float bridges or by spurs from the Bay Ridge-Hell Gate line, from which spurs are to be run to Jamaica Bay and Flushing Bay. Marginal lines would skirt the Harlem and East Rivers in the Bronx from Spuyten Duyvil to Throggs Neck and other lines are virtually to encircle Staten Island. Yonkers and the communities north are to be served by joint car-float stations reached from Piermont. Existing belt lines would be improved to serve the Hudson River and Upper Bay water fronts in New Jersey. New lines along both sides of Newark Bay and the Hackensack River, the west bank of the Arthur Kill and the north bank of the Raritan River are to serve Newark, Jersey City, Bayonne, Elizabeth, Perth Amboy and other communities.

The commission states that the Long Island belt-line railroad system would form a part of a more comprehensive belt system for the entire port, and for New Jersey recommends that there be three classes of belt lines, designated as inner, middle, and outer lines. The commission's "Summary of Joint Report" contains the following explanation of the belt-line plan:

The primary purpose of the inner or waterfront belt lines is to serve steamship terminals and industries along their routes.

Nuclei for two such belt lines already exist—one the fragmentary Brooklyn marginal railroad referred to on the preceding page, the other the National Docks Railway, the New Jersey Junction Railroad and the Erie Terminals Railroad, which collectively extend along the east base of Bergen Ridge and the Palisades from Bayonne to Edgewater. Both will require improvement as to alignment and trackage.



JOINT COMMISSION'S BELT-LINE PLAN FOR PORT OF NEW YORK

A number of other marginal railroads are indicated on the comprehensive plan along other navigable waters in both states. The proper sequence of construction should be determined by the permanent Port Authority in collaboration with the communities affected. The lines need not be continuous, but each must have easy access to the other parts of the belt line system.

There should be one middle belt line on each side of the

Hudson. The Long Island-New York Connecting Railroad and the line recommended along the Harlem River from Spuyten Duyvil to the East River will constitute the middle belt line for New York. That for New Jersey will have to be built, and should extend along the east side of the Hackensack Meadows as shown on the comprehensive plan, connecting with all of the railroads.

The primary purpose of the middle belt lines is to afford a means for the direct interchange of cars between railroads and a thoroughfare for all of the railroads of the port to and from the joint car-float and joint lighterage stations recommended by the Commission. Because these cars almost invariably require classification at the break-up yards, the proposed belt line in New Jersey is located wherever possible just east of those yards.

Outer Belt Line

The third class belt line, the outer belt, is at first required for New Jersey only. It should encircle the entire western half of the Port, from tidewater on New York Bay to tidewater well up the Hudson River, passing outside of the break-up yards. Its chief immediate purpose is to serve as a bypass around the congestion nearer the waterfront for all freight that need not pass through the break-up yards, and as an auxiliary to the middle belt line, the capacity of which bids fair to be taxed by the increased traffic of the next decade. The traffic that can be diverted may include trainload shipments to and from steamships, interchange between the New York Barge Canal and the New Jersey railroads, railroad interchange originating at or destined for points beyond the break-up yards, such as Paterson, and traffic between the New Jersey railroads and Yonkers and the communities to the north of that city, which can be reached from Piermont by a car-float service.

This is by far the most extensive of the belt-line projects recommended, and the one requiring the most extensive study. A tentative location has been established through a survey made for the Commission by the forces of the State Engineer and Surveyor of the State of New York.

The line as located will begin at Piermont, N. Y., on the Hudson River, pass southwesterly to the west of Paterson, N. J., and the Orange Mountains, come through the Orange range near Summit and continue in a generally easterly direction to termini on deep water, reached by short branches. It is proposed to establish one such terminus on Newark Bay, one in Bayonne along the Upper Bay, one on the east shore of Staten Island and one on the Raritan River.

Steamship Terminals

Steamship terminals will naturally be built at each of the southern termini, and a Barge Canal terminal at Piermont. A large classification yard will be required on this outer belt line, probably in the vicinity of Newark Bay, and the middle and inner belt systems should be connected with the outer belt near that yard.

In a relatively short time the railroads will need to add to their break-up yard facilities, and the additions will presumably be built at the junctions of their lines with the outer belt. These additions will enable the outer belt to serve more and more as a relief to the middle belt.

All of the new belt lines will open up new territory for industrial development, and should in time handle a large amount of local industrial traffic.

The engineering staff of the commission consists of: B. F. Cresson, Jr., chief engineer; W. W. Drinker, terminal engineer; J. E. Ramsey, chief statistician; C. W. Stark, engineering editor.

Safety Lessons for Automobile Drivers

A set of twelve safety bulletins and safety lessons for automobile drivers is being distributed by the National Safety Council, 168 North Michigan Ave., Chicago. The charge for the sets of lessons is 15c. for single sets and 9c. per set in large quantities.

Letters to the Editor

It is the editors' desire to publish here all worthwhile letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

The Hydraulic Jump Again

Sir—In your issue of Jan. 20, 1921, p. 135, there is a letter on "The Hydraulic Jump," by Jeptha A. Wade. Why Mr. Wade should question the statement that "the first derivative of the area with respect to the depth is the width at the top of the water" is not apparent. Reference to any integral calculus will show that to obtain the area in question the differential area is taken as xdy.

It may be of interest, however, to state that Mr. Wade's differentiation of the equation for the area of a triangular section is incorrect. He treats T as a constant, while it is in fact a variable, having in a given triangular channel a constant relation to d. If this constant relation is designated by the letter K, so that $T = Kd$, then

$$A = \tfrac{1}{2} Kd^2,$$

and differentiating $dA/dd = Kd = T$, which leaves equation (9) undisturbed.

Mr. Wade's interest in the discussion of the hydraulic jump is appreciated, and it is hoped that he will challenge other questionable points. It might, however, be of mutual advantage to all concerned if debatable points were discussed "out of court" before publication.

Denver, Col., Jan. 25. JULIAN HINDS.

[Through oversight we did not submit Mr. Wade's criticism to Mr. Hinds before publication as is our custom in such cases.

A letter pointing out Mr. Wade's error has also been received from A. G. Husted, assistant engineer, Department of Public Service, Cleveland, Ohio. Mr. Wade begins his letter by an appreciative reference to the article, "A Few Lapses in Textbooks," by R. Fleming, in our Engineering Literature section of Jan. 20, p. 125, and cites Mr. Wade's letter as an example of a similar lapse. All such lapses, Mr. Husted urges, emphasize the danger of following "empirical formulas or even generalized statements set forth in various textbooks without first investigating them as to their applicability to the problem in hand."—Editor.]

Federal Highway Appropriations

Sir—*Engineering News-Record* is to be congratulated upon its illuminating editorial in the Jan. 13 number, p. 50, entitled "Federal Highway Appropriations." We agree with you that the federal-aid act has won wide approval, but we cannot agree with your statement that "its operation has disclosed no major direction in which change is needed." The suggestion of having the states themselves provide the funds with which to meet the federal aid instead of calling upon the counties is a change much needed, for there are now approximately one-third of the states using county funds to meet federal aid, and their highway departments are, therefore, merely clearing houses through which the Federal government co-operates with the counties in building roads.

A state, unable or unwilling to adopt a system of taxation by which all contribute in proportion to their wealth toward road improvement, and which pursues a policy that results in roads in rich counties and in pauperizing poor counties should be penalized in not receiving federal funds for roads within its borders. If the wealthier states are willing to contribute money to help the poor states build roads, then it follows that the prosperous counties should be willing to help build roads in the undeveloped counties.

In addition to the amendments made in the MacArthur bill and the one suggested in your editorial there is another change in the federal-aid act which should be made before more federal appropriations are provided, and this has to do with some plan which will insure proper maintenance of federal-aid roads. The only remedy the federal government has to require maintenance is that the Secretary of Agriculture may refuse to approve any new project *in a state or civil sub-division thereof, as the case may be*, if the roads already built are not properly maintained.

There are now about seventeen states in which funds for meeting federal-aid roads are raised largely by the counties; hence, the initiative rests with those counties and the road is maintained by the county under state supervision.

Let it be supposed that a federal-aid road has been built across one of these counties and is not properly maintained. The government then gives notice to the state, which, in turn, passes the notice on to the county, that unless the road is properly maintained further federal aid in that county will be withheld. The county, knowing that it has received all the federal aid which it can reasonably hope for within the next few years, would be inclined to do pretty much as it pleased with reference to the maintenance of any road complained of.

It would seem quite necessary that the maintenance clause of the existing aid act should be greatly strengthened before additional appropriations are made thereunder.

M. O. ELDREDGE,
Director of Roads, A.A.A. Good Roads Board.
Washington, D. C.

Marshall Plan for All-California Irrigation Held Chimerical

Sir—R. B. Marshall, formerly chief geographer of the U. S. Geological Survey, has proposed a scheme commonly known as the "Marshall Plan" for the development of irrigation and power in the great central valley of California. This plan has been extensively advertised in the past six months and is now being carried to the legislature, with the request for an appropriation of half a million dollars to further the scheme. Mr. Marshall is authority for the statement that $1,000 a month is being spent for postage stamps to send out literature regarding the scheme. Such widespread advertising of an engineering plan which to date has not received careful study by responsible people should not be allowed to go unchallenged.

The Marshall plan provides for the collection of all the streams which enter the great central valley of California into a series of grand canals skirting the mountains on both sides of the valley and distributing the water to the land and developing, incidentally, hydroelectric power. The waters of the Sacramento valley are carried south into the San Joaquin valley, where land is more plentiful than water. The Kern River, at the southern end of the valley, is taken through a tunnel under the mountains to the Mojave desert in southern California. In order to compensate the valley for this water taken out of its shed, the Klamath River is to be brought over the Shasta divide and dropped into the Sacramento valley. Statements concerning this plan are so filled with glittering generalities of an attractive nature that many well-meaning people are impressed by them and have loaned the influence of their names to the promotion. No one whose opinion on irrigation or power matters is worth considering has so far endorsed the plans as feasible, and all who have looked into it consider the scheme most ill-conceived and chimerical. Engineers who have devoted their lives to the irrigation and power business regard the plan as having no point of merit and know it to be altogether fantastical. It will do much harm to the serious development of the state and will cause many people to class the engineering profession with these promoters, much to the detriment of the profession.

The Marshall plan would, if carried out, first of all destroy all vested rights to water. It would substitute for these rights an indefinite interest in the waters of a stream or streams possibly miles away. It will confuse and disrupt the efforts of fifty years to bring about some system in the distribution of water and will offer no advantage to the millions of acres now being irrigated. It will destroy many power and irrigation developments now under operation or being developed.

Every stream entering the great central valley has already some well-defined plan for water conservation now under consideration. The reason these do not go forward faster is because of the difficulties in settling the question of water rights or of the high cost of the work. If the settlements of the difficulties in one of these smaller projects is so hard to accomplish, how little chance there is for this tremendous scheme which involves wiping the state clean of all rights and redistributing the waters of the greater part of the state at a cost of billions of dollars!

The literature sent out by this organization is full of misstatements. Mr. Marshall, in one of his talks recently, said that the execution of his plan would make unnecessary the carrying out of the existing flood control project. Not only this, but he states that the whole system of leveeing the Sacramento and San Joaquin Rivers (and the Mississippi also) is a great mistake—worse than useless.

Cost alone will kill the plan, for the seven hundred million talked about by Mr. Marshall will not start the work. Its cost will probably be billions!

There is no need for any large expenditure to investigate this matter. A group of experienced irrigation men can prove it chimerical without expensive surveys.

San Francisco, Jan. 31.

GEO. S. NICKERSON, THOS. H. MEANS,
H. H. WADSWORTH, J. D. GALLOWAY,
MAX W. ENDERLEIN, W. L. HUBER.

A 24-Foot Water-Wheel Pump in Wisconsin

Sir—I read with interest O. Sherven's description of primitive water wheels in China in your issue of Jan. 20, p. 134. During the summer of 1919 I was making surveys for water power development on the Namakogen River in northern Wisconsin and found a home-made water wheel of this type. The wheel was about 24 ft. in diameter and was driven by the current of the river, as there was no waterfall or rapids at this point. The water raised by this method was used to flood cranberry swamps about a half mile distant. The country was sparsely settled and the owner of the cranberry swamp found pumping by gasoline engine and centrifugal pumps too expensive and so used this old Chinese method instead.

Foreman, Ark., Jan. 24. D. CUYLER WASHBURN.

Concerning the Proposed Redesign of the Belle Isle Bridge

Sir—I notice in your issue of Jan. 29, p. 190, a news article relative to new design for the Belle Isle bridge, and I wish to make certain comments.

The design for the Belle Isle bridge was made by the Belle Isle Bridge Commission, consisting of: Mortimer E. Cooley, Francis C. McMath, William R. Kales, Emil Lorch, and Henry E. Riggs. Added to this commission was Prof. Lewis M. Gram, who acted as engineer on the work. That article relative to new design for the Belle Isle bridge, and not in any sense a "steel bridge faced with concrete," as is quoted in your paper.

It is untrue that the construction of a bridge of the reinforced concrete arch type would employ practically 50 per cent more labor than the bridge designed by the commission, as you say "is stated." It is untrue that a bridge as mentioned in your article can be constructed using materials which can all be obtained locally (the reinforced-concrete cantilever bridge designed by the commission will use local materials) and that its construction could be begun immediately, as no plans for a reinforced concrete arch bridge have been completed which will be approved for this site.

The statement is made that practically 50 per cent more labor will be required on this proposed reinforced-concrete

arch bridge than on the original design, and yet it is proposed by Mr. Luten to bring the cost down to $2,600,000, while the estimates on the reinforced-concrete cantilever bridge after two bids amounted to over $4,000,000. You cannot increase the labor 50 per cent and at the same time provide everything as is required by the original design and reduce the cost $1,500,000.

The nature of the soil on which this bridge is to be built is of such a consistency of blue clay that the bridge commission, after a year's study, decided unanimously that only a bridge in which all the actions were vertical would be safe on that soil, and after they had considered not only the reinforced-concrete arch bridge but all other types they decided that the reinforced-concrete cantilever type was the only safe type to be used.

Mr. Luten has presented nothing new in his proposed plan, yet he is acting with full knowledge as to the investigation and study which the original bridge commission made on this matter.

Detroit, Jan. 31. H. H. ESSELSTYN,
Esselstyn-Murphy, Engineers.

Why States?

Sir—Nothing can be more pathetic than the huge docility with which suffering humanity goes on hugging and extolling the fetters with which its forbears have bound it. The fathers have eaten sour grapes, and the children's teeth are set on edge. Happily, the children are not wholly debarred from voicing their discomfort.

In *Engineering News-Record* of Jan. 27, p. 157, R. I. Meeker, in his paper on "Interstate Water Conflicts and Possible Solution," describes the 'pretty mess' arising from the fact that "physical conditions . . . are antagonistic to divided authority." This should teach us to beware of saddling, upon our descendants, institutions, which, while they may have some value for us today, must be but millstones about their necks.

Before the advent of the steam engine ushered in modern industrial conditions, and while New York was much farther from Lake Erie than it now is from the Pacific, there was perhaps some excuse for the politicians who carved our unhappy country into "sovereign states" and separated these little "sovereigns" by boundaries which, as Mr. Meeker remarks, "do not coincide with drainage basins."

Today these "sovereign states" number forty-eight, each with its own governor and its own cumbrous legislature busy grinding out laws in conflict with those of its neighbors; and Mr. Meeker's paper sharply reminds us what a tangled web we weave for posterity when we thus bindly follow the calf paths of our ancestors.

But Mr. Meeker's paper nevertheless is not without encouragement for the optimist. For instance, it is profoundly reassuring to find Mr. Meeker asserting that the hodgepodge, which he so graphically describes, is "commencing to awaken thinkers among engineers" and others.

It is by the pressures of ill-adjusted environments, rather than by the *a priori* reasonings of reformers, that conditions get ameliorated.

As a rule, things must get pretty bad before the awakening of thinkers is commenced. Pharaoh, hardening his heart until the first-born were slain, is typical of conservative humanity in general. It has required a World War, threatening the destruction of civilization, to commence awakening thinkers to the eminent necessity and practicability of what, seventy years ago, was regarded as only a poet's dream: "The parliament of man—the federation of the world."

But if the awakening has really commenced (and we have Mr. Meeker's word for it), the outlook is not hopeless. Emerson has said, "Beware when the great God lets loose a thinker upon this planet!"

If, as Mr. Meeker tells us, the thinkers have already been forced to the conclusion that "some legal adjustment of state water laws . . . must be reached"—if they have already formed a "League of the Southwest"—how much longer can they hold out against the obvious need of a League of the United States or of the World?

How much longer can they refrain from insisting upon the abolition of our antiquated and generally arbitrary interstate boundaries (and of the "states" and their state governments with them) and upon the recognition of a single nation, or state, divided (not for political but only for administrative purposes) into main and subsidiary districts co-extensive with our main and subsidiary drainage basins? JOHN C. TRAUTWINE, JR.

Philadelphia, Pa., Jan. 29.

[Those interested in the specific application of Mr. Trautwine's spirited discussion, summarized in his concluding paragraph, may find the same general idea elaborated at some length in a letter by C. G. Lyman, mayor, Royal Engineers, British Expeditionary Force, in *Engineering News-Record*, July 31, 1919, p. 239, entitled "A Plea for Making Watersheds and Administrative Areas Coincide" (which, by the way, is a rare instance of the use of "watershed" in its proper sense). The relationship between administrative areas and watersheds or river drainage basins, we add, is a subject worthy of consideration by engineers, legislators and government administrative officers. To reinforce his remarks on blindly following "the calf paths of our ancestors" Mr. Trautwine sends a clipping from the Philadelphia *North American* of Dec. 6, 1915, containing some forceful humorous verses by Samuel Walter Foss, entitled "The Calf Path," which, though familiar to many, deserve wider reading. The verses may be found in the humorous section of Stevenson's voluminous "Home Book of Verse" and presumably in other anthologies.—EDITOR.]

Code of Ethics for Engineering Profession

Sir—My attention has been called to an editorial entitled "No General Code" in your Dec. 2, 1920, issue, in which you disparage our efforts to prepare a common code of ethics for the engineering profession. One would infer from your editorial that the ethics of the civil engineer are essentially different from those of other classes of engineers and therefore that it would be impossible for civil engineers to join with the others in considering a common code.

Your attitude in this is not well founded. There can be no difference of opinion as to the fundamental basis for a Code of Ethics. This must essentially be a statement of right, just and honorable conduct in the relation of engineers with the public, with the employers, employees or clients, and with fellow engineers. Opinions may differ regarding the form in which these statements may be framed but not to any extent about the fundamental ideas. The Golden Rule was not intended for any one class of engineers. The fundamental justice of the Square Deal is recognized by all. Therefore, since the underlying principles to govern professional conduct are readily recognized, and can be applied generally by all engineers in their daily work, the logical thing to do is to prepare a Code of Ethics for the whole profession which will state these guiding principles in terms applicable to engineers. This is what our Committee on Ethics had in mind when an invitation was sent to the other Societies to join with us in considering the preparation of such a Code.

It is time that engineering became recognized as one of the learned professions just as law and medicine. This can only be attained when the public recognizes high ideals of service to the state, to their profession and to individuals on the part of all engineers. The best way to ensure such ideals among engineers is by jointly subscribing to and enforcing a code of ethics in which such ideals are stated. The public will never consider engineering more than a trade as long as any one group of engineers insist they have all the virtues and the others most of the vices. Our committee hopes, with the help of engineers in all professions, not only to prepare a code that will be acceptable to all, but also to recommend procedure in administering it. We hope that *Engineering News-Record* can yet give us its co-operation, assistance and criticism in the preparation of such a code of ethics.

A. G. CHRISTIE,
Chairman Code of Ethics Committee, A. S. M. E.
Baltimore, Jan. 17.

NEWS OF THE WEEK

New York, February 10, 1921

$10,000,000 for Wilson Dam Approved by Senate

By a vote of 36 to 27, the Senate has approved the appropriation of $10,000,000 for continuing work on the Wilson dam at Muscle Shoals on the Tennessee River. Whether the conferees on the bill will retain the item is problematical. The Appropriations Committee of the House refused to embody the item in the bill which it drafted. An unsuccessful effort was made on the floor of the House to add the item to the bill. After a hard fight in the Senate committee an amendment to the House bill was approved. The Senate itself approved the item on Feb. 5.

More than $12,000,000 already has been expended on the dam. An additional $5,000,000 will have been expended by May 1, it is estimated. In addition to these amounts, Colonel Hugh Cooper estimates that $33,000,000 will be required to complete the project.

Senator Smoot of Utah favors abandoning the project. He thinks it is better for the government to take its loss now rather than to spend more money. Senator Lenroot of Wisconsin, another of the more active opponents of the project, favors suspending work for two or three years so that the proposition can be investigated more closely.

Approaches of Lincoln Memorial Must Be Underpinned

The terrace wall, the walks and the steps of the Lincoln Memorial at Washington, D. C., have settled to the point where the engineer and architect in charge have asked Congress to provide funds to enable them to put in foundation piers to bed-rock. The original plans called for rock foundations for the terracing and approaches. In an effort to expedite the work and to reduce the expense, the plans were changed and a spread slab concrete foundation was substituted, though the foundations of the building itself were sunk to rock. The memorial is on filled ground which has been consolidating from nine to thirty-four years. The changes now found necessary are estimated to cost $363,000. The total cost of construction for the Lincoln Memorial up to Jan. 1, 1921, has been $2,589,188.24. The settlement in no way affects the Memorial building itself

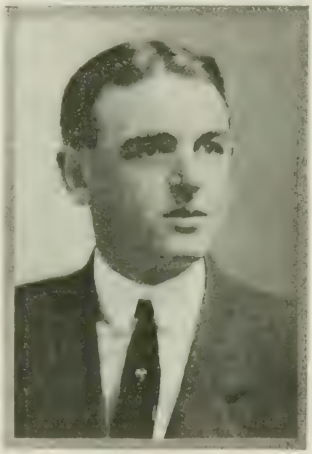
Licensing Bill in W. Va.

A bill to license engineers has been introduced in the West Virginia legislature by the American Association of Engineers and the West Virginia Engineers' Society.

Hirst Resigns as Chief Engineer of Wisconsin Highways

A. R. Hirst has submitted his resignation as chief engineer of the Wisconsin Highway Commission to take effect not later than Dec. 31, 1921. As explained in a statement by Mr. Hirst on p. 265 of this issue, he is unwilling to assume responsibility for the state's highway work with the underpaid staff which the present organization policy allows him.

Mr. Hirst was born in Elmont, N. Y., in 1881, and was graduated from Maryland Agricultural College in 1902. His professional experience includes service



A. R. HIRST

with the Pennsylvania R.R., the highway division of the Maryland Geological Survey, the Illinois Highway Commission and the Wisconsin Geological Survey. In August, 1911, Mr. Hirst became acting state highway engineer of Wisconsin and the following year he was appointed chief engineer of the Wisconsin Highway Commission, in which position he has served continuously to date. In 1912 he was elected president of the American Association of State Highway Officials.

To Hold Highway Education Conference

Under the auspices of the Permanent Committee on Highway and Highway Transport Education, the University of Michigan and the Michigan State Highway Department, a mid-western conference on highway and highway transport education will be held in Ann Arbor, Michigan, Feb. 23.

Canadian Engineers Hold Annual Meeting

Legislation and Grading of Members Most Discussed—Professional Sessions in Sections

The thirty-fifth annual general and professional meeting of the Engineering Institute of Canada was held from Feb. 1-3 at Toronto, Ont., and fully equaled in enthusiasm and attendance the record which has come to be expected of these meetings. Over 600 members and guests were registered and the attendance at the several meetings seemed to indicate that little of the registration was merely nominal. As is customary with the Canadian meetings, the social features were emphasized. On two of the three days there were luncheons with over 300 present and on each of the first two evenings there were entertainments, on the first night a lively smoker and the second a banquet of exceptional brilliance as regards speakers. An innovation this year was the sectionalization of the professional meeting for one day. Instead of a joint session there were five, devoted respectively to municipal, electrical, structural, chemical, and mechanical subjects. On the last day there were illustrated lectures on subjects of interest to all the members.

Council Report

The Council report for the year 1920 showed the Institute to be in a thriving condition. A deficit of last year has been transformed into a surplus of over $6,000 and the membership has increased so that at present there are 4,173 enrolled. The local branches, which have been so emphasized in the policy of the Institute, are equally thriving and two additional branches, one at Moncton, N. B., and the other at Sydney, N. S., have been added, making now twenty branch societies, to which, by the present scheme, about $4,500 was returned in rebate from the parent society for the partial financing of the branches.

Proposed amendments to the by-laws of the Institute were discussed at the meeting and, according to the existing by-laws, were passed without change to letter ballot. The most important of the changes include enlargement of the discipline provisions of the by-laws. By an addition to one of the sections it would be in the future required that any member signing a complaint against any member, provided the complaint results in an inquiry into that member's fitness for membership in the Institute, must present himself in person at the inquiry and, failing to give a sufficient excuse for not doing

so, the complaining member himself will be expelled. The second provision of the by-laws raises all of the fees $4 or $5 ($1 for students) so that the highest rate paid under the new provision will be $18 for resident members.

In a general report of conditions it was stated that an arrangement had been made with the American Institute of Mining and Metallurgical Engineers and the American Society of Mechanical Engineers whereby those societies and the Canadian Institute will mutually extend privileges of publications to other members; that is, any member of the American society may obtain the publications at the same rate as the Canadian society member, and vice versa. This action was the result of the efforts of a committee on international relations which is endeavoring to develop ties between the American and the Canadian societies. It was also announced that through some joint action of Canadian societies a uniform boiler code was in a fair way of adoption in all of the Canadian provinces.

Prizes awarded during the current year were as follows: The Leonard prize for 1919 to E. E. Campbell for his paper entitled "Hidden Creek and Its Operation," presented to the Canadian Mining Institute; for 1920 to J. C. Nicol and Staff for the paper entitled "Mining and Smelting Operations of the International Nickel Co. of Canada," also presented to the Canadian Mining Institute. The Plummer prize for 1919 to Dr. A. Stansfield, for his paper before the Engineering Institute, entitled "Electrical Furnaces." The Gzowski prize to R. deL. French for his paper entitled "Design and Construction of Reinforced-Concrete Covered Reservoirs" before the Engineering Institute, and the Student prize to J. R. Dunbar for his paper "Primary Triangulation of the Topographical Survey of Canada" presented to the Engineering Institute.

Registration Laws

Considerable time was given in one of the meetings to a discussion of the proposed registration legislation in Canada. Through the efforts of the Institute some kind of an engineering registration law has now been adopted in each of the Canadian provinces, except Saskatchewan, Prince Edward Island, and Ontario, and in these provinces work is well along toward the successful passage of such legislation. As yet there is little to report as to the operation of these acts except that it was noted that the extra fee required by the Canadian laws for membership in the professional associations (which, as noted in *Engineering News-Record*, Jan. 6. p. 21, are the media through which the registration is made) has a material bearing on the possibility of increased dues in other engineering societies such as the Engineering Institute. No little part of the opposition to increasing dues as required by the by-laws to be submitted to letter ballot was due to this fact.

Another long discussion resulted from the proposal that something should be done to revise the grades in the Institute. There are now students, juniors, associate members, and members, of which the latter two are corporate and have voting powers, and also associates who are not members at all and affiliates who are men, as the word indicates, affiliated only with the local branches. While the discussion as to the necessity for reducing this large number waxed long, it did not have any outstanding unanimity, but the probabilities are that the Council or the committee on policy will make a study of the matter in the ensuing year. The committee on policy, incidentally, reported little more than progress because it has not as yet had time to function actively. It has under consideration, however, a series of recommendations for submission to the Council respecting an appropriate policy for the Institute.

Sectional Meetings

The wide attendance on and interest in the sectional professional meetings were particularly significant.

The paper which attracted most attention was entitled "Operation of Toronto Filtration Plant" by James Milne, of the Public Works Department of the City of Toronto. This paper gave the relative costs of construction and operation of the slow sand filters built some years ago at Toronto and the later drifting sand filters installed under the so-called VerMehr patents. The contents of the paper were criticised, particularly by Allen Hazen, of New York City, who was the engineer on the earlier plant. Fuller details of the paper and the discussion will appear later.

The principal officers for the ensuing year elected by ballot were: President, John M. R. Fairbairn, chief engineer of the Canadian Pacific R.R.; vice-presidents, H. G. Acres, hydraulic engineer of the Hydro-Electric Power Commission of Ontario, and Walter J. Francis, consulting engineer, Montreal. The secretary of the Institute is Fraser S. Keith, with offices at 176 Mansfield St., Montreal.

New President of the Engineering Institute of Canada

J. M. R. FAIRBAIRN

J. M. R. Fairbairn Elected President of Canadian Institute

John Morrice Roger Fairbairn, chief engineer of the Canadian Pacific Railway System, was elected president of the Engineering Institute of Canada at its annual meeting in Toronto Feb. 1-3. Most of his professional experience has related to the railway field.

Mr. Fairbairn was born in Peterborough June 30, 1873. He was graduated from the School of Practical Science in Toronto in 1893 after devoting his summer vacations, while still a student, to practical engineering work, including service under the late W. A. Ramsay, chief engineer of construction for the Canadian Pacific Ry.

His first position was with the Canadian Department of the Interior as principal assistant on topographical surveys in Alberta and later he was transferred to the drafting division of the Department of Railways and Canals. Following a short period with the Department of Railways and Canals as transitman on right-of-way surveys he became engineer in charge of construction of the Lachine and St. Laurent lines of the Montreal Park & Island Ry. In 1897 Mr. Fairbairn became associated, as principal assistant, to Charles A. Stoess on mining claim and land grant surveys in British Columbia, acting also, for a time, as city engineer of Kalso, B. C. He then entered private practice as a civil and mining engineer at Kalso and Greenwood until, in 1900, he joined the construction department of the Canadian Pacific Ry.

In August, 1901, however, he rejoined the Department of Railways and Canals as engineer in charge of Section 3, Simcoe-Balsam Lake Division. He then returned to the Canadian Pacific, in 1901, where he has served continuously in various capacities, starting as principal assistant to the division engineer at Montreal and being promoted steadily until his appointment as chief engineer became effective July 1, 1918.

Mr. Fairbairn has acted as a member of the Council of the Engineering Institute of Canada and as its vice-president.

Northwestern Contractors Annual Convention Announced

A general invitation to contractors has been issued by the Northwestern Association of General Contractors to attend their annual convention in St. Paul March 11 and 12. Convention headquarters will be at the St. Paul Hotel.

Vehicle Tunnel Policies Endorsed by Transport Interests

Recommendations originally made by the engineers of the New York-New Jersey Tunnel Commissions with respect to matters of roadway and traffic, in the vehicular tubes underneath the Hudson River have been concurred in by an advisory transportation committee of twelve members, representing motor vehicle manufacturers and other transportation interests, selected last year by C. M. Holland, chief engineer to the commissions. The report of this committee, made public Feb. 7, endorses the two-way roadway, 20 ft. wide, in each tube; the provision for a maximum vehicle width of 8 ft.; a flat (uncrowded) roadway without grooveways; mobile equipment for hauling disabled vehicles out of the tunnel; and the installation of a railroad system of signalling.

The transportation committee has recommended for the vehicular tubes a pavement of close-jointed, cement-grouted granite block. The commissions, however, have not yet reached a decision as to the type of paving.

Condemn "Marshall Plan" for California Irrigation

Sixty-one members of the San Francisco Section of the American Society of Civil Engineers, at a special meeting Feb. 4, passed resolutions condemning the "Marshall plan" for an extensive irrigation system in the central valley of California. The plan, for which R. B. Marshall, formerly chief geographer of the U. S. Geological Survey is sponsor, is receiving support at the state capital in the form of a proposal to appropriate $500,000 for a survey. Propaganda designed to win over the farmer element has been very active.

The civil engineers, at their special meeting, declared the scheme to be physically, legally and financially impracticable, affirming also that the publicity given to the plan has seriously interfered with irrigation and reclamation projects now under way.

A letter, signed by a number of San Francisco engineers and setting forth the case against the Marshall plan, appears on p. 273 of this issue.

Interest Rate on California Road Bonds Raised to 5¼ Per Cent

The California state highway finance board on Jan. 28 authorized the sale of $3,000,000 in highway bonds at 5¼ per cent. This is the first action taken by the newly created board which was formed to adjust the interest rate from time to time to suit conditions of the money market. This first block of bonds is expected to finance the first part of the 1921 construction program. Announcement has been made that bids for paving about 75 mi. of state highway will be received Feb. 21, this work to be financed by the bonds which it is expected can be sold at 5¼-per-cent rate.

Alameda Site for Pacific Naval Base

In a report to the House Committee on Naval Aairs the special joint committee of five members of the Senate and five members of the House, created to investigate the advisability of building a naval base on San Francisco Bay and other matters, reported under date of Jan. 31, favoring the selection of the site at Alameda on the east shore of San Francisco Bay directly opposite San Francisco. This site was selected in preference to the Hunters Point site, in San Francisco proper, and the extension of the Mare Island Navy Yard. The report does not detail any of the deficiencies of Hunters Point, nor many of the advantages of Alameda, but devotes considerable space to demonstrating why Mare Island should not be used. The arguments against Mare Island are mainly, according to the committee's report, the difficulties of future extension, the remoteness (two miles) of the existing shops from the proposed new layout, and the disadvantage of "a location on a shallow and muddy estuary reached by a dredged channel several miles long through Pinole Shoals, making access difficult." The committee admits, however, that the Mare Island development would be much cheaper.

The same report recommends the adoption of the San Pedro (Los Angeles Harbor) site for a submarine base, San Diego for a lighter than air naval aviation base, Port Angeles as an advance operating station for small units, and San Point near Seattle as a heavier than air naval base.

Urge Widening of Lake Washington Canal

At a public meeting held recently at Seattle, Wash., recommendations were made that the Lake Washington ship canal be widened to 300 ft., tapering to 225 ft. at the bottom, with a depth of 30 to 34 ft. at low tide. Recommendations were made to Col. Edward Schultz, U. S. Army engineer in charge of this district. A number of speakers present urged that another canal lock be built, and that it be large enough to accommodate battleships and capital ships of the Pacific fleet. Figures were presented to show the growing use of the canal and locks, and statistics presented were as follows:

In 1916 (four months) 3,230 boats; 1917, 23,392 boats; 1918, 23,250 boats, 1919, 24,700 boats; there is an increase of approximately 25 per cent over the 1919 figures for the year 1920. Testimony indicated that lively industrial and commercial development of the sections bordering on Lakes Washington and Union would follow the widening and deepening of the canal and improvement of facilities at the lock. The Port of Seattle Commission, of which George F. Nicholson is engineer, in a letter to Col. Schultz, went on record as strongly favoring the widening of the canal.

Army Motor Equipment Needed for State Roads, Says Reavis

Another effort to secure motor equipment and other materials from the War Department for use by the states in road building activities has been launched by Representative Reavis of Nebraska. Mr. Reavis declares that the War Department is holding equipment suitable for road-building purposes greatly in excess of its requirements. Much of this material he declares is on the point of becoming useless, due to deterioration. He urges that Congress act while there still is a chance to prevent this equipment from becoming almost a total loss.

His latest bill, which is more comprehensive than the measures introduced previously by the Nebraska Representative, directs the Secretary of War to turn over 1,000 five-ton caterpillar tractors, 500 ten-ton caterpillar tractors and 200 mobile machine shop units. The bill also directs the Secretary of War to turn over shop machinery, machine tools and other equipment suitable for the repair and rebuilding of motor propelled vehicles.

The bill provides that the states are to pay 20 per cent of the estimated value of the property, from which freight and loading charges may be deducted. The valuation is to be made under the direction of the Secretary of Agriculture. The bill provides that none of this material may be sold by the state as long as it is in a serviceable condition.

"Journal of Electricity" Enlarges Its Scope

Enlargement of the editorial scope of the *Journal of Electricity* and a change in its name to *Journal of Electricity and Western Industry* were announced at a dinner given Feb. 1 in San Francisco. The date marked the thirty-fifth anniversary of the *Journal of Electricity*, which has been one of the McGraw-Hill publications since September, 1919. Robert Sibley will continue as editor of the enlarged paper.

The *Journal of Electricity and Western Industry* will be devoted to the upbuilding of the West as an industrial section, and it will interpret Western progress through the application of electric power, light and heat in industries and homes.

House Committee Recommends Atlantic-Gulf Canal Survey

The Committee on Railways and Canals in the House of Representatives on Jan. 27 brought in a report accompanying House Bill 10,919, which requires the Secretary of War to cause to be made a survey "for a canal from Cumberland Sound to the mouth of the Mississippi River." The secretary is instructed in the bill to make a survey and an estimate of cost for a sea-level ship canal, for a lock ship canal, and for a barge canal; $50,000 is authorized for the survey.

To Correlate Standardization in Mining

Recent recommendations of a conference on standardization of mining equipment and practice have resulted in the American Engineering Standards Committee inviting five organizations to designate two members each to represent them upon a general correlating committee, with the understanding that the nucleus so formed might enlarge itself. The correlating committee has been formed with the following membership: American Institute of Mining and Metallurgical Engineers, Graham Bright and Howard N. Evenson; American Mining Congress, Charles A. Mitke and Warren R. Roberts; Mining and Metallurgical Society of America, E. S. Berry and B. Britton Gottsberger; National Safety Council, F. P. Sinn and S. J. Williams; U. S. Bureau of Mines, E. A. Holbrook and O. P. Hood.

The work of the committee will include such matters as: Delimiting specific projects which might be most advantageously handled as units; recommending the order in which the various projects should be taken up in order that the needs of the industry should be served best, and making recommendations as to what bodies should act as sponsors for specific projects, and as to what bodies should be represented.

Michigan Engineers Want State Aid for Colleges

More than 200 engineers attended the three-day convention, Jan. 25, 26 and 27, of the Michigan Engineering Society, State Assembly of A. A. E., at Detroit.

Endorsement was given of the budgets of the University of Michigan, Michigan Agricultural College and the Michigan College of Mines. In the resolution were clauses commending higher education as a state benefit and therefore calling through proper compensation for the most able and competent instructors. The St. Lawrence-Great Lakes deep waterway project was endorsed and further detailed study by a board of "competent highly qualified engineers" called for. Salary schedules of the A. A. E. were adopted for engineers in state railroad highway, municipal, country and state service.

A special committee was appointed to assist in enforcing the engineers' license law. It was recommended that the list of registered engineers be sent to all state, country and municipal officials, since they have already been asking where engineers so qualified might be obtained.

The Governor has proposed the creation of a state department of public works and the committee was named to get in touch with the Governor and investigate the proposals. Recommended revision of the state's drainage laws are to be brought in by a committee at the next meeting.

New York Office Opened to Aid Trade in Germany

In the interests of American manufacturers, exporters and importers, and for the purpose of giving information on all matters pertaining to commercial intercourse between the United States and Central Europe, the American Chamber of Commerce in Berlin has established an office in the Park Row Building, New York City, in charge of S. George Fremont, secretary and manager.

Structural Section Formed by Boston A. A. E. Men

A structural section of the Boston chapter of the American Association of Engineers was formed at a meeting held Jan. 7. Prof. E. H. Rockwell, Tufts Engineering School, was elected president; Paul B. Covey, New England Structural Co., vice-president; R. B. Johnson, Harvard Engineering School, secretary-treasurer.

Edison Company Lays Out Big Power Development Program

The railroad commission of California on Jan. 21 authorized the Southern California Edison Co. of Los Angeles to proceed with a construction program that is to call for the expenditure of approximately $48,000,000 in the next six years. The work contemplated includes the construction of reservoirs, conduits and power plants on the San Joaquin River and its tributary, Big Creek, in Fresno County. The additions made to the power company's system under this program are to increase its capacity by 360,000 kw. and add to the annual output 1,500,000,000 kw.-hr.

In authorizing this development the commission says, "It appears that the demands for electricity in the territory now supplied by applicant are constantly increasing and must be met largely by the construction of new hydroelectric plants. The funds to be used in this work are to be obtained from the sale of applicant's stocks and bonds."

The principal items of construction included in the program which has been thus approved are (1) Florence Lake reservoir at the head waters of the San Joaquin, capacity 43,000 acre-feet, (2) tunnel 11 mi. long, connecting Lake Florence with Huntington Lake, (3) conduits from Huntington Lake to Shaver Lake, (4) a new hydroelectric generating station above Shaver Lake to be known as power house 1-A, (5) a reservoir at Shaver Lake, capacity 138,000 acre-feet, (6) conduits from Shaver Lake reservoir to a generating station to be known as power house No. 2-A, (7) a new hydroelectric generating station to be known as power house 2-A on Big Creek, (8) a third generating unit to be installed in the present power house No. 1 on Big Creek, (9) enlargement of hydroelectric generating station known as power house No. 8.

Fifteen Millions for Rivers and Harbors

A lump-sum River and Harbor bill carrying $15,250,000 has been reported to the House of Representatives. Of that sum, $15,000,000 is to be allotted to the Chief of Engineers for maintenance. The remainder, $250,000, is to be expended for surveys and contingencies. The bill, as reported, is a decided reduction from the $57,000,000 requested by the Chief of Engineers. A minority report was made which includes a substitute bill carrying a total of $28,271,850.

The majority of the Committee on Rivers and Harbors contends that the $15,000,0000 plus the $47,000,000 of river and harbor funds from previous appropriations, which have not been expended, should be enough to carry the work to June 30, 1922. The minority claims that the $47,000,000 on hand is credited to certain projects and can not be applied where the new appropriation is needed. The minority takes the position that Congress is delegating its responsibility to the Chief of Engineers when it fails to bring in an itemized bill. The majority contends that the lump-sum bill makes available all the money needed to take care of the work urgently needed.

Nova Scotia Highways Investigated

Charges of irregularity in the administration of the Nova Scotia Highway Act are being investigated by a committee consisting of two judges and F. W. W. Doane, city engineer of Halifax. The opening and alteration of tenders after the hour for closing had passed are among the alleged acts which have started the controversy. Certain changes in personnel have accompanied the investigation, among them the appointment of W. A. Hendry of Bedford as chief engineer to succeed John Roland.

Will Not Consider Use of More Flow of Niagara

No applications under the Water-power Act involving the prospecting use of water from the Niagara River, under an amended treaty with Great Britain, will be considered by the Federal Power Commission. This announcement was made by the commission during the course of its hearings held in Washington Jan. 24, 25 and 26. Even discussion of the problems involved, should additional diversion be authorized, was ruled out, but the commission made it clear that it would give consideration to possibilities under additional diversion in considering proposals for the use of existing water.

The city of Buffalo is the only applicant contesting the claim of the Niagara Falls Power Company. Representatives of the city of Buffalo were accorded much time at the hearing, but it was evident that the commission was

not impressed with all their arguments. Among other things it came to the attention of the commission that the commissioners of Buffalo are divided on the water-power policy to be pursued.

Brick Makers Discuss Building Costs

Discussions of the broader problems affecting the industry, as well as those having to do with methods of increasing the production and consumption of brick, were given prominent place on the program of the joint session of the National Brick Manufacturers' Association and the Common Brick Manufacturers' Association, whose annual meetings were held in the Hotel Pennsylvania, New York City, Jan. 31-Feb. 4.

Though the greater part of the convention time was consumed in discussion of more or less technical methods of brick manufacture, handling and transportation, action was taken through resolution on several important issues which concern employment relations and the broad administration of the industry. Chief among the resolutions were those (1) Recommending co-operation with architects and others in stimulating enrollment of apprentices in the brick-laying trade; and (2) urging upon Congress the adoption of custom duties that will result in a reciprocal agreement for the shipment of brick between the United States and Canada.

Tariff duties from the United States to Canada now are 30 per cent ad valorem, with an anti-dumping clause. To the United States from Canada, brick is taxed 10 per cent ad valorem, an anti-dumping clause also being included in the tariff provision. The National Brick Manufacturers' Association recommended all duties on brick be removed and that there be no anti-dumping clause, or at least that the duties not exceed 10 per cent ad valorem.

It was stated from the floor of the convention that approximately 90 per cent of the plant capacity of the Common Brick Manufacturers was now idle. When a resumption in brick manufacture will occur, depended, it was said, upon a lowering in wage cost. One statement was made that a recession of 25 per cent in the common labor wages would probably result in a drop of from $1 to $2 per thousand in the price of brick. Despite the present condition of the industry, it was frequently stated that a resumption in building construction was bound to come, though it would not come perhaps until several months after normal spring construction begins.

The belief was generally expressed that during the coming year or so brick will have its greatest market in building house construction. Therefore, in order to make a brick house competitive in first cost with any other type, a new type of wall has been developed, called the "ideal" wall. It is a hollow wall, having several forms, the simplest being the laying of the brick so that every other brick in every course is a header. Tests are now being carried on to determine if that type of wall will meet city building code requirements. Once its status as an approved design is secured, a large increase in the consumption of brick is looked forward to.

Contracts Awarded in January 1920 and 1921 Compared

Contracts actually awarded in January, 1921, as reported in the construction news section of *Engineering News-Record* have a money value of more than $54,000,000. The total for the same month of 1920 was approximately $175,000,000. Most of the difference between these two figures is accountable in the decline in industrial building, in the construction of office, bank, school, loft and business buildings, and in miscellaneous construction. The amount of money involved in waterworks, sewer, bridges, street and road, railway, and excavation and dredging contracts actually awarded in January, 1921, compares favorably with the aggregate value of contracts of the same classification let in the corresponding month of 1920. In January of this year the money value of industrial works contracts was but approximately $13,000,000 and that of buildings but $17,500,000; whereas in January, 1920, contracts to the extent of $56,000,000 were awarded for industrial buildings and $87,000,000 for building construction.

A comparison of the money valuation of the various classifications for the corresponding months of 1920 and 1921 are given herewith:

Classification	Jan., 1920	Jan., 1921
Waterworks	$1,143,777	$519,028
Sewers	1,863,840	3,146,948
Bridges	2,021,553	3,030,477
Streets and roads	12,203,970	11,597,810
Railways	75,000	80,000
Excavation, dredging	1,341,526	1,206,346
Industrial works	56,041,047	12,881,968
Buildings	87,095,987	17,455,673
Federal government	4,980,945	2,071,141
Miscellaneous	8,256,071	2,358,976
Totals	$175,163,766	$54,408,367

Brindell Is Found Guilty

Robert P. Brindell, president of the New York Building Trades Council, whose trial on charges of extortion has been going on before Justice McAvoy in the New York Supreme Court for the past several weeks, and whose indictment resulted from the investigations made by the Lockwood joint legislative committee on housing, was found guilty Feb. 3. The jury reached a verdict on the first ballot. The offense of which he is convicted carries with it a maximum penalty of fifteen years' imprisonment, there being no alternative of a fine. This is the first conviction growing out of the investigations made by the Lockwood committee.

Brindell's attorney was given time in which to file a motion for an appeal.

Trial of Hettrick, Code of Practice Author, Begins

The trial of John T. Hettrick, of "code-of-practice" fame, whose indictment was returned by a New York grand jury growing out of an investigation made by the Lockwood joint legislative committee on housing, began Feb. 8 before Justice McAvoy of the Supreme Court. The charge against Hettrick is that of coercion. The case is based on allegations that Hettrick with certain labor co-defendants, coerced firms and individuals to join the code-of-practice to restrain competition. Prosecution of the case is in the hands of Henry L. Stimson, former Secretary of War.

Toledo Creates Emergency Unemployment Fund

In order to care for the unemployed the city of Toledo recently passed an emergency measure calling for the appropriation of $25,000 with which to repair streets, alleys and public buildings. A number of the city's former unemployed are already at work.

Thirty Per Cent of Eighty-four Chicago Unions Idle

A recent announcement made at a meeting of the Chicago Federation of Labor was to the effect that in 84 unions but two-thirds of the members were employed. The largest percentage of unemployed is in the building industry. There are approximately 200,000 union workers in the 300 unions in Chicago.

Nation-Wide Move to Scale Down Railroad Wages

Through its decision in the application of the Atlanta, Birmingham & Atlantic Ry. for authority to reduce wages the United States Railway Labor Board, meeting in Chicago Jan. 27, opened the way, in the opinion of many railroad executives, for a nation-wide readjustment and scaling down of railroad wages. Following the decision meetings of the labor committee of the Association of Railroad Executives have been held at which agreement is reported that operating expenses must be reduced a half billion a year, since it is not considered feasible to raise rates above the present level. It is also indicated that some $150,000,000 per year can be eliminated by abrogation of national shop agreements of which the Association of Railway Executives may ask annulment.

The Railway Labor Board decided that the Atlanta, Birmingham & Atlantic Ry. had no status before the board inasmuch as it had failed, first, to negotiate with its employees before appearing before the board. It is considered that the decision opens the way for individual negotiation by the carriers with their employees for such revision downward as is considered consistent with the present trend of readjustment.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11

AMERICAN CONCRETE INSTITUTE, Detroit; Convention, Chicago, Feb. 14-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 2[illegible]

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; Convention, Chicago, Feb. 9-12.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Convention, March 15-17.

The New Jersey Sewage Works Association at its annual meeting, Feb. 18, will be addressed by the following speakers: Weston Gavett, "Sewage Siphons"; Thomas J. Headlee, "Certain Phases of the Biology of Sewage Disposal"; John R. Downes, "Practical Operating Data on Imhooff Tanks and Screens"; C. M. Nichols, "The Design and Operation of Single-Story Tanks." There will be an open discussion on assessment methods for new sewers.

The American Wood Preservers Association held its annual meeting in San Francisco, Jan. 25-27. More than a score of committee reports and papers had been printed in advance for distribution and most of these were read in abstract in order to afford as much time as possible for discussion. There were joint dinner-meetings with the San Francisco Section Am. Soc. C. E. and with the National Association of Railroad Tie Producers. Officers elected for the ensuing year were president, C. M. Taylor, superintendent of treating plant, Philadelphia & Reading railroad and Central Railroad of New Jersey; vice-president, F. J. Angier, superintendent timber preservation, Baltimore & Ohio railroad; secretary-treasurer, G. M. Hunt, chemist, forest products laboratory, Madison, Wis. The next annual meeting will be held in Chicago in January, 1922.

The National Association of Railroad Tie Producers held its annual meeting in San Francisco, Jan. 27-28. In accord with the usual custom reports from regional representatives were received and a limited number of papers relating to the tie producing industry were presented. Officers elected for the ensuing year were: president, Charles R. McCormick, Charles R. McCormick & Co., San Francisco; vice-president, J. H. Johnson, B. Johnson & Son, Richmond, Ind.; secretary, Warren C. Nixon, Western Tie & Timber Co., St. Louis; Treasurer, J. J. Schlafly, Potosi Tie & Timber Co., St. Louis. The 1922 convention is to be held at Chicago, Ill.

The Indiana Sanitary and Water Supply Association will hold its fourteenth annual meeting at the Claypool Hotel, Indianapolis, Ind., Feb. 16-17.

The American Water Works Association, New York Section, at its meeting Feb. 16, will be shown moving pictures of trenching machines manufactured by several companies and their representatives will answer questions after describing the machines. How to cut labor costs on pipe laying work will be discussed at this meeting.

PERSONAL NOTES

T. CHALKLEY HATTON, chief engineer, Sewerage Commission, Milwaukee, Wis., has left for Europe where he will spend two months in the study of municipal sewage disposal plants in France, England, Germany and Italy. He will also gather data on the operation of the Schaefer-ter-Meer sludge de-watering machine.

E. C. MACY has gone to Japan in the interests of Stone & Webster, New York, to take charge of the design and construction of a hydro-electric development on the Sho River for the Shogawa Hydro-Electric Co. He was recently in charge of the construction of the Caribou hydro-electric development for the Great Western Power Co. on the Feather River in California.

THORNTON A. MILLS has resigned the position of designer with the Madera Irrigation District of California to go to the Philippines as civil engineer, department of public works, at Manila, P. I.

JOSEPH C. LETTS, former Captain of Engineers, U. S. A., has been appointed a construction engineer in the U. S. Public Health Service, with headquarters at Waukesha, Wis.

HARRY THOURAT, formerly employed in the county engineer's office, Trenton, N. J., has been appointed town engineer of Union Hill, N. J.

D. FAIRCHILD has been appointed acting supervisor, bridges and buildings, Puget Sound division, Northern Pacific Ry., with headquarters at Seattle, Wash., to succeed W. E. Bradley, who is on a leave of absence.

S. H. INGBERG has been transferred from Chicago to Washington, D. C., to take charge of the investigations on fire resisting properties of building materials conducted by the U. S. Bureau of Standards.

COLONEL A. EARCHMAN of Kemptville, Ont., engineer-in-chief of Ottawa-Prescott highway work, has had the Order of the British Empire conferred upon him by the Imperial Government for notable service rendered during the World War as commanding officer of a railway battalion.

DUDLEY F. HOLTMAN, associate editor *American Contractor,* and formerly senior structural engineer, Interstate Commerce Commission, has been made construction engineer of the National Lumber Manufacturers Association in charge of the technical and research department.

C. K. CALVERT, chemist, Indianapolis Water Co., since 1908, has resigned to become the chief chemist for the Sanitary Board of Indianapolis. N. D. Doane, who succeeds Mr. Calvert, was formerly at the South Pittsurgh filtration plant.

FREDERICK STUART GREENE, who resigned as New York State Commissioner of Highways Feb. 1, plans to open an office as consulting engineer and to begin active practice in March, upon his return from a trip to Panama.

R. C. STARR, construction engineer with the San Joaquin Light & Power Corporation, and F. M. Thebo, construction engineer, have organized the firm of Thebo & Starr, engineers and contractors, Sharon Building, San Francisco. They will undertake design and construction work generally, specializing on hydro-electric and irrigation projects. In addition to devoting time to the new firm Mr. Starr will retain his position in charge of design and construction with the Power Company.

OBITUARY

COL. HARRY E. TALBOTT, engineer and manufacturer of Dayton, Ohio, died Jan. 31 at Miami, Fla. He was born in Cincinnati in 1860 and was graduated from the University of Cincinnati in 1880. Early in life he was connected with the engineering department of the Cincinnati Northern R.R. In 1883 he was appointed division engineer of the Northern Pacific Ry. He gave up railroad engineering in 1891 and went to Dayton in 1892 to engage in contracting. Among the works with which he was connected were the Sault Ste. Marie dam, the Lake Superior Paper Co.'s plant at the Soo and the water-power plant of the Laurentide Pulp & Paper Co. at Quebec. During the World War he organized the Dayton Metal Products Co. and entered into a contract with J. P. Morgan & Co. for the purpose of manufacturing fuses for high explosive shells. This company also took over and financed the Dayton Wright Airplane Co. [illegible] was

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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Railway Working Agreements

LAST week the Railway Labor Board refused to entertain the request of the railway executives that the war-made working agreements be set aside. The request was denied because, in the judgment of the board, the matter fell within the jurisdiction of the Interstate Commerce Commission, the reason for the request being that the working agreements made it impossible to earn the net return aimed at in the Transportation Act. Presumably, therefore, the question of the agreements will come in for a full airing before the commission. In any event the injection of them into the Chicago hearing has served to direct toward them the attention of the public. The information offered, though, is far from adequate. It has barely served to whet the public's appetite. What is needed is clear and convincing evidence of the effect of these agreements. The public is ready to lend its support to any movement aimed at getting back, in all lines of endeavor, to payment by results. Moreover, the railroad problem is the public's problem. The public, through its agents, forced upon the railroads these agreements. The public, through rates, must pay the bill. What more logical than that the public be given the facts?

It should be remembered, too, that the public's attitude toward the railroads is now a fair one. Little protest was made to last year's rate increases, while the improvement in service was highly commended. Repeated statement is necessary, of course, to awaken a large number of people to the meaning of such a situation as that which confronts the railroads but the public's attitude is certainly receptive.

Non-Partisan League Experiments

NORTH DAKOTA has been in the public eye for some years as an experiment ground for state operation of functions generally discharged by private corporations. Controversy has raged over the merits of what was being done. Those socialistically inclined were loud in their praises. Others saw dangers and predicted ultimate failure. Even now the experiments cannot be said to have reached a conclusion but the failure of the state-owned and operated bank, the Bank of North Dakota, is probably the beginning of the downfall of some of the other state-operated institutions. It will undoubtedly be claimed by those who seek escape from the shortcomings that attach to private ownership that public operation cannot be expected to produce its full results when surrounded by the enmities of those who favor private ownership and management. That sort of claim, of course, is always made when governmental ventures fail. The outstanding fact is, however, that no matter what the theoretical merits, these socialistic experiments have a habit of getting into trouble. In this regard North Dakota's experiments are calculating true to form." Some day the millennium but it seems still to be very far away.

What of Business?

NO QUESTION today is more often asked than, What of business? There is little activity in engineering lines. Do we face a dead year? Will there be a revival in the spring, or in the late summer? As we set forth in the first issue of the year, *Engineering News-Record* takes a relatively optimistic view of the situation. As there explained, conditions are more favorable for construction than for some years. Materials prices have receded somewhat, labor is more plentiful and more efficient, transportation promises to be better than last year. As yet, however, there are not definite signs of what the spring will bring. It is worth noting, though, that the volume of contracts let in January of this year compared favorably with that of January of last year, except as to buildings (see last issue, p. 279). Moreover, we know that much highway money is available. That much of it will be used seems very certain. The New York State opening of bids week before last should be an encouragement. On twenty contracts advertised there were 83 bidders, and the low bids were well under the engineer's estimate. Pennsylvania this week receives bids on 104 miles of road, and the results there will also furnish some index of what can be expected from highway bidders. In other lines of public works evidence of special activity is not yet apparent, but with conditions favoring more economical construction than for some years we are still hopeful of a considerable revival within the next three months.

An Adverse Report

OLD acquaintances confront us in the crucial factors of the Long Beach dome collapse: high stress, and lack of bracing. The combination has often been fatal. In most cases where high stress has figured as a cause of failure—possibly in all—there was also a lack of adequate bracing, and so we may call lack of bracing the chief factor here. A substantial piece of steelwork, stiff in all its details, has rarely or never failed. These things are fairly well appreciated. Yet, according to the report printed on page 294, one engineer was so far oblivious of them as to erect a ponderous concrete dome on a square of slender trusses unbraced except by flexible web hitches; and an architect and a board of church officials were foolhardy enough to build to this design in the face of an adverse report. Surely, on some or all of these parties rested a responsibility weighty enough to prevent the faulty construction. So far as it rests on engineers, we are making progress in fixing such responsibility and making sure that they are competent to bear it. License laws and joint action through societies will accomplish this result. But how about the responsibility of the layman? When we have made engineers fully responsible to the community, must there not be a reciprocal responsibility? Shall an architect, or a board of church trustees, be free to disregard an engineer's adverse report?

Structural Effects of Vibration

UNLIKE most structural failures the collapse of the Strathmore apartment house in New York on Dec. 1 has been found due to a group of minor possible causes acting in co-operation rather than to a single controlling cause. The report of the superintendent of buildings, noted on p. 315, absolves the reconstruction operations from direct blame and lays chief responsibility on the loose, unbonded structure of the building, involving brick masonry in shattered condition and joists that were not anchored to the masonry but merely rested on corbel courses. It is interesting to note the emphasis placed on lack of anchorage, in connection with the description of the structure given in *Engineering News-Record* of Dec. 9, p. 1155. In fact, the possible wedging away of the heavy but shallow and flexible floors from the walls was suggested in early discussions of the failure. Perhaps the most important item of the report, however, is its mention of vibration as a probable factor in the failure—evidently referring to vibration set up by traffic near the building. The adjoining streets are paved, and heavy vehicles pass frequently; a double-track street railway and a four-track subway line pass the Broadway front. That paved streets set up perceptible tremor of the ground is within everyone's experience. In bad cases such tremor may be felt within buildings, and, though representing an extremely minute range of motion, it has an obvious potentiality for harm to poorly bonded structures. While specific cases of injury to buildings from traffic vibration have not been reported, it is to be remembered that heavy truck traffic is a matter of relatively recent growth. But the effect, if there is any, is bound to be a continuing one. It is therefore a strong added reason for providing thorough bond between the several parts of a structure. With respect to existing buildings, it may be well to watch for any appearance of "opening up" of joints between structural parts, and take steps to check such disintegration if it appears.

Pavement and Rail Tremor

AS TO the effect of rail traffic in setting up earth tremors like those noticed at the passage of a heavy truck, little seems to be known. Street-car traffic, of course, is directly comparable with pavement traffic, and rail joints with roughnesses of the street surface. On the other hand, rapid-transit subway traffic generally produces small surface effects—at the worst points only very slight tremor compared with that set up by street vehicles. Below the surface the comparative effects may be different, since street-traffic tremor is probably a superficial action, while a vibration set up by subway traffic originates at some depth and may therefore pass into building foundations lying above track level. With respect to buildings the subsurface effect obviously is the more important. Present experience, which is all negative and only of limited amount, seems to acquit rapid-transit subways of any charge of injurious effect by sending out vibrations. In view of the novelty of the point raised in the Strathmore report, however, it is only fair to remark that we know next to nothing about the effects of either pavement or rail-traffic vibration. On the basis of past experience, neither would be suspected of possible destructive effects on buildings. In any event, however, it may be set down as axiomatic truth that well-bonded construction has nothing to fear from vibration of either origin.

Drainage Development an Open Field for Engineering Societies

IN THE IMPORTANT field of improvement and reclamation of agricultural land by drainage and flood protection, the engineering societies of the central and southern states have large possibilities which thus far have been little realized. These societies do deal to some extent with the technical, legislative and agricultural aspects of drainage. Many of them have drainage sections or committees. Most of their work, however, is confined to the consideration of papers and reports at meetings, and the occasional passage of resolutions relating to legislation, with infrequent support of measures before legislative bodies. The activities of such societies, also, are individual rather than co-operative. A society rarely lends active aid to its drainage committee and the societies do not combine their work or influence. The germs of action are existent but dormant.

In furtherance of land drainage there is much need of education to show the value of co-operative construction and maintenance, and the need for better drainage laws. Co-operation is needed in securing concerted action by landowners in a drainage area and in promoting harmonious relations between the authorities of small adjacent districts, so that even if the drainage systems are carried out separately they may form parts of a large interconnected system or at least not be injurious to one another. In such cases there should be active co-operation on the part of the several engineers.

Many local drainage authorities are badly in need of education as to what drainage engineering means. Except in the case of large projects the engineer is often looked upon as a necessary evil or as a skilled hired man who sets out ditch lines. The rural engineer, however competent, has little time or opportunity for educational work.

Again, maintenance of drainage ditches is so generally overlooked or neglected that it may hardly be said to exist, except on some large projects. The engineer seldom has connection with a project after it has been completed, and though he may point out the desirability of keeping ditches clear his advice is rarely taken. In later years, however, when the ditches silt up and fail to carry off the water in wet seasons or floods, the landowners may lay the blame upon the designers.

As to drainage laws, they are defective and cumbersome in many states, but as a rule attempts to revise them have to face the double disadvantage of a strong opposition and an indifferent or even divided support.

Along these lines—co-operative action, ditch maintenance and improved legislation—as well as the broader lines of land reclamation as a local and national benefit, much assistance may be given by local and state engineering societies, perhaps in co-operation with farmers' institutes and similar organizations. All such work would be part of a needed campaign of education on the essential requirements as well as the prospective results of land drainage. Such work, too, would give support to the work of individual engineers and help to prepare the ground for further projects. But the campaign must be carried on continuously and in the face of discouragement and opposition, recognizing that the ultimate results will be highly beneficial to the profession, to the communities and to the country at large.

Which of the state engineering societies will lead in opening such a co-operative campaign in the interests of professional and agricultural development?

Permanent Bridges

IF THE popular term "permanent bridges" applied to stone and concrete structures is considered in the light of some recent failures of arch bridges its propriety is bound to appear somewhat doubtful. Experience shows that such bridges are not always permanent. For example: Two small arch structures in an Eastern state recently failed, one when just completed and one shortly after completion; in the far West a bridge over an important river failed when only six or seven years old; and finally the recent failure of the Third St. bridge at Dayton after sixteen years' satisfactory existence is to be considered. The latter is not yet fully explained, though it is significant that there was extensive disturbance of stream conditions by the hand of man, which was likely to set in action external forces of destruction. But with respect to the other bridges mentioned, normal natural forces worked unaided; in two cases the foundations scoured out, in another the chief blame must be laid on the superstructure. Engineers are bound to recognize that such occurrences imply a serious limitation on the qualification "permanent."

The public conviction as to the propriety of the term "permanent" is quite logical, however. Since the material is virtually everlasting—*good* stone and *good* concrete are referred to—structures built of it should realize this quality. If the engineer does not succeed in making his structure permanent the fault is his. What more natural, then, that bridge failures of the kind mentioned should be laid at the door of the engineer? He, or his profession, is charged with lack of skill, or with negligence. But the engineer himself is partly responsible for having the public blame him, since, knowing that some failures of this kind will happen, he yet has encouraged the view that stone and concrete bridges are inherently permanent.

One or two points bearing on the question need to be thought of. The manner in which foundation problems are involved was suggested in these columns last week. If foundations are not always permanent, then also the structures which they carry can not be considered permanent. We will not be fully justified in calling a bridge—or any structure—truly permanent until we construct our foundations of such unquestionably rugged character that they will resist the tooth of time and the infinitely varied attack of nature.

But it must also be remembered that the popular "permanent" bridges commonly involve arch construction. We incline to forget the old warning that the arch never sleeps, yet time verifies its truth again and again. Especially in the great present-day preference for arch structures it is well to bear in mind that the continuous distortions and movements of bridge arches and their piers may not in every instance be harmless. Experience has proved that stone arches have very long life (though all our conclusions are based only on those structures that have survived). Suppose we assume that this is equally true of arches constructed of perfectly made concrete, on rigid foundations. It may not be true where concrete of commercial grade, or somewhat below this grade, is concerned. To what extent the constant movement of the arch will take advantage of the slight imperfections of concrete that are apt to occur in most structures we do not yet know; but we do know that stone arches because of their voussoir construction can adapt themselves to slight distortion, and that concrete arches probably can not. Only experience of some length of time can tell us how far the adjective permanent must be qualified in its application.

In fine, it seems a proper caution, in applying the term "permanent" to concrete and stone arch bridges, to refrain from interpreting the term too rigidly. We should not believe, nor must we lead the public to believe, that such structures are proof against all the vicissitudes of an indefinitely long existence. It is a fact that they will be the more truly permanent the more carefully the engineer and the constructor foresee future contingencies. But a chance for deterioration or failure will always remain; it may be classed under the heading of insurance or under that of maintenance, but under either name it puts a measurable upkeep charge on the bridge besides (statistically speaking) limiting the life of the structure and making it something *less* than everlasting.

My Right-Honorable Opponent

WHY do engineers so frequently harbor personal feelings toward those with whom they disagree on technical matters? That was the question put recently when after the adjournment of a meeting in which there had been sharp discussion it was apparent that personal animosities still persisted. The speaker added that engineers should cultivate the habit of lawyers of being able to argue subjects with the utmost earnestness and, immediately thereafter, lunch together on entirely friendly terms.

The question and the comment are well worthy of the consideration of engineers. We do not know whether engineers are more sensitive regarding disagreements of opinion than are other classes of individuals, but if they are we can readily see why this might be so. An engineer is accustomed to dealing with facts and with immutable natural laws. He feels instinctively that there is about everything a definite position that must be right; what differs from it is wrong. Following the usual course of human failings he is inclined to consider his own analysis and conclusions as correct, and, applying his rigid standard, is likely to suspect the honesty of one who espouses a different view.

Of necessity, there is a right and a wrong to every problem, but the difficulty is that most problems are so complex that our feeble human brains are unable to tear them apart and with absolute correctness appraise the value of each factor. Even where the separation into elements has been made the interpretation of the applicable standards rests upon individual training, experience, and prejudices. What wonder then that on even simple questions there should be a variety of views!

Engineers are no exception to the fallibility of human nature. Some of their problems are subject to exact mathematical determination, but by far the greater number of them call for the application of the standards of individual experience, in other words, of judgment.

We need, therefore, to realize that the other fellow may have as good ground as we for his conclusions, and to derive from that reflection an attitude of tolerance—and respect—for opposing views. Above all, we need to regard problems as objective, and to refrain, unless the grounds are appallingly clear, from imputing motives to our opponents. Let there be fair, even strenuous discussion, but let the personal relations be in no wise disturbed.

Allegheny River Bridge Reconstructed at New Grade

Baltimore & Ohio R.R. Crossing at Pittsburgh Replaced by New Structure of Longer Spans at Higher Elevation—New Side Span Raised 15 Feet When Channel Span, Built at New Grade, Is Rolled In

A DIFFICULT piece of bridge replacement, involving several series of operations of rolling and jacking heavy spans, was successfully completed on Dec. 20, 1920, when the new Allegheny River bridge of the Baltimore & Ohio R.R. at 33rd St., Pittsburgh, was put into service. Unusual complications controlled the planning of the work, as described in *Engineering News-Record* of Nov. 4, 1920, p. 904. It was necessary not only to replace the bridge piecemeal by rolling in successive spans at different times, but to build part of the new structure at the old grade and part at the new grade, in order to maintain traffic. The final work, carried out in a single traffic interruption of 19 hr., involved three simultaneous operations: (1) Replacing two old spans of 245 and 157 ft. by a single 434-ft. channel span with a 75-ft. approach girder span coupled to it; (2) setting several approach spans, and (3) raising a 261-ft. truss span through a height of 15 ft. from the old to the new track elevation. The latter was the slowest and probably the most hazardous item of the day's work.

Among the complicating factors in the renewal of this bridge were change of span lengths and elevation of bridge (under orders of the War Department) the requirement that the river channel be kept open for navigation, the necessity of building the new structure on the old alignment because of property conditions, and the impossibility of arranging for detour tracks on the east bank where the approach viaduct passes through Thirty-third St. Raising the grade had therefore to be carried out on one track at a time. Due to the necessity of keeping the river open, the bridge had to be replaced span by span, and in this work the difference of new and old span lengths made it necessary to introduce a short temporary connecting span at one point. Further, the new piers, which had to be built under the old bridge, could not be caried up to final elevation, so that in shifting the new spans to place they had to be landed on temporary supports on the uncompleted piers. The 75-degree skew of the river spans and varying skews of the west approach, and the interference of the west approach detour track with the renewal of this approach, also helped to make the problem intricate.

The design of the new bridge was shown in the article already cited. One of the illustrations of that article is reproduced herewith as Fig. 2, to show the condition of the river spans before the final operation. It explains the interrelation of the two major items of the operation carried out on Dec. 20, namely, the rolling of the channel span and the jacking of the 261-ft. side span.

Prior to Dec. 20 the whole bridge was operating at its old level, but only the westbound track was in service, as the eastbound track of the Thirty-third St. viaduct (at the right hand in Fig. 2) was being raised to take traffic at the new grade after the final change of the river spans. The two easterly spans of the four-span old structure had been replaced on Sept. 1 by a new 261-ft. truss span and a plate-girder span of 95 ft. 8 in., erected on falsework alongside the bridge at the old track grade and rolled into place, pushing out the two old spans; simultaneously, a pair of plate girders was put in position at the west end of the new work to span the gap between the new pier C and the old pier 3, as indicated in Fig. 2. From the west end of the old river bridge the westbound track deflected to the right, reaching a detour alongside the approach, while the new approach viaduct was being erected on the final alignment. This viaduct was built complete up to within three spans of the river bank, which spans had to be left until the day of the final change on account of interference with the detour.

FIG. 1. FINAL REPLACEMENT OF BALTIMORE & OHIO R.R. ALLEGHENY RIVER AT 33RD ST., PITTSBURGH
Looking upstream before rolling of channel span — East end of 261-ft. span during raising to new track grade.

The new channel span was erected at the elevation of the new track. Steel bents were provided to support it on the new piers after rolling, these piers being about 14 ft. below their final height. As the shoe plates of the new span were a little below rail level of the old spans, it was possible to set in place the bent on pier C without fouling the track. At the other end of the span, however, pier D was located under the old structure, so that the pier bent could not be erected; it had to be built on the falsework as part of the new span and moved to place with it. Because of this difference the sketch, Fig. 3, of the rolling arrangement at pier C does not apply directly to pier D, where the rollers were under the shoes of the pier bent instead of under the shoes of the span.

In conjunction with the raising of the eastbound track of the viaduct in Thirty-third St. the half of the girder

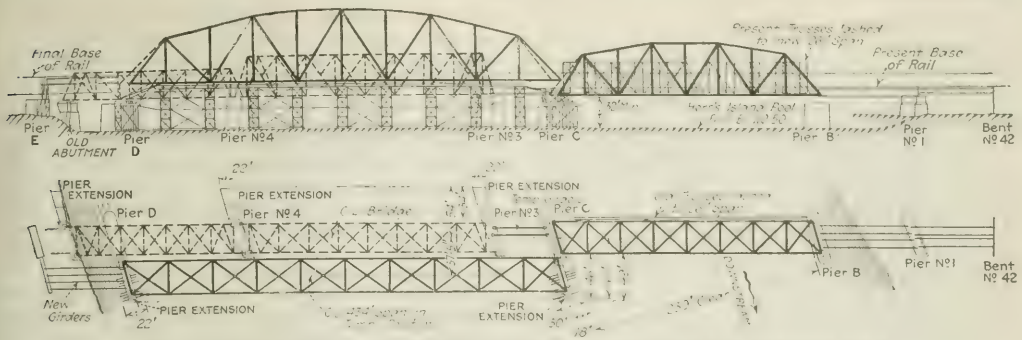


FIG. 2. RIVER SPANS OF 33RD STREET BRIDGE BEFORE TRANSFER OF CHANNEL SPAN

span *AB* at the east bank of the river was raised to the new grade prior to Dec. 20. This work was done by derrick cars, which lifted the pair of girders and set it on steel supporting bents. At the west bank, a similar girder span, erected on falsework with the channel span, had to be rolled with the latter.

Rolling the Channel Span

In rolling the large span, methods well established in a number of prior bridge renewal operations involving rolling were applied, and no difficulty or delay was experienced in the actual execution. These methods involve hauling the span on nests of closely spaced rollers placed under the shoes and themselves carried by a track formed by a rail grillage or by the flange plate of a girder, the hauling being done by tackle fixed between the span and the far end of the pier worked by hoisting engines usually carried on the moving span. To guide the movement and control it so as to hold the span in exact alignment, horizontal gage boards at the ends of the span marked off in feet and inches, are observed by a transitman, the foreman in charge of the rolling having telephone communication with the transitman and with the operators of the several hoisting engines. Practice has shown that a load on the rollers equal to the usual loading of expansion rollers is satisfactory and has given data on the amount of friction to be expected, so that the forces to be dealt with are known quite accurately.

In the present case a simplification was made as compared with some earlier undertakings of the kind, by allowing the new spans to push the old ones out of the way by means of blocking. As shown in Fig. 3, 3-in. rollers 8 ft. long were used, on 4-in. spacing, held by side bars made of flats bored to fit over the ends of the rollers. Taking account of the bearing length under the shoe bed plates, the roller load in the present case amounted to 1,960 lb. per lineal inch of roller, or about 650 lb. per lineal inch per inch of diameter. Rolling friction was assumed at 0.006 for 1-ft. diameter or the equivalent of 0.024 for the 3-in. rollers in the present case, although experience shows that this amount is possibly 20 per cent too high when the track is so supported that little local crushing occurs at the transfer between wood and steel or masonry supports.

The load to be moved included 5,500,000 lb. weight of the new channel span, 200,000 lb. weight of the girder span *DE*, and 1,880,000 lb. weight of the two old truss

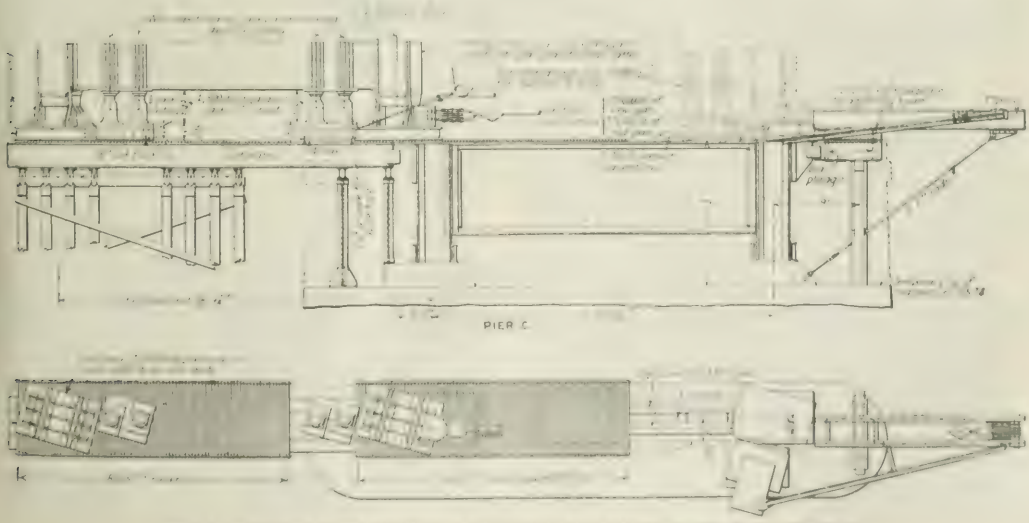


FIG. 3. ROLLING [illegible]

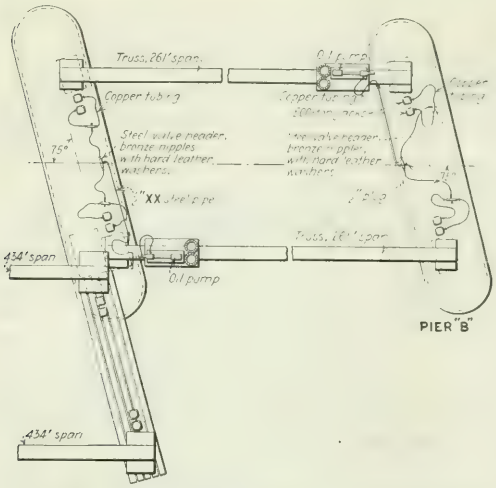


FIG. 4. PLAN OF JACKS AND PUMPS FOR RAISING 261-FT. SPAN TO NEW TRACK GRADE

spans; of the total, about 3,520,000 lb. was to be moved at pier C, 4,000,000 lb. at pier D, and something over 100,000 lb. at E. The rigging used, arranged as shown in Fig. 3, consisted of twenty-part tackles of ¾-in. steel rope at *C* and *D*, and an eight-part tackle of 1¾-in. manila rope at *E*. Connection of old and new spans was made by placing wooden blocking and struts between the posts of the two spans at a number of points; the pushing resistance of the old spans thus had to be resisted by the lateral bracing of both old and new spans.

Moving was accomplished in 14 min. actual moving time. The total distance of rolling was 38 ft. 9⅞ in., the average movement nearly 3 ft. per minute.

The falsework supports on which the span was swung consisted of eight 8-pile longitudinal bents, each capped with a 12 x 12-in. timber and two 24-in. I-beams. At pier C these were pony bents resting on a lower story of similar construction, which had previously served as end support for the 261-ft. span. On the caps of the bents were placed five 30-in. girder beams as track for the rolling, extending over the end of the masonry pier and carried here by two short steel bents as indicated in Fig. 3; they were also spliced to the shoe-supporting bracket of the pier bent which formed the remainder of the track.

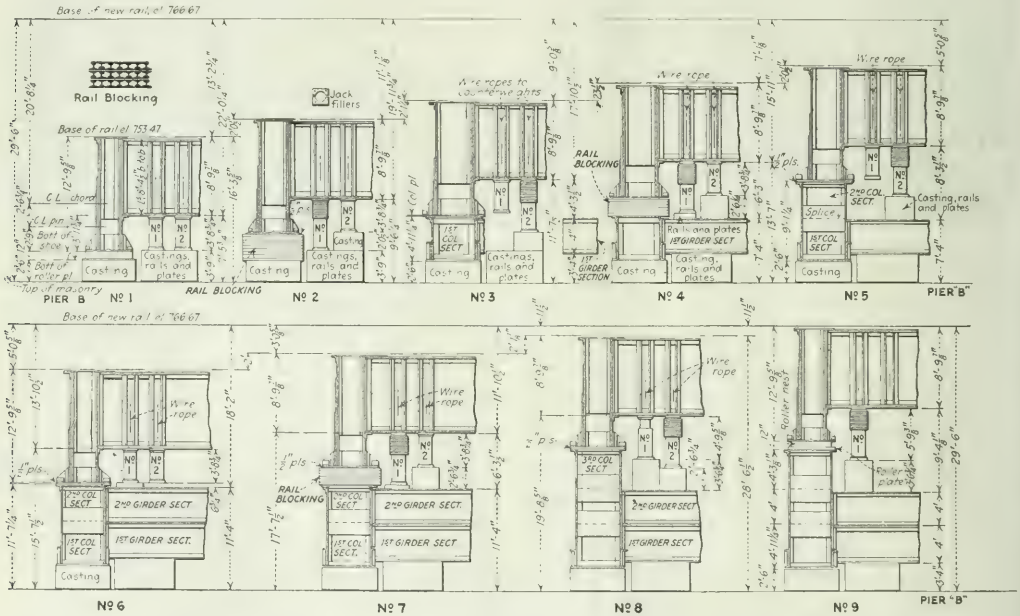


FIG. 5. SUCCESSIVE STAGES OF JACKING AND BLOCKING IN RAISING 261-FT. SPAN; DETAILS AT PIER B

Operation 1—Two 500-ton jacks supported on blocking, in place under end floor-beams. Both jacks counterweighted, using a spare jack as counterbalance. Jack 2 was held up against the floor beam by counterweight so as to be carried up with span. Jack 1 was pumped up and, as the span rose, annular filler plates were placed between the cap and barrel of the jack to take the load in case the hydraulic connections failed.

Operation 2—Blocking of rails, placed alternately head up and base up, was built under the shoe of the span and under Jack 2 as the span went up. A total lift of 2 ft. ½ in. was made. Roller nest and roller plate were removed, making the blocking under the shoe 3 ft. ½ in. high. The span was lowered to bearing, releasing Jack 1, the filler plates were removed from this jack and it was pulled up to the bottom flange of the floorbeam.

Operation 3—Jack 2 now lifted the span 2 ft. 1¼ in. The blocking under half the area of the shoe was removed and the first section of column pushed under, then the other half of the blocking removed and the column section set in final position. The span was lowered to bearing on the column, Jack 2 slacked off, the filler plates removed and the jack pulled up to the floor-beam. The first section of girder was set in place between the columns and bolted, blocking wedged in tight under the girder and blocking placed under Jack 1.

Operation 4—Jack 1 raised the span 1 ft. 11½ in., and blocking was built up under Jack 2 as it went up, also under the truss shoe. With 2 ft. 6¼ in. blocking under Jack 2, Jack 1 was slacked off and pulled up.

Operation 5—Jack 2 now raised the span 2 ft. ¼ in. The column cap was taken off, a second column section placed with the cap on it, and the span lowered to bearing on the column cap.

Operation 6—Jack 2 was pulled up and the second girder section set and bolted. Blocking was then placed under Jack 1.

Operation 7—Jack 1 raised the span 2 ft., the shoe and Jack 2 being blocked.

Operation 8—Jack 2 raised the span 2 ft. 1⅞ in., the column cap was removed and the third column section with cap set in place.

Operation 9—With 3 ft. 6¾ in. blocking under Jack 1 the span was raised 11½ in. to final grade.

In preparing for the rolling, the old spans were picked up by four hydraulic jacks at each end of each span, working against short lifting girders from which hung wire rope slings bent around the end pins of the spans. Then the rollers were inserted under the shoes and the spans lowered down on the rollers. The sections of roller nest between the shoes were then placed and linked up. In the case of the new span the rollers had been placed under the shoes before swinging the span, so that it was only necessary to complete the roller bed. After the move the roller sections between shoes of the new span were first disconnected and removed, and the span then raised by jacks placed under the end floorbeams, to remove the rollers under the shoes.

At pier D, where the pier bent moved with the span, knee-braced struts from the base of the bent to the lower chord of the span served to stiffen the connection and provide for longitudinal forces. At pier C the span rests on an expansion bearing as sketched in Fig. 3; these rockers of this bearing were blocked by locking plates until the move was completed and the rollers removed from under the shoes.

Raising 261-Ft. Span 15 Ft.

Immediately after completion of the rolling, the work of raising the 261-ft. span to the new track grade started. The amount of the lift was 13 ft. 2⅜ in. at the east end (pier B) and 15 ft. 2⅜ in. at the west end (pier C). The load to be lifted was about 1,200 tons, or 600 tons at each pier. Four hydraulic jacks of 500 tons capacity were used at each pier, in sets of two working and two idle, as indicated in diagrammatic plan in Fig. 4. These jacks had a run-out of 26 in. By lifting the idle pair of jacks with the span, setting blocking under it and then using these jacks for a further lift, a continuous lifting process was possible. However, to avoid having to carry up blocking more than moderate heights, the steel columns that were to support the span in its raised position were made in three superimposed sections, so arranged that they could be set in place successively as the span reached one-third, two-thirds and full height. Similarly, the girder diaphragms connecting the two columns on either pier were constructed as three superimposed sets of girders for successive placing. After setting in place any one story of the columns, it was necessary to lower the span to bearing on the columns, raise both jacks and remove the blocking under them, and insert the girder section between the columns. For the further operation the jacks footed on the girder as previously they had footed on the pier.

Sequence of Operations

Thus the lift at each end was accomplished in three successive raises of about 4 ft. each. A fourth lift was made at pier C for the purpose of inserting a cast pedestal intended to equalize the shoe heights of the two adjoining spans.

Fig. 5 sketches the sequence of operations, and gives the necessary explanations. It represents the work on pier C, that at the other end being slightly different in the final stage only. At each pier the two sides were jacked as a unit, by virtue of the arrangement of the piping shown in Fig. 4. For the first fleet of the jacks both ends were carried up together; after that the ends were jacked up separately, as the height of the blocking at this stage of the operation made this method desirable, due to its increased stability and freedom from vibration.

All preparations on the two piers having been made in advance, jacking started at 9 a.m. on Dec. 20, and went on continuously, the work being completed at 12 midnight.

No difficulties of any kind were encountered in the jacking, but the work of placing the girders between the pier columns proved slow because of the skew of the girders with respect to their end connections and the columns. Work after dark also proved exasperatingly slow.

Connecting up the new track required another hour after the span was finally landed and secured. The first train crossed the new bridge at 2:05 a.m., 19 hr. after traffic was interrupted.

For the American Bridge Co., Richard Khuen, Jr., general manager of erection, and James L. De Vou, division erecting manager, were in general charge of the work. N. H. Orr, assistant engineer, directed the field operations. S. T. Frantz was general foreman. For the Baltimore & Ohio R.R., H. A. Lane, chief engineer, was in general charge. The immediate supervision of the work was in the hands of P. G. Lang, Jr., assistant engineer of bridges, and A. C. Clarke, district engineer. The services of J. E. Greiner, ocnsulting engineer, were also retained in connection with this bridge.

Seattle Additional Water Supply Plans To Go Forward

The projected addition to the water supply of the city of Seattle, Wash., to cost about $6,000,000 will soon be started. The following outline of the project has been supplied by A. H. Dimock, city engineer.

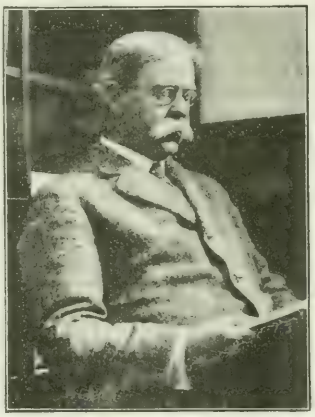
The new scheme utilizes Swan Lake, with an area of about 500 acres, 15 miles southeast of the city along the main supply conduit from Cedar River. The lake will be raised about 20 ft. by earth dams, the construction of which are now under way, giving an available storage capacity of about 4,500,000,000 gal. and will be tapped by a two-mile tunnel connecting with the Cedar River conduits and a new pipe line to the city reservoirs.

The new pipe line will be of steel, 66 in. in diameter and 16 miles long. The plans also provide for enlarging Volunteer Park reservoir in the city of Seattle by the addition of a second basin which will increase the storage capacity from 23,000,000 to 60,000,000 gal. The new pipe line will increase the water supply of the city to a total of 100,000,000 gal. daily, the combined capacity of the two existing pipe lines now serving the city being about 60,000,000 gal. per day, which is all needed at times of maximum draft. Contracts for enlarging the reservoir will be let immediately and will soon be followed by contracts for the steel pipe line.

Plans not yet authorized and not included in the $6,000,000 estimate contemplate the construction of a fourth pipe line which will increase the supply to 150,000,000 gal. daily, the construction of additional distributing reservoirs having a capacity of 250,000,000 gal., and a diversion conduit leading from Cedar River to Swan Lake and having a capacity to deliver 300 sec.-ft. of water.

William T. Sedgwick

Dr. William T. Sedgwick, senior professor and professor of biology and public health at the Massachusetts Institute of Technology, widely known as a sanitarian, epidemiologist and civic worker, whose death Jan. 26 was announced in this journal Feb. 3, was born at West Hartford, Conn., Dec. 29, 1855, and graduated from the Sheffield Scientific School, Yale University, with the degree of Ph.B. in biology, in 1877. In 1881 he took the degree of Ph.D. at Johns Hopkins University. Later Yale gave him the degree of D.Sc., and but recently he received from the University of Cincinnati the degree of LL.D. In 1883, having had experience in teaching both at Yale and Johns Hopkins, Dr. Sedgwick became assistant professor of biology at the Massachusetts Institute of Technology. There he remained until his death, becoming associate professor of biology in 1885, full professor in 1891, and director of the Sanitary Research Laboratory and Sewage Experiment Station in 1902.



PROF. W. T. SEDGWICK

From 1888 to 1896 Dr. Sedgwick was biologist of the Massachusetts State Board of Health. This was during the inception and early years of the studies of water and sewage purification at the Lawrence Experiment Station. In these and later years Dr. Sedgwick also established and maintained a high reputation as epidemiologist, particularly in connection with water-borne outbreaks of typhoid fever. He also created and carried on the course in sanitary biology at the Institute, which has trained hundreds of men in the fundamentals of public health work, including engineers, chemists and bacteriologists. Since the reorganization of state health administration in Massachusetts in 1914 Dr. Sedgwick had been a member of the Public Health Council. He was also a member of the Advisory Board of the Hygiene Laboratory of the U. S. Public Health Service since 1902, Assistant Surgeon-General, U. S. Public Health Reserve of late and at his death was a member of the International Health Board, Rockefeller Foundation, and chairman of the administrative board of the Harvard Technology School of Public Health. He was curator of the Lowell Institute from 1897 and trustee of Simmons College, Boston, from 1899 until he died. He had been president of many scientific and civic associations, including both the Boston and the Massachusetts Civil Service Reform Association, the Society of American Bacteriologists, the American Society of Naturalists, the New England Water Works Association, and the American Public Health Association.

Dr. Sedgwick will be remembered by many as a charming and effective speaker and writer. Besides his numerous addresses he was joint author of a "General Biology," 1886; assistant editor of the "Life and Letters of William Barton Rogers, Founder and First President of the Massachusetts Institute of Technology," 1896; author of "Sanitary Science and Public Health," 1902; and joint author of "The Human Mechanism and the Sanitation of Its Surroundings," 1906, and "A Short History of Science," 1917.

One of the crowning honors of Dr. Sedgwick's long, varied and useful career was his appointment in 1920 as first exchange professor from the Massachusetts Institute of Technology to the Universities of Cambridge and Leeds, England, where he delivered lectures last year.

A more extended outline of Dr. Sedgwick's career up to the time he became president of the New England Water Works Associations appeared in *Engineering News*, Jan. 11, 1906, p. 31.

From an appreciation of Dr. Sedgwick prepared for *The Tech*, by Prof. George C. Whipple, M.I.T., '89, the following extracts are taken:

In his early days Professor Sedgwick was a scientist, keen for research; in his middle life he was an educator in science and an administrator in public health; and in his later life he was scientist, educator, administrator, and counselor —but always, first and foremost, he was the friend of young men.

I count myself fortunate to have been one of these young men — one who knew him in the early days when the science of bacteriology was in its infancy and when a splendid vision of the applications of biology to problems of sanitary engineering and public health was dawning in his soul. I was fortunate in being present at a dinner attended by about seventy-five of Professor Sedgwick's former students in 1906, at which time a volume of scientific papers written by them in commemoration of the 25th anniversary of his doctorate was presented to him. Now, fifteen years later, his students are far more numerous and through them his influence has been felt not only throughout America but the world over. His mature judgment on fundamental problems of education and public health was always a source of strength to his colleagues and the enthusiasm of his early years never failed him.

I count myself fortunate to have been present at the dinner given in the Walker Memorial last Saturday [Jan. 22] in honor of one of his favorite pupils, Prof. C.-E. A. Winslow of Yale, on the eve of his departure for Europe. At this dinner Professor Sedgwick presided with even more than his usual grace and the pleasant hours were spent looking both backward and forward—he looking forward to Winslow's new work at Geneva with the League of Red Cross Societies, and Winslow looking back to the days spent with his chief in the Institute laboratories. It was a small gathering of old friends and of students who have come from the many nations now represented in our School of Public Health. This gathering, small though it was, was typical of his expanding life.

Professor Sedgwick's interests overflowed the bounds of sanitary science and many of the people of Boston know him best as Curator of the Lowell Institute, as trustee of Simmons College, as President of the Sharon Sanitorium, or the Civil Service Reform Association.

Professor Sedgwick was fundamentally a great teacher. Those of us who knew of his weak heart—he often said jokingly that it was better than an insurance policy—marvelled at his activities during the war when he took on extra work that the American cause might not suffer.

Both Motor Trucks and Industrial Railway Used on Road Job

Dual Haulage System With Moving Transfer Point Solves Construction Problem on 7-Mile Concrete Job Laid from One End

By H. Eltinge Breed
Consulting Engineer, New York City

Every reliable and competent contractor knows that no matter how carefully he bids he runs the frequent risk of getting a bad job. When Samuel R. Rosoff of the Rosoff Engineering Co., New York City, discovered that his was the only bid on the Castle Creek-Whitney Point road in Broome County, New York, he scented trouble. And he got it. The way he emerged from it and escaped failure may be of interest to other contractors.

The specifications for the road looked harmless enough, and a preliminary survey of it indicated no unusual difficulties. The contract was awarded Dec. 9, 1919. The road is 6.93 miles long, surfaced with a concrete pavement 16 ft. wide, of a 1:2:4 mix, and reinforced with 25 lb. of metal per 100 sq.ft. The section is 6 in. in depth at the side and 7 in. in the center. The main items of the contract were: 53,500 cu.yd. of earth excavation; 12,100 cu.yd. of reinforced-concrete pavement; and 19,380 bbl. of cement. The engineer's estimate for the work was $305,472.50; and the contractor's bid was $303,837.48.

A study of the profile of the road revealed one difficulty. The only source of supplies was at the foot of a hill. Most of the road had to be built up that hill, and atop it. Stone came from a local quarry located at Sta. 335 in the valley. Deliveries of cement, sand, coal and plant had to be made by freight. The railroad crossed the road at Sta. 339, also in the valley, and here the contractor installed a switch and siding. The crusher was installed at Sta. 336.

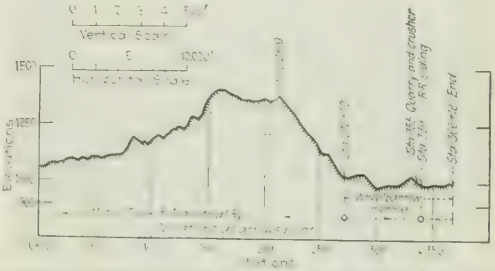
The problem was, how to proceed. The soil was a heavy clay that once excavated would be impassable after a rain. To go to the far end, start at 0 and work back toward the crusher would be impossible, because it would necessitate passing the steam shovel doing excavation. Moreover, extra cost would be involved because the heavy loads hauled over it would cut up and rut the subgrade.

The next method was abandoned because it involved losses of time that would have delayed the completion of the work until 1921. This method would have been to take a one-mile or a two-mile section and lay the pavement toward the source of supply, then wait the necessary fourteen days for the curing of the pavement to resume traffic over it and haul the materials to start the next section.

The other possibility was to start from the source of supplies and lay continuously to the far end. If this could be done, with no delays for bad weather, it was thought to be possible to complete the contract within the season.

The steam shovel would have to be started at the source of supply and work toward Sta. 0. Thus it could be kept far enough ahead to be out of the way of the concreting gang. The total yardage was 53,000, of which 42,000 was shovel excavation. This meant approximately 7,000 cu.yd. a month for a ¾-yd. traction shovel, or, allowing twenty days to the month, an average of 350 cu.yd. a day.

The obvious equipment for the work was industrial railway. But a complete equipment of this kind, with the other plant necessary for the work, would mean an outlay of over $100,000. This might have been justified had the nature of other work the contractor contemplated made it probable that he would have use for it in future. Such was not the case. For a single job of this size the expense was, of course, disproportionately great. Also, on this work there was an opposing maximum grade of 8 per cent in two stretches, one 1,325 ft. and the other 1,300 ft. long; and a 7 per cent climb on one part of the hill, the total of all grades being 443 ft. in elevation. In 5,600 ft. of distance with as stiff a grade as this the speed for



PROFILE SHOWS HEAVY GRADES IN GREATER PART OF SEVEN MILE CONTRACT

a train of four cars carrying eight batches of three-bag size for the 1:2:4 mix was estimated to be 2.4 miles per hour for about 7½ tons. On the 8 per cent grade with a six-ton gasoline locomotive this same train ran 2.6 miles per hour. Although the speed of operation could have been increased by using additional locomotives it seemed more economical to install only enough industrial railway equipment to allow the concrete to cure sufficiently so that it could be used for the hauling of materials over it in motor trucks. Therefore it was decided to use the railway and motor truck haul combined to do the work. The point of transfer was constantly to be shifted ahead as the pavement cured.

The main items of plant on the work were as follows:

One ¾-yd. traction steam shovel
One jaw crusher (200-ton capacity with 50-ton bins)
Four five-ton motor trucks
One one-ton motor truck
Seven thousand feet of 20-lb. industrial railway track.
One six-ton gasoline locomotive
Twenty-four cars
Forty-eight batch boxes
One concrete paver
One finisher
Steel forms, pipe line, etc.

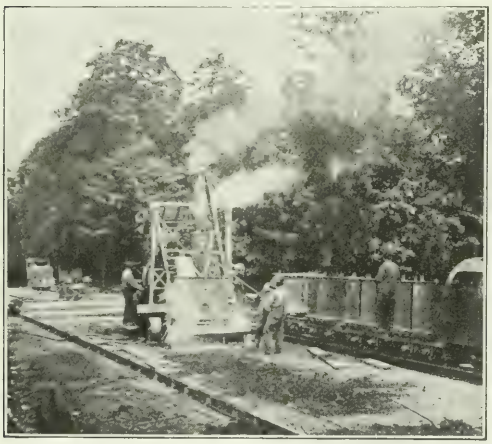
The total investment in plant was about $80,000.

In the actual construction, difficulties started immediately with transportation. No deliveries would be made on plant until June 1. To wait so long was fatal. So work started on May 10 at the end of the contract, Sta. 366. On May 18 the pavement was in up to the railroad track at Sta. 339. Aggregates were dumped on the sub-grade, and charged by the shovel and wheelbarrow method. The best day's work with a gang of 32 men was 450 ft. of pavement.

The cement gave out but by May 26 enough more was obtained to start again. The plant, of course, had not arrived, so by the former method concrete was laid from Sta. 272 back to Sta. 339. Thus, 1.75 miles of pavement was laid by June 21. Then came the inevitable wait for cement and industrial plant. By July 6 everything was in order, the plant set up at Sta. 272, and the work proceeded thence to the end of the contract.

A description of the locomotive and cars may be of interest.

The specifications for the locomotive called for one which would produce the drawbar pull of 2,400 lb.,



MIXER OPERATING ON 8 PER CENT GRADE
Note small mixing crew.

and would pull the following loads in cars that were required not to exceed 30 lb. per ton drawbar pull on a level:

Grades	Hauling Capacities Tons of 2,000 Lb.
Level	80
2 per cent	31
4 per cent	17
5 per cent	14
7 per cent	9
8 per cent	8

The weight of the locomotive was 6 tons. It had three speeds in either direction—low speed of about 3 miles an hour, intermediate speed of 6 miles per hour, and a high speed of 9 miles per hour. The transmission was of sliding gear selective type. All car frames were of steel provided with drawbar springs, and roller bearings. These weighed 1,007 lb. each and were fitted with 23-cu.ft. batch boxes weighing 480 lb. each, made of steel plates and stiffened at the corners by angle irons. The discharge was through the bottom, two doors being used which were held in place by a chain passing over the bearing on the top edge of the boxes and locking in position by means of a lever pin. The release of the pin opened the lever and dropped the doors. The doors were provided with projecting lips which overlapped when closed, making the boxes tight.

A train was composed of four trucks with eight batch boxes, this being the maximum load that the motor would take on the 8 per cent grade. The proportions of the different kinds of material were marked on the inside of the batch boxes and they were filled to their respective levels with sand and stone to which the cement was added. This transfer or reloading was done by hand. We estimated that hand loading was not quite as cheap as machine loading but we chose it because, among other considerations, it would insure continuity of operation with no losses due to equipment getting out of order.

One locomotive was used to transfer the loaded cars from the reloading station to the mixer. A second locomotive of lighter weight was used to spot the cars alongside of the mixer, and a turn-out was located between the mixer and the reloading station so that a passing point would be provided. The operation was to take a train of four cars up to the mixer and bring back four empties and take another loaded train up and bring back the empties in order that the mixer could be worked to full capacity. The small amount of equipment kept on this work made it necessary to have two loaded trains at the mixer for the start of work in the morning. Four cars were used till the summit of the hill was reached when the train load was increased to eight cars. The transfer point was advanced as the concrete gained sufficient strength to stand the motor-truck traffic.

The mixer had a rated capacity of 18 cu.ft. loose so it was necessary to keep it level as we were overloading it, using a three-bag batch, or about 21 cu.ft. of loose materials.

Personnel

The men operating this equipment consisted of a crusher gang which included: One fireman, two platform men, one loading, two drilling, one team, and six to seven men on loading stone. This outfit was able to keep the concrete gang laying in a nine-hour day from 335 to 420 lin. ft. of concrete, 16 ft. wide, and 6 in. thick at the sides and 7 in. thick at the center.

One ton of dynamite was used in quarrying 4,250 cu.yd. of crushed stone from a limestone quarry with a 30-ft. face operation in two levels. From two to five five-ton trucks were used to haul aggregate, depending on the length of haul.

The reloading gang was composed of six men shoveling sand, screenings and crushed stone, two men on cement, two boys with a foreman on cement sacks and greasing cars. Two engineers composed the train crew. One man took care of the pump which was amplified by a booster. He also took care of a second pump when it was necessary to run it.

The concrete gang consisted of one mixer engineer, two men spreading concrete, one man on mechanical finisher, one covering, two men on batch boxes, one foreman, two men setting forms, one man truing up grade. It took from six to eight minutes to load the eight batch boxes. The time to unload a train at the mixer was sixteen minutes.

The best day's work on the hill, using Sta. 272 as a reloading point, was 335 ft. of pavement. On July 20 and 21 about the same amount was laid, from Sta. 253 + 31 to 246 + 60. A glance at the profile will show the opposing grades upon which the trains were operated.

The advantage gained in utilizing motor trucks for the major part of the haul is that on grades such as these the motor truck can maintain a speed of from 5½ to 6 miles per hour as against the speed of approximately 2½ miles per hour with the industrial equipment. When the top of the hill is reached the train

length, train speed, and speed of mixer operation can be increased.

Considerable trouble was experienced in swinging the boxes around over the charging skip when the mixer was up hill because the mast was inclined down hill and would swing the batch boxes forward. In order to obviate this, wedge blocks were used under the front of the mixer to level it up so that the load would swing freely over the charging skip. To place these wedges the mixer was run a couple of feet back of its final position, and the wedges were placed on the plank; then the mixer advanced on the blocks. These had a cleat attached to the far end to keep the wheels from riding over the wedge, and a block was placed back of the wheel to hold it in position. These blocks also had another advantage in that they so leveled the mixer as to give full capacity on an 8 per cent grade.

The advantages to the contractor of the use of this equipment and method are obvious. The money work, that which costs least and shows the greatest margin of profit, is done first. That was, in this case, the short-haul concrete pavement, and its completion helped the contractor materially in his final work.

Wherever the pavement had been finished, haul over it by motor truck was much more rapid than it would have been by industrial railway.

In spite of the clay soil, concrete could be laid two hours after a rain.

Except a mile of track, two locomotives, batch boxes and running gear which all together cost $16,000, the major part of the plant may be easily salvaged or used in other lines of construction.

The completion of the work on time (the concrete pavement was finished Nov. 8), through the use and layout of this equipment meant an approximate saving of $20,000 which would have been lost had the work had to go over the winter.

Mr. Rosoff's own words throw light on the success of the work. He said, "The things that made that job go, that would make any job go, were the right equipment and layout; hustling from the word go, along every active foot of the road, from the contractor himself down to the last laborer—there shouldn't be five minutes of idleness on a job in man or machine; and then having someone from the outside to come in and help plan things and catch up the loose ends. Those factors saved the job, that bade fair to be the big loser in the state, and has turned out a winner."

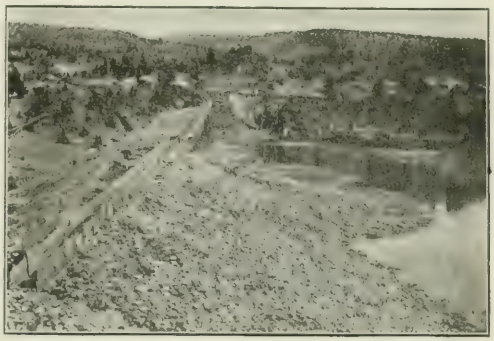
Arches and Girder Spans for Bridges

Several failures of newly constructed concrete arch highway bridges in New Jersey have been found due in part to improper design and in part to the inherent unsuitability of arch construction for the particular location in question. Bearing on this same point Charles A. Mead, bridge engineer of the State Highway Commission, said recently in a paper read before the New Jersey Association of County Engineers, "There seems to be a widespread notion that arches are beautiful. Some are. Being predicated on immovable abutments they should never be used in flat, marshy country where there is the slightest question of security concerning the founding material. Simple spans giving vertical reaction can be made attractive in appearance, and when they are in harmony with their surroundings and express a structural necessity they are pleasing."

Sheerboards Used in Building Hydraulic Fill Dam

Same Method Sloped Coarse Material or Placed Blanket of Fines — Lumber Cost, 1½ Cents Per Yard Sluiced

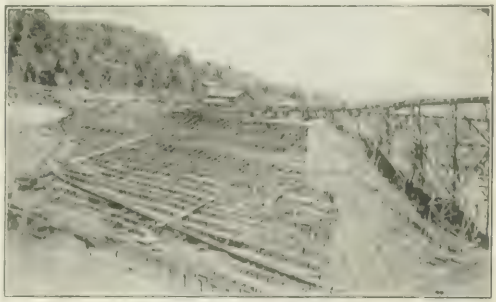
A METHOD of building high earth enbankments with sheerboards, which has previously been applied to regrading and terracing on a large scale (*Engineering Record*, May 4, 1912, p. 480 and Sept. 12, 1914, p. 288) was used in the construction of the dam recently built by the hydraulic sluicing method for the Ochoco Irrigation District near Prineville, Ore. The dam is 1,000 ft. long on top, 126 ft. high and contains 541,000 cu.yd. of fill. Three advantages claimed for the sheerboard



SHOWING SEPARATION OF COARSE AND FINE MATERIALS
(Compare gradual slope of fines in shallow center pool with coarse rock slope under flumes)

method, cited by the contractors as reasons for using it, are economy, accurate control of material and stability in the dam. In other words, the slight additional cost of lumber used for sheerboards made possible a large saving in labor; the method could be applied so as to segregate or consolidate material, as occasion required, and by this accurate control the proper class of material in core and embankments was secured, thus reducing the danger of sloughing or settlement.

The sheerboarding consisted of heavy stakes, set about 4 ft. apart, on the inside of which rough boards were nailed, beginning a few inches above the ground. As the fill progressed the sheerboards were set so the top of each lift was on the same level as the bottom of

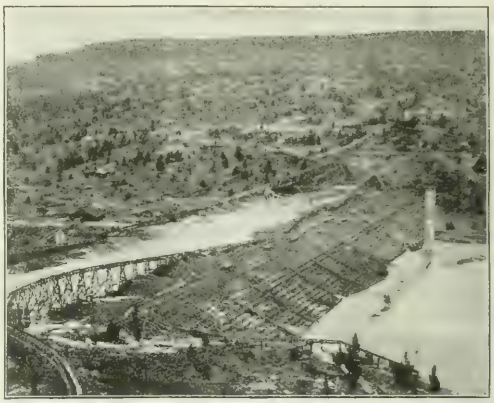


CHANNEL FOR THE STREAM MAINTAINED BY SHEERBOARDS

the horizontal spacing between lifts, the lifts having a standard height of 3 ft. Using this method, two men built up sheerboards as fast as required. Practically all the lumber was removed to be used over and over again. A simple stump puller, usually operated by a crew of three men, lifted out the stakes, after which most of the boards were easily removed by hand. The cost of sheerboard lumber for the entire job amounted to 1½ cents per cubic yard of fill.

The dam was built in three sections. In order to store water for the sluicing pumps, work was first concentrated on the upper toe dam, which was built to a height of 50 ft. Here the comparatively narrow core necessitated such careful segregation of material that temporary sheerboard bulkheads were occasionally used on the inside of both upstream and downstream prisms to keep the coarse material from the center core. When the work was started a small opening was left at the south end of the dam to take the flow of the creek. This channel was maintained as the fill progressed and was protected by carrying up a slope across the end of the fill by the sheerboard method. Thus for awhile the main fill had sheerboard slopes on two sides and one end.

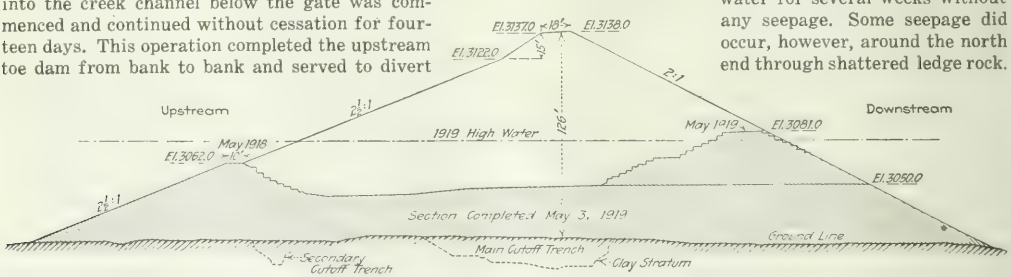
The method of affecting closure of the stream flow was as follows. When the toe dam had been completed to a height of 50 ft., except for the section near the south end where the stream channel was maintained, all fluming, timber bulkheads and other wooden structures as well as all loose rock were removed from the creek channel and banks. A timber gate for controlling the flow of the creek through the dam had previously been built and when preparations were completed this was closed and the creek waters were retained in the reservoir. Immediately thereafter the sluicing of material into the creek channel below the gate was commenced and continued without cessation for fourteen days. This operation completed the upstream toe dam from bank to bank and served to divert the waters of Ochoco Creek through the outlet conduit 35 ft. above the natural creek bed.



TYPICAL MATERIAL IN PLACE NEAR DOWNSTREAM SLOPE

taken from the spillway excavation. This was made impervious by sluicing over it a blanket of fines 6 to 8 ft. thick, placed as desired by the use of sheerboards.

In building up this downstream toe the sheerboards were used for consolidation or mixing rather than for segregation. No tight center core being required in this case the coarse material was not kept on the sides but was spread over the entire surface, and the fines, directed by sheerboards, were forced to flow over the coarse material filling the interstices and effectively consolidating the fill. The fill thus placed constituted a blanket on the down-stream toe dam and retained the water for several weeks without any seepage. Some seepage did occur, however, around the north end through shattered ledge rock.



CROSS-SECTION OF DAM, SHOWING PROGRESS OF FILL ON SLOPES

Upon completion of the upstream toe, work was commenced on the full width of the structure, depositing material on the downstream toe only, retaining the coarse material there and directing the fines into the center. When the fill had thus been brought to a height of 38 ft. it became desirable to begin storing water for the next season's irrigation. To do that effectively required a height of about 69 ft.

Accordingly work was concentrated on the downstream toe of the dam and this was carried on up independently as a separate structure 31 ft. above the remainder of the fill as it then stood. Water was impounded to a depth of 20 or 30 ft. over the major portion of the completed fill, as shown in the sketch, and to within 7 ft. of the top of the downstream toe dam. A part of this toe dam was made of large-sized rock

When the reservoir level could be lowered work was resumed and the full cross section completed.

The summit pool on this dam was kept small and shallow; the average center depth of water varied from 2 to 4 ft., the range being controlled by the 20-in. sections of the central downspout which were added from time to time. The stable condition of material in the bottom of the pool is shown by the fact that on one occasion two men in a boat were able to force down a 1-in. rod only 11 ft. of which about 2 ft. was in water. Soundings from a boat indicated that as each additional length of downspout was added a new stratum formed. These strata appeared to dip toward the center.

The work on the Ochoco dam was done by the Puget Sound Bridge & Dredging Co., Seattle, through its sluicing department, formerly Lewis, Wiley & Morse, Inc. R. W. Rea was project engineer for the irrigation district and J. M. Howells was consulting engineer.

Traffic Policies for Vehicular Tunnels Endorsed

Transportation Committee Approves Two-Line 20-Ft. Roadways and Railroad Signal System

POLICIES of the New York-New Jersey Tunnel Commissions with regard to roadway width, traffic regulation and other matters connected with the vehicular tubes under the Hudson River were endorsed in a report by an advisory transportation committee, made public Feb. 7, as noted in the news columns of last week's issue. This committee, selected last year by C. M. Holland, chief engineer to the commissions, consisted of 12 representatives of motor vehicle manufacturers and other transportation interests. The committee recommends cement-grouted granite block with close joints for the tunnel roadways. The substance of its report, which consists chiefly of answers to seven specific questions, is given below:

Question 1—What should be the minimum width of a two-line roadway in order to take care of traffic needs, keeping in mind the great cost which is involved with each 6 in. of roadway width, and the fact that any such excess would necessitate a larger tunnel, which introduces additional difficulties in construction and increased first cost, consequently making a continuing increased operating charge? The present cost of the project is estimated to be approximately $30,000,000, which is 2½ times that which was originally fixed for the project.

The committee, having in mind the great cost and construction difficulty of each additional 6 in. of width of roadway, decided after observing the two lines of traffic on the Williamsburgh bridge for one hour, to recommend the adoption of Mr. Holland's plan for a 20-ft. roadway. The 20-ft. roadway will provide sufficient clearance between vehicles to allow rapid progress of two lines of traffic. Insufficient clearance between lines would slacken the speed, but this would occur only when two vehicles of maximum width were abreast. That condition rarely occurs. There will be no appreciable effect upon the speed of the lines because drivers operate in an enclosed structure with other vehicles near them, providing that each vehicle is required to remain in the line in which it starts. Strict rules should be made and enforced keeping slowly moving vehicles in one line.

The committee decided that it was not necessary to make practical road tests with several motor trucks loaded, running the trucks in two lines, because the observations from the Williamsburgh bridge gave a most practical demonstration of what could be expected.

Question 2—What will be the ultimate size of the automobile truck? Is it not true that this will undoubtedly be fixed by a legal limit and become standardized, similar to railroad equipment in America today? In other words, will not the limitations imposed upon rolling equipment, due to layout of city streets in the past, prove the ultimate limiting factor? This does not mean that there will not be wide avenues, but how about all of the secondary streets which serve as feeders to the main arteries of travel?

The ultimate size of the automobile truck—that is, its length, width and weight—will undoubtedly be fixed by legal limit and become standardized, similar to railroad equipment. Due to the layout of city streets in the past and the impossibility of widening all of them, it will be necessary to impose limitations upon rolling equipment. As a matter of fact this has already been done in many cities, limiting the width to 7 ft. Even if the width of vehicles allowed to use the tunnel was fixed by the States of New York and New Jersey at 8 ft., still a 20-ft. roadway should give 2 ft. operating clearance between and 1 ft. on each of the outer sides of the lines and the committee considers this clearance sufficient.

Question 3—At approximately capacity operation, should not all vehicles be compelled to keep in the line in which they start?

At capacity operation all vehicles should be compelled to keep in the line in which they start, except in case of stoppage by wreck or otherwise. If the stoppage can not be quickly moved, the police should allow vehicles in the stopped lines to alternate with vehicles in the moving line and thus pass on through the tunnel.

Question 4—What provision, if any, beyond a center line marker, should be made to keep vehicles in their respective lines? Should a crown be introduced, or should there be fixed boundaries such as grooveways or curbs?

Only a center line marker should be used to keep vehicles in their respective lines and the police should enforce this rule. A flat road surface should be provided, there should be no boundaries, such as grooveways or curbs. If grooves or curbs were provided serious delay would result in cases of stoppage of one line or during the time of day when the tunnel is being used to its maximum capacity. The lines would be retarded by slowly moving vehicles if prevented by grooves or curbs from passing the slowly moving vehicles.

Question 5—What is the recommendation of your committee in regard to the best method of taking care of disabled cars?

The best method of taking care of disabled cars would be by apparatus and removing disabled cars. Many heavily loaded vehicles will pass through the tunnel and some of them will break down; therefore strong, heavy wrecking wagons (motor driven) should be provided and equipped with jacks, blocking dollies, etc., so that if necessary the broken down vehicle could be towed out of the tunnel, thus clearing the line. No driver should be allowed to attempt to make a repair or adjustment or change any tire in the tunnel if the operation would take longer than one minute, except during the times when travel through the tunnel is less than 50 per cent of capacity.

Question 6—What suggestions have your committee in regard to the regulation of the movement of traffic, such as signal devices and police regulations?

The railroad system of signalling should be adopted. That is, when a stoppage occurs the nearest police officer should signal with a red light, if vehicles are required to come to full stop; yellow light if required to proceed slowly; green light to indicate lines clear. These signalling devices should be so arranged that one line could be controlled independently of the other. Sufficient police force should be employed to enforce rules adopted and special attention should be given to vehicles entering the tunnel, so as to start slowly moving vehicles in one line and the faster ones in the other line to the greatest possible degree, even though many more vehicles might be started in one line than another.

Question 7—What suggestion has your committee as to the best method of cleaning the roadway of oils and gasoline drip, in order to have a safe roadway surface and eliminate the hazard of fire?

The best method of cleaning the roadway of oil and gasoline would be the application of a liberal quantity of torpedo sand, which should be swept away by mechanical sweepers at least once in each 24 hr. The committee is not in favor of having the roadway flushed with water as this would, on account of the grades, make the driveway hazardous when the roadway was wet; vehicles entering the tunnel from dry streets would not be prepared with chains to prevent skidding. Therefore, we believe dry cleaning is the proper method and suggest that it may be necessary occasionally to apply an alkaline powder which with the torpedo sand would scour the surface of the pavement. Bank sand should be provided at frequent intervals along the driveway on each side to be used when necessary to extinguish fire and soda-acid extinguishers of 10-quart capacity should be supplied and located in convenient places along each side of each driveway for further use in the extinguishing of fires. Also fire hose with suitable reel

and valves should be provided, the hose lengths to be sufficient to reach or lap one over the other and with sufficient capacity and water presssure to force a stream of water through a ½-in. nozzle at least 50 ft.

The signers of the foregoing report are:

E. E. LaSchum, (chairman) manager, motor vehicle department, American Railway Express Co.
P. V. V. Tobin, secretary, Howes Transfer & Contracting Co.
B. K. Rhoads, asst. supt. motor transport dept., American Railway Express Co.
I. A. Hungerford, manager, transport dept., Borden's Farm Products Co.
Frank B. Kurtz, manager, truck dept., Pierce Arrow Motor Car Co.
Frederick C. Horner, engineer, Packard Motor Car. Co.
C. G. Pepoon, manager, transport dept., Tide Water Oil Co.
Charles S. Lyon, chief engineer, Packard Motor Car Co.
E. C. Walker, supt. of motor vehicles, William Farrell & Son Inc.
Henry S. C. Brooks, vice-president, Burns Bros. Coal Co.
M. J. McDermott, traffic manager, James Butler Inc.
W. H. Moore, manager, Garford Motor Truck Co.

Failure of Steel Truss Support Wrecks Concrete Dome

By Edward R. Bowen
Consulting Engineer, Los Angeles, Cal.

On DEC. 16 the steel truss supports of a concrete dome over the auditorium of the new First Christian Church at Fifth and Locust Sts., Long Beach, Cal., failed, allowing the dome to fall. The building was nearing completion. Forms had been removed from the dome for more than two months and the ceiling of the auditorium was plastered; the exterior art stonework was being set. The failure occurred at noon, just after the workmen had stopped for lunch, so that there were fortunately no fatalities and only a few minor injuries.

The concrete dome (Fig. 1), the top of which was 76 ft. above ground, was 48 ft. in diameter, springing from a vertical concrete wall 8 in. thick, resting on steel trusses. The dome structure comprised eight 12 x 12-in. ribs carrying a 3-in. shell, all reinforced with rods and steel fabric. Its total weight was 200 tons.

A square of four steel trusses, supported upon four reinforced-concrete columns, carried the dome. The steel framing is shown in Figs. 1 and 2. At the time of the failure the entire dead weight of the structure was not on the trusses, as the stone veneer on the top of the dome had not yet been placed, a weight of about 60 tons.

The concrete columns formed a square about 62 ft. on a side. The C trusses are rested on the columns and the D trusses framed into these. The diagonal E trusses framed into the C and D trusses near their midpoints. The foot-wall of the dome was carried by the E trusses and by 15-in. diagonal I-beams framing between them. The C and D trusses were strutted to the E trusses by 6-in. H-sections as shown on the diagram, Fig. 6; these struts extended from the top chords of the C and D trusses to the top chords of the E trusses. The top chords of the D trusses were tied into the east and west walls of the building by two 15-in. I-beams which carried small turrets. The plans showed these beams framing into the top chord but in the construction they were dropped about 2 ft. below the top chord and hung to a gusset plate, so that the only lateral stiffening was that of the ½-in. plate. The 20- and 24-in. I-beams carrying to the C trusses framed into a vertical member about 3 ft. above the bottom chord, so that the top chords of these trusses had no lateral support save that given by the E trusses and the 6-in. H-section.

Details of the trusses are shown in Fig. 2. The bottom chord of both the C and D trusses was given lateral stiffness by the ceiling joist resting on longitudinal angles about 2 ft. above the bottom chord.

Examination of the wreckage shows that the columns are in excellent condition, the only damage being a slight spalling off of the corners and inside face where the trusses scraped in falling. While the dome fell with the trusses, its concrete was excellent; no evidence of poor concrete was observed anywhere in the building.

Failure originated in the steel framing, probably in the east truss D, as this truss is at the bottom of the débris. The exterior walls on the east and west sides fell *outwards*, the wall on the north side fell *inwards*. The south wall was not extended above the 20-in. I-beams, but these beams were pulled in. The position of the trusses C and D after failure is shown in Fig. 6. In the writer's opinion the east D truss failed by buckling outwards in the top chord. This pulled on the two attached E trusses, which drew the

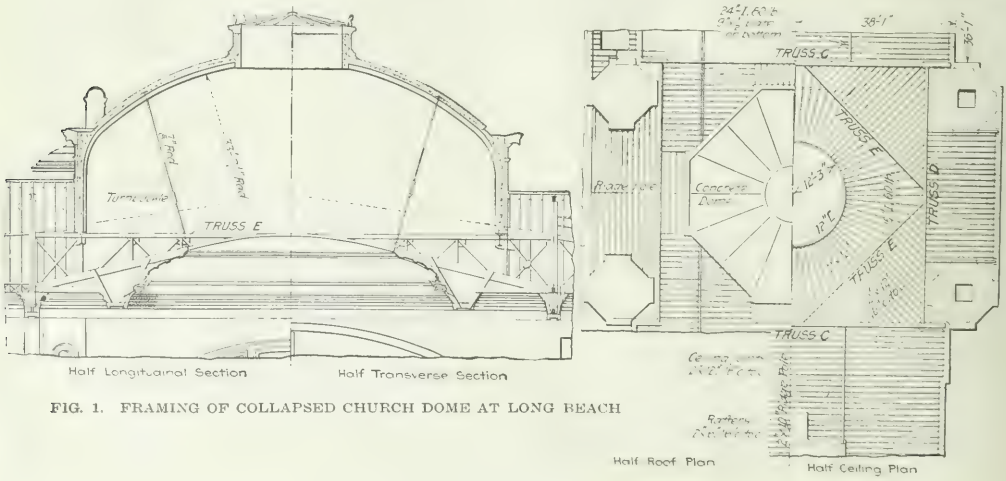


FIG. 1. FRAMING OF COLLAPSED CHURCH DOME AT LONG BEACH

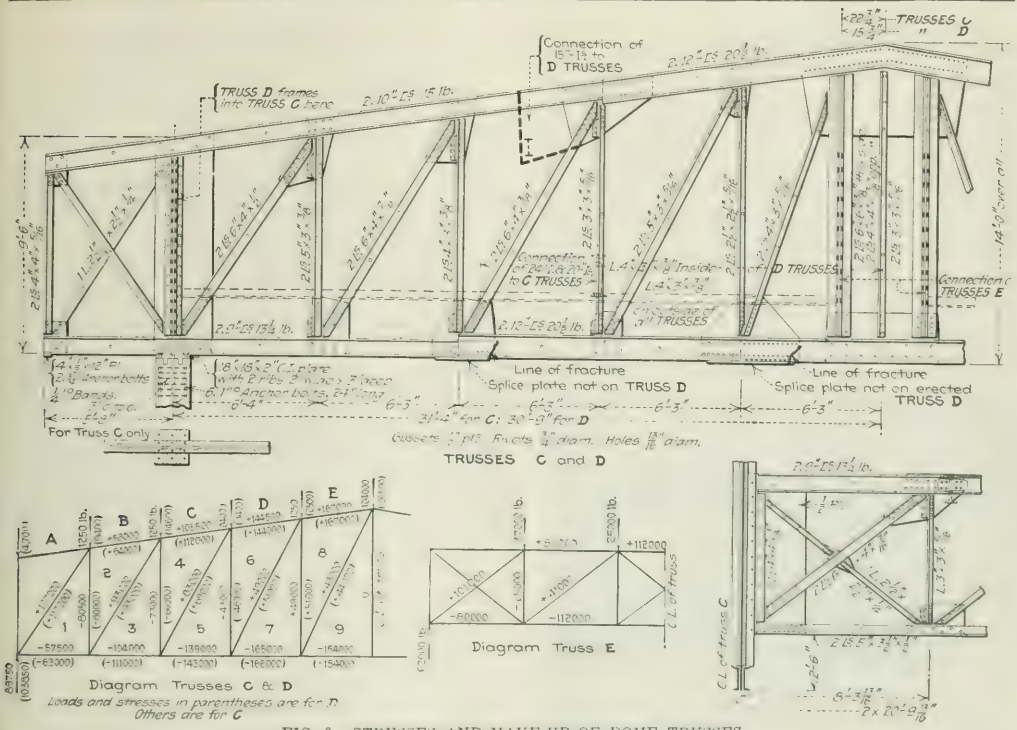


FIG. 2. STRESSES AND MAKE-UP OF DOME TRUSSES

C trusses inwards and, so long as the columns were firmly held, pushed the west D truss outwards. The bottom chord of the east D truss shows a fracture at the point indicated in Fig. 2. The bottom splice plate shown there was not on the erected truss. Sections of the bottom chord at this point are being tested, but the appearance of the fracture did not indicate poor quality steel to the writer.

The débris is being cleared away as rapidly as possible, and the owners plan to complete the building at once.

The architect was Robert H. Orr of Los Angeles, and the contractor was J. D. Sherer of Long Beach. Prior to construction a report on the structural steel framing was rendered by E. L. Mayberry, a structural engineer of Los Angeles, at the solicitation of the contractor. Mr. Mayberry condemned the design upon the ground that no allowance had been made for wind loads, the dead load only having been considered, and that there was not sufficient lateral strutting. He approved the design of the reinforced-concrete columns and the I-beams carrying the roofs of the wings and the turrets.

Referring to the trusses, Mr. Mayberry presented the stress tables reproduced below, for trusses E and C, including the safe strengths of the members and the stresses given on the architect's design drawing (sheet 113, of which a part is reproduced in Fig. 2 herewith). He computed the live-load stresses for 30 lb. per horizontal square foot, the amount specified in the Los Angeles building ordinances, except in case of the dome and turrets, on which he assumed a 15-lb. live-load.

Concerning the stresses he says in this report:

You will observe from these tables that my dead loads check very closely to the recorded loadings on the stress diagram on Sheet 113. You will also see by the tables that in the majority of instances the stresses in the members of the trusses as recorded on the stress diagrams on Sheet 113 are in excess of what is considered to be the allowable safe stress which the members are good for.

STRESS TABLE FOR TRUSS E

Member	D. L. Stress	Combined	Member Good For	Recorded Sheet 11
A-1	104,000	110,500	91,000	101,000
B-2	82,000	87,000	120,000	80,000
C-4	110,500	125,500	116,500	112,000
1-0	82,000	87,000	114,000	80,000
3-0	116,500	125,500	114,000	112,000
5-0	116,500	125,500	114,000	..
1-2	26,500	30,000	24,000	25,000
2-3	43,500	48,500	39,000	41,000
3-4	.....	.....	.....	.....
4-5	.....	.....	.....	.....

The first table is for truss E and the second for truss C. On account of the results obtained in connection with truss C, I did not think it necessary to further investigate truss D, in view of the fact that I would anticipate similar results in the case of truss D as those obtained for truss C.

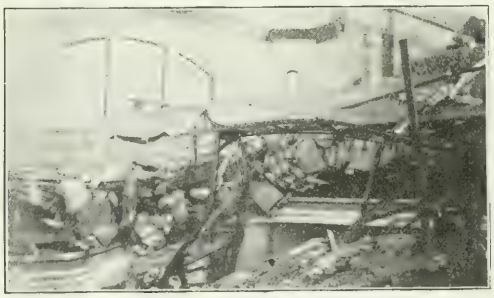
STRESS TABLE FOR TRUSS C

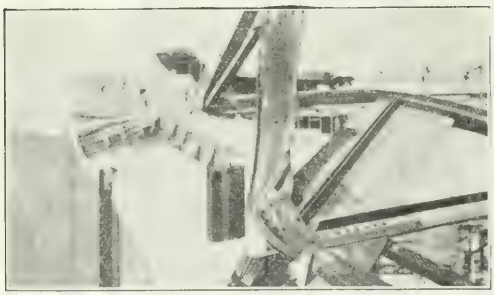
Member	D. L. Stress	Combined	Member Good For	Recorded Sheet 113
A-1	101,500	143,000	99,000	107,000
1-2	75,000	106,500	81,000	80,500
2-3	88,000	125,000	82,000	93,000
3-4	68,000	95,500	68,800	73,000
4-5	77,500	109,000	67,000	83,000
5-6	41,500	50,500	48,400	43,000
6-7	46,500	57,000	34,000	49,000
7-8	38,000	47,000	38,400	49,000
8-9	42,500	52,000	31,000	43,000
B-2	57,000	81,000	116,000	58,000
C-4	104,000	146,500	116,000	105,500
D-6	141,500	200,000	157,000	144,500
E-8	163,000	226,500	157,000	167,000
1-0	56,500	80,000	112,500	57,500
3-0	102,500	145,000	112,500	104,000
5-0	140,000	198,500	178,200	139,000
7-0	161,000	224,000	178,200	165,000
9-0	180,000	247,000	178,200	184,000

The results as given in the foregoing tables are based upon the assumption that the trusses are strutted properly in a lateral direction. There is at present an entire absence of such struts.

This report was rendered Dec. 17, 1919. In a supplementary report some days later Mr. Mayberry credited the web diagonals with somewhat higher strength on account of restraint of their ends by the heavy chords, as the result of a discussion of the stress sheet with the engineer for the steelwork, H. A. Larsen. He therefore stated:

Allowing a little more liberal construction of the problem, we find in the case of truss C the two members A-1 and 2-3, instead of being overstressed as shown by the table, to be good for a stress equal to the recorded stress on Sheet 113. The other three web struts, 4-5, 6-7 and 8-9, would be overstressed 10 per cent, 28 per cent and 7 per cent respectively, considering the recorded stresses, which





FIGS. 3 TO 5. VIEWS OF DOME WRECKAGE
Upper—South C Truss and West D Truss.
Middle—East D Truss and South C Truss.
Lower—East End of North C Truss; Part of Bed Plate.

Mr. Larsen has informed us are for dead-load conditions only. In regard to the top chord of the truss, there is only one way in which to consider the length of struts, and that is from center of panel point to center of panel point. This, however, does not change the condition that the truss is

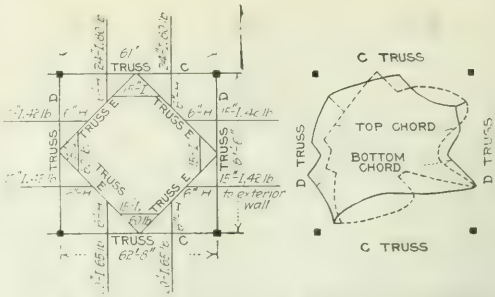


FIG. 6. POSITION OF TRUSSES BEFORE AND AFTER COLLAPSE

not calculated to carry any live load whatsoever, and it is my opinion that under existing conditions, with the high wind velocities that exist at Long Beach, it is absolutely necessary to take into consideration a live-load stress.

As stated before, my calculations are based entirely upon the top chords of these trusses being properly strutted.

These trusses will probably stand up under a dead-load condition only without consideration of wind pressure or possible superimposed live load. However, this is not in accordance with good design, and I am still of the opinion that the trusses should not only be strutted, but strengthened.

In fuller explanation of his attitude on the bracing of the trusses Mr. Mayberry advises *Engineering News-Record* that he "did not investigate the top chords in their unstrutted condition, as it never occurred to me for a moment that anyone would authorize the construction of these trusses in the face of my report."

Subsequently another engineer was engaged by the owners to report on the steelwork. The design was approved by him, and thereupon the contractor was instructed to proceed.

Australian Steam-Electric Plant to Use 50-Cent Coal

Construction is to be started April 1 on a 125,000,000 kw. steam-electric plant, 112 mi. from Melbourne, Australia, according to announcement from Australian government offices. This is a governmental undertaking, to be carried out by the Victoria Electricity Commission, which proposes to develop extensive coal deposits at the plant site, use the coal for generating electrical energy and transmit the power electrically to Melbourne and other industrial centers. Included in the project for which immediate construction is planned are a total of 1,800 mi. of high tension transmission line and three terminal substations. The trunk line voltage will be 132,000.

The coal deposits are said to be very extensive, enough being available within a half-mile radius of the power house to operate the new plant for 150 years. The coal is found in a seam 273 ft. thick under a 33-ft. overburden and can be delivered to the power house for about 50 cents per ton the report states. Condensing water is supplied by a river alongside the power house. A single building is to be provided for engine room and boiler plant, while control apparatus and offices will be housed in a second structure. Transmission will be over a two-circuit steel tower line with towers spaced 1,000 to 1,500 ft. apart, these long spans being deemed most economical for the high tension insulators to be used.

Some Recent Developments in Wood Preservation

Abstracts of Papers and Committee Reports Presented at the San Francisco Convention of the American Wood Preservers Association, Jan. 25, 26 and 27.

Conclusions of Experiments With Cresoil

By R. G. Smith

CRESOIL is a solution of 95 per cent mineral oil, preferably of an asphaltic base, and 5 per cent of cresol or cresylic acid. Results of tests made on Douglas fir at the St. Helens creosoting plants are as follows:

The solution is stable, i.e., there is no separation or filtering action of the wood on cresoil. It can be injected into wood satisfactorily and more easily than creosote. One test indicated a greater toxicity than creosote and another test less toxicity, but sufficient. The loss due to evaporation is less than one-half the amount of creosote. After ties had been evaporated to a constant weight, three times as much of both creosote and cresoil was left as necessary to kill all fungi. Service tests on ties placed in 1915 on two different railroads indicate a wide margin of safety in toxic value in amount left, 2.23 per cent and 2.43 per cent respectively.

Creosote Treatment for Douglas Fir Pipe Staves

By H. E. Horrocks

IN THE PROPER treatment of wood for stave pipe, the principal ends to be obtained are as follows: Adequate protection of the wood from decay; freedom of the stave from shrinking or distortion from its section and contour when machined; minimum of contamination of water flowing through the pipe; wood must retain its original strength and elasticity; no deposit left on the stave after treatment.

For both machine-banded and continuous stave pipe, the staves must be treated before assembling. Attempts were made to treat small sizes of completed machine-banded pipe, but the heat and handling invariably loosened the wires, making the pipe useless.

The stave stock must be thoroughly air or kiln dried in the rough, then machined to its finished shape before treatment. Being well dried, it is ready to receive creosote with pre-seasoning in the retorts. This insures against loss of strength or elasticity, against shrinkage, and, with careful stowing on retort trams, against distortion.

For adequate protection against decay it is not necessary that the creosote penetration be deep, since no further machining, framing or cuts for fastenings that might open up untreated wood are necessary. Through and through penetration would be highly undesirable, since the untreated but thoroughly dry wood in the interior of the stave very readily absorbs moisture, rapidly expands and insures a tight conduit. A ¼-in. penetration from all surfaces is considered satisfactory treatment.

An accumulation of pitch or sediment on the surfaces or edges of the staves would contribute to contamination of the water. It would also seriously interfere with close and accurate laying up of the pipe, increase the diameter of the pipe, and cause unequal bearing between staves, making watertightness difficult to accomplish.

If much free oil apppears on the surface of the staves, even though entirely liquid, water flowing through the pipe will very likely be contaminated for some time. To overcome these objections a straight distillate creosote is used for stave treatment.

The empty-cell process is used with 50 lb. initial air pressure, following the creosote pressure period with several minutes re-heating at about 25 deg. F. in excess of any previous temperatures, then a vacuum of not less than 20 in. maintained for from 30 min. to 1 hour. By this process a satisfactory creosote penetration is obtained and the staves come out thoroughly clean and so dry as to scarcely soil one's hand.

Treated Lumber for Insulating Roofs of Moist Factories

By F. J. Hoxie

A NEW USE for treated boards and planks is developing: heat insulation of roofs of cotton-weaving mills and paper mills. The object is to stop the rot which is rapidly progressing in them, by keeping the temperature above the dew point of the air in the room below. Two such roofs were installed two years ago in New England and are giving good results, not only in stopping rot, but in preventing sweating which has been troublesome in cold weather.

At present a Rhode Island weaving-mill roof is being covered with treated ⅞-in. North Carolina pine. This will require 130,000 ft. of lumber, which is being treated in an open tank in the mill yard. An absorption averaging 6 lb. per cu.ft. is obtained, although some of the light boards take up 12 lb.

When the treated boards were put on the roof the slag of the old roof was scraped off one bay with chisels. This involved considerable expense, and somewhat damaged the tarred paper, therefore, on the remainder of the roof the slag was simply swept off with stiff brooms.

The 2 x ⅞-in. sleepers were then nailed on, leaving a ⅞-in. air space under the insulating boards, the old slag roof remaining below the insulating covering to prevent the moisture from coming up into the air space from the highly humidified air in the room below. The present 2½-in. spruce-plank roof was installed 14 years ago, and has commenced to show unmistakable signs of rotting, although it still has sufficient strength to support itself and the new insulating covering.

Replacing the rotted planks of such a roof is by no means an infallible remedy, if the insulation or heating is not changed to keep the temperature below the dew point. Parts of two bays only two years old are now the worst rotted planks in the entire roof, due doubtless to the lumber containing considerable sapwood and having been kilndried. Therefore, when subjected to the highly humidified air of the weaving mill the lumber swelled and made a tight surface and kept the liquid water in, which had passed into the wood as a vapor and condensed in the cooler interior.

This form of insulation will considerably increase the

life of a new roof, or a new roof can be made of heavy plank thoroughly creosoted and sheathed underneath having a thin air space, the sheathing serving as a painting surface and to prevent dripping.

Effect of Zinc Chloride Treatment on Strength of Wood

By Committee on Preservatives, Alfred L. Kammerer, chairman

CONCLUSIONS drawn from three papers on the effect of zinc chloride treatment on the strength of wood by Prof. W. K. Hatt, by H. B. Luther and by T. R. C. Wilson and Ernest Batemen are as follows:

The treatment of wood with the usual strength of zinc chloride solution seems to have but little permanent effect upon the strength of wood in bending even five years after treatment, provided the temperature of the wood during that time is not excessively high. There seems to be a slight permanent decrease in the resistance of zinc-treated wood to shock even at the normal temperature. This decrease seems to be greater with greater absorptions of zinc chloride. At temperatures somewhat higher than the normal there may be a considerable reduction in all strength values.

Douglas Fir Paving Blocks

By Specification Committee on Wood Block Pavement, J. E. Horrock, chairman.

SOUND wood of at least six annual rings per inch is required; sapwood is not a defect. Depths of blocks are specified as 4 in. for very heavy traffic, 3½ in. for moderate traffic and 3 in. for light traffic; the preferable length is twice the depth and the width should be 3 to 4 in. Variations of $\frac{1}{16}$ in. in depth and $\frac{1}{8}$ in. in width are permissible. The preservatives are coal-tar oil or distillate oil having the following requirements.

	Coal-Tar Oil	Distillate
Max. water content	3%	3%
Max. insoluble in benzol	3%	0.5%
Sp.gr. of oil at 38° *	1.07-1.12	1.03
Max. distillate up to 210° C *	5%	5%
Max. distillate up to 235° C *	25%	15%
Sp.gr. at 38° of distillate from 235° to 315° C.	1.03	1.15
Sp.gr. at 38° of distillate from 315° to 355° C.	1.10	1.10
Max. coke residue	10%	2%

* Compared with water at 15° C.

Air-seasoned or green timber is permissible but must be treated separately as follows: The charge shall be boiled in creosote at not to exceed 190 deg. F., under vacuum of at least 20 in. for 2 hours and not to exceed 6 hours, depending upon the degree of dryness of the timber. Pressure shall then be applied not exceeding a maximum of 125 lb. until the preservative has been absorbed in an amount about 3 lb. per cu.ft. in excess of the specified quantity. The temperature of the creosote shall then be raised to and held at 225 deg. F. for 1 hour, then exhausted from the retort, the steam shut off from the coils and a quick vacuum of 20 to 25 in. applied for a period of 30 min. to 1 hour.

In any charge, the blocks shall contain at least 12 lb. of water-free oil per cubic foot of wood at the completion of the treatment. The blocks after treatment shall show the preservative well diffused throughout the wood, and the sapwood shall be entirely and well treated. To determine this at least 25 blocks shall be selected from various parts of each charge, and if more than one of the blocks show untreated sapwood, the charge shall be again treated. After re-treating, the charge shall be again subjected to a similar inspection. The surface of the blocks, after treatment, shall be free from heavy pitch or tar-like deposits, and all blocks that have been materially warped, checked or otherwise injured in the process shall be rejected.

The blocks shall preferably be laid in the street as soon as possible after being treated. If they cannot be laid immediately, provision shall be made to prevent them from drying out by stacking in close piles and covering them, and, if possible, by sprinkling them thoroughly at intervals. In any case, where they are not laid as soon as they are received on the street they shall be well-sprinkled about two days before being laid under the direction of the purchaser. It is important to have the wood sufficiently wet to be swelled to its maximum size before it is laid.

Conditions Under Which Non-Pressure Treatments Are Justified

By Committee on Economics, Carl G. Crawford, chairman

SINCE 46 per cent of all wood used in this country is used on the farms pressure treatment is available for but a fraction of 1 per cent of it. Great quantities are also used in other construction where pressure treatment is unobtainable, therefore non-pressure treatment is the only alternative. None of the commercial plants have any provision for small quantity distribution. As the annual decay of non-treated wood is estimated to exceed the loss of standing timber by forest fires, insect damage and disease an intensive educational campaign is recommended. Specific cases in which the engineer is interested where non-pressure treatments are likely to be advisable are as follows:

(1) For treating timbers and lumber used in building and car construction and repair work which must be framed at the building site, or which are used in such small quantities that it is impracticable to send them away for pressure treatment. Of the various non-pressure treatments possible hot and cold bath treatment with creosote will generally be most effective. When apparatus for this process is not available surface treatments may be used. For places where the odor or color of creosote would be objectionable water-soluble preservatives applied by the steeping process may be desirable. These preservatives are not suitable where the wood is likely to be wet frequently.

(2) For timbers used in interior construction where the ends are placed on concrete, brick or stone foundations, and only the ends are subject to decay, and for any other timbers where only points of contact with wood or other material are likely to decay prematurely. Surface treatments are usually the only methods which can be used in such places, but great benefit at little expense can be expected.

Perforating Poles To Obtain Better Non-Pressure Treatment

By Committee on Non-Pressure Treatments, L. L. Hill, chairman.

SINCE June 1, 1920, a commercial plant at Sand Idaho, has accelerated the non-pressure treatment of poles by the use of a perforating machine. The perforating is accomplished by chisel-pointed punches in the ends of heavy iron bars. These bars are raised by cams and allowed to fall, driving the punches into the wood by the weight of the bars. The distance through which the punches fall is regulated by an adjustable carriage upon which the pole rests, but is usually 2 to 3 in.

The bars operate independently but are released at the same time. This perforates a line of holes lengthwise of the pole. The pole is then automatically turned partway around and another line of holes perforated. In this way the entire surface of the pole for a distance of 1½ ft. above and below the ground line is perforated. The holes are so spaced that the oil is required to travel a distance of 2½ in. vertically, and not more than ⅛in. circumferentially, in order to obtain complete penetration.

The machine is not yet mechanically perfect and the operators plan to improve its construction. It is stated, however, that as now operated the machine permits of practically complete penetration of oil to the depth of the perforations. It is also stated that in some cases this penetration is not secured during treatment, but the continued movement of the oil in the wood after treatment is said ultimately to treat all the wood between the holes.

While the committee is greatly impressed with the possibilities of the perforating process definite conclusions cannot be drawn.

Financing Small Municipal Water Supplies in Illinois

Abstract of report of Committee on Water Supply presented to Illinois Society of Engineers by W. D. P. Warren, Decatur, Ill., chairman.

TWELVE cities in Illinois with populations of more than 2,000 people and 600 cities and villages with a smaller number have no water supply. Few new supplies have been installed in recent years and extensions to meet increasing demands in many cases have been inadequate. The past year was dry and conditions were especially bad in many cities that depend on surface or shallow ground water supplies. With the high cost of materials and insufficient bonding capacity to meet the expense of proper improvements, the situation has developed to a point where dangerous sanitary conditions will be created and industrial growth greatly retarded unless immediate relief is provided. A few cities have realized the situation and have remedied it, generally through the financial aid of citizens.

At Jacksonville, a citizens' committee organized a company to finance and purchase 380 acres of land essential to the development. A lease and option to and with the City Council for twenty years was then effected.

At Hillsboro, an $80,000 improvement was made with only $8,000 available from a bond issue. A part of the cost of the 14-in. cast-iron supply main, and the 300 acres of land necessary for the impounding reservoir, was financed by optional contract. Citizens executed notes running five years, for $100 and $200 each, to a trustee, who held title to a part of the land purchased, and who gave his notes as trustee to banks, putting up the citizens' notes as collateral. The city pays interest and at least $1,000 annually on principal.

Decatur, a much larger city, is now constructing a water impounding project which will cost $2,000,000, at least $1,000,000 of which will be raised by other than bond issue. A water-supply company financed by citizens was incorporated to acquire lands to be flooded and to furnish money to alter roads, raise bridges, etc. With this company the city enters into a contract in the nature of a joint undertaking to furnish water to the city. The city builds the dam, furnishes the existing pumping plant, water mains and intake. From a joint account into which revenues are deposited the city is to receive operating expenses exclusive of dam maintenence, depreciation betterments and further capital expenditures. The remainder of the joint fund is to be divided equally betwteen city and company. Cancellation of the contract by the company is provided in case a sum sufficient to pay a fixed return to the stockholders is not received. An option permits the payment to the company of a certain fixed sum and "payment in advance for successive periods of thirty days each of 8c. a 1,000 gal. for all water pumped during the preceding month." In case of default of contract by the city, the city is required to drain the reservoir. The company was organized with a nominal amount of no-par value stock and $1,000,000 of retirable par value stock. When the latter has been retired the few stockholders of the no-par value stock can cause the water company to convey its entire property to the city and wind up the corporation.

From Ralph J. Monroe, corporation counsel for Decatur, the committee obtained outlines for several possible ways of financing new water supplies and extensions. (1) New construction or purchase can be financed by the issuance of water certificates bearing interest and secured by mortgage and payable out of the income of the property and from no other source. A difficulty arises in applying this scheme to finance improvements since it is always a legal impossibility to devise any proper division of income which can be allotted part to the old plant and part to the new. (2) All other schemes depend on private capital, some of the common forms of which are (a) organization of a water-supply company to construct and operate the plant; (b) trustees to sell trustees' certificates, purchase the property and lease it to the city, (c) contract with a construction company to build the plant and later sell to the city on a conditional sales contract. Plan (a), the one in use at Decatur, is desirable where it can be used. It has an advantage over the municipal water certificate plan in that the corporation will hold title to the property until paid for and no foreclosure is required. The trustee arrangement, the one commonly used, is satisfactory, except that if the investment is sufficiently large, the amount payable in any one year might be a violation of the debt limit, but this can be avoided by having quarterly installments payable in advance.

The plan of letting a construction company build the plant has its advantages in that such an agreement relieves the city administration and local citizens from the worry and work in financing, but it will be found upon examination that this relief from worry and work is dearly paid for, as any contractor knows that his security is not of the best. He has to be well paid for the risk, local committees being much more restive if the security is all held by the contractor who knows that it is a long-time investment and figures on discounting the contract through some brokerage or banking firm. The discount is always very heavy; but as a last resort perhaps this plan is better than none.

Panama Canal Dredging Operations for Slides

Dredging operations were resumed at Cucaracha Slide on Nov. 15, 1920, owing to another general movement over this area, which occurred on the night of the previous day. Since that time, according to the *Panama Canal Record* of Jan. 5, one dipper dredge has worked continuously on a double-shift basis, removing from this slide 59,600 cu.yd. of material. Another general movement started on the last day of the month, but all material coming into the Canal at this point has been confined to the basin and has not interfered in any way with canal traffic. Including the excavation for November, the dredges have removed a total of 2,127,600 cu.yd. of earth and rock from this area since the slide of Feb. 22, 1920. Both Culebra and Barge Repair slides showed some slight surface movement during the month. At the Pacific entrance of the canal, 75,000 cu.yd. of earth, classified as maintenance work, was removed from the west side and center line of the Canal. In the Chagres River 25,200 cu.yd. of mud was removed in uncovering new gravel beds, and deepening the channel to the beds. At the Atlantic terminal a total of 75,400 cu.yd. of material was removed and dumped between the East Breakwater and Margarita Point.

Snow Surveying for the Forecasting of Stream Flow

Methods, Factors and Results in Making Spring Predictions of Summer Water Supply for Irrigation and Power in Streams Fed by Mountain Snows

By J. E. Church, Jr.
Nevada Co-operative Snow Surveys, Reno, Nev.

Part II—Predicting Run-Off from Large Areas—Inaugurating a Snow Survey System—Cost of Surveys

Wide-Area Forecasting—Uniformity of the snow cover in adjoining basins is an important feature in making practicable the forecasting of run-off from large areas. This condition of uniformity is due to the fact that winter storms which build the snow cover on the mountains are usually widespread in their sweep and that the gradient of their intensity is low and uniform for relatively wide distances. This is particularly true of the "big storms" that often furnish the bulk of the winter precipitation. However, in seasons of heaviest snow cover, the oscillation (as shown in Table IX) appears at times, but not uniformly, to be more accentuated than in seasons of normal or light snow cover.

The similarity of snow cover in adjoining basins is indicated distinctly by the snow surveys of 1917-20, the last two covering a distance of 95 miles, as shown by Table X. The gradient increases toward the south in 1917-18 and 1919-20, but toward the north in the intervening year. This uniformity is not a local peculiarity, but has been found also in the Wasatch range, Utah. For example, the snow surveys of 1913-16 in the City Cañon and Big Cottonwood Cañon creeks, conducted by the U. S. Weather Bureau and the engineering department of Salt Lake City respectively, varied from each other during the entire period only 1.7 to 2.9 in seasonal per cent, but the distance between these basins is only 14 miles.

Conditions for the Sierra Nevada Range—An important point is the probable uniformity and maximum variation in the snow cover of the entire Sierra Nevada range, as shown by the run-off of the streams. Owing to the relatively limited area of the snow surveys so far established, a broad view of the interrelations of the snow fields of the entire range must be obtained provisionally by using the run-off of the streams as the basis of comparison. To reduce the streams to a common standard, the seasonal percentage of each in terms of its own normal has been taken. Furthermore, to avoid all possible influences except that of the snow, the normals and seasonal percentages have been confined to April-July. The streams have been grouped laterally and transversely along the range to determine the probable amount of oscillation in the snow and the detailed snow surveys necessary to detect it.

Table IX includes the division by slopes. The western slope is fully represented except for the omission of the Pit and McCloud basins in the north and the Merced basin in the south. The eastern slope still lacks the minor basins of Honey Lake and Goose Lake in the north and the long Owens basin in the south. The foothill streams, being fed only to a minor extent by snow, are segregated from the rest. The primary peak of their flow occurs in midwinter, and only occasionally does their April-July run-off correspond closely with that of the crest streams.

If the run-off of the twelve major streams on the western slope were represented graphically, there would be a curve varying from end to end annually from 16.8 per cent to 308.8 per cent. The latter represents the season of 1915-16, when the snow cover increased from 81.5 per cent in the upper Sacramento basin at the northern end of the range to 390.3 per cent in the Kern basin at the far southern end, and disastrous floods occurred at San Diego.

If the slope is divided into three sections of approximately 150 miles each, the extreme annual variation in each would be somewhat reduced: Northern section, 1.8 to 71.5 per cent; central section, 8 to 38 per cent; southern section, 9.7 to 259 per cent, the latter occurring the year of the flood. If the Sacramento and Kern

TABLE IX.—VARIATION IN RUN-OFF BETWEEN STREAMS ON SAME SLOPE OF SIERRA NEVADA (APRIL-JULY PERIODS)

Side of Range	Basin	(Per Cent of Normal) Year 1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19
A. East Side:											
Central Sierra (80 miles)	Tahoe[1]	73.85	172.29	35.76	67.68	151.60	88.76	111.20	127.40	62.61	81.99
	Carson	64.14	176.70	42.43	57.18	162.95	93.33	125.71	128.65	61.31[2]	66.58
	West Walker	96.57	150.58	56.23	50.96	...	...	119.98	106.85	81.95	70.34
	Max. variation	32.4	26.1	13.8	16.7	11.4	4.6	14.5	21.8	20.6	15.4
B. West Side (440 mi.)											
1. North Sierra (Approx. 150 mi.)	Sacramento	71.0	112.2	80.2	79.0	115.8	141.3	81.5	91.0	53.0	69.8
	Feather	60.7	183.7	46.2	69.2	123.5	139.5	115.7	114.1	47.0	72.8
	Max. variation	10.3	71.5	34.0	9.8	7.7	1.8	34.2	23.1	6.0	3.0
2. Central Sierra (approx. 150 mi.)	Yuba	66.67	146.10	56.58	68.10	112.61	117.27	111.87	104.93	47.67	70.82
	American	77.58	184.12	56.20	60.13	109.25	124.04	110.88	110.10	53.46	76.85
	Mokelumne	79.95	168.22	53.24	51.84	113.75	109.01	109.35	113.54	63.64	75.29
	Stanislaus	74.31	163.92	49.80	44.14	105.16	105.46	110.32	109.74	60.65	61.09
	Tuolumne	76.49	150.66	59.82	59.49	113.17	105.65	102.33	107.95	73.12	67.21
	Max. variation	13.3	38.0	10.0	24.0	8.0	18.6	9.5	8.6	25.5	15.8
3. Southern Sierra (approx. 140 mi.)	San Joaquin	82.4	176.1	55.1	42.7	136.9	104.2	131.3	97.2	76.4	60.1
	Kings	78.8	142.3	52.8	49.7	123.8	101.7	150.1	97.5	77.2	60.2
	Kaweah	50.0	116.4	53.1	53.9	98.3	95.8	151.3	105.8	55.1	66.0
	Kern	87.6	174.1	62.5	52.6	170.3	113.0	390.3	139.1	83.1	76.5
	Max. variation	37.6	57.9	9.7	11.2	72.0	17.2	259.0	41.9	28.0	16.4
	Max. variation, exclusive of Kern	32.4	57.9	2.0	11.2	38.6	8.4	20.0	8.6	23.1	5.9
Max. variation of West Side		37.6	71.9	34.0	36.3	72.0	45.5	177.5	48.1	36.1	16.8
Foot-hill Streams: B. Westside											
2. Central Sierra	Cosumnes	77.23	218.65	62.88	57.24	91.34	153.42	114.48	142.02	64.72	72.0
3. Southern Sierra	Tule	58.7	112.8	63.2	37.7	95.5	154.3	207.3	147.8	36.2	65.8

[1] The rise of Tahoe has been corrected for excess or deficiency of precipitation upon its surface to make more comparable with the run-off of the streams.
[2] At Clifton, 21 miles below empire, where measurements are usually taken. Correction probably +5.0 per cent.

FIG. 3. SNOW SURVEYING IN DAGGETT'S PASS, SIERRA NEVADA

basins, situated at the extreme ends of the range, are treated as parts of new sections, the variations in the northern section, when the data for the Pitt and McCloud basins are included, should be less than at present, and in the southern section the variation will be reduced to the reasonable extremes of 2 to 57.9 per cent. Finally, and of greatest importance for forecasting, the individual percentages for several adjoining basins represent, with occasional exceptions, a fairly uniform curve of change, not only within the several sections but also overlapping from one section to another.

Even closer uniformity exists on the eastern slope, if the rise of Lake Tahoe is corrected for excess of deficiency of precipitation upon its surface to make the run-off in its lake basin more comparable with that in river basins. The variation might be even smaller if corrections were made for evaporation and diversion of water in the Tahoe and Carson basins respectively.

Likewise, if a cross-section of the two slopes is taken, a similar uniformity in the snow fields, with occasional variation, is shown by the streams that head in a common summit but flow down the range in opposite directions. Unfortunately, all examples are confined as yet to the Central Sierra section. In the Tahoe-Yuba-American basins the extreme annual variations are 0.3 to 42.4 per cent; in the Carson-Mokelumne-Stanislaus basins, 2.3 to 57.8 per cent, and in the West Walker-Tuolumne basins, 0.1 to 20.1 per cent. In this last case, data are lacking for the year of probable maximum variation. Table XI furnishes details of the records.

Oscillation in the Snow Cover—The second marked characteristic of the snow cover, as shown by the flow of the streams, is its occasional heavy oscillation along or across the range. A striking illustration of the former is the continuous and frequent zigzag in the seasonal percentage between the basins along the western side of the Sierra Nevada in 1910-11, when the maximum variation even within the individual sections was at its peak of 38.0 to 71.5 per cent. Another illustration is the sudden upward sweep in the Kern basin of 72 per cent from the neighboring Kaweah basin in 1913-14 and 239 per cent in 1915-16.

Oscillation across the range is illustrated by the diversity in the stream flow in the Central Sierra section in 1913-14. Although the maximum oscillation along the range, as measured on the western side, was only 8.1 per cent, the oscillation across the axis in the three several groups of basins varied from 42.4 to 57.8 per cent, the excess being uniformly on the eastern side.

Quadrangles in Forecasting—On the basis of stream flow, both uniformity and oscillation over the range can be detected and forecast most accurately by dividing the range into a series of quadrangles, the length of each quadrangle according, theoretically, with the length of oscillation. Practically, the quadrangle should be sufficiently short to keep the normal oscillation within reasonable magnitude without regard to its overstepping from one section to the other. The width of the quadrangle should be sufficient to include all foot-hills above the elevation of 6,000 to 7,000 ft. on both sides

FIG. 4. SAMPLING SNOW AT HEAD OF WARD CREEK

of the crest, in order to furnish as long a transverse base line as possible. Crest stations with outposts on either side should be maintained to reveal any deviation in the seasonal percentage either along or across the range. Each basin should be represented by one or more crest stations, the number depending upon the size of the basin or the reliability of the station.

In the California-Nevada co-operative survey, three quadrangles have been formed. The oldest is the Central Sierra quadrangle comprising the Tahoe, Carson and Walker basins on the eastern slope, and the Yuba, American, Mokelumne, Stanislaus and Tuolumne basins on the western slope. Crest stations representative of the entire quadrangle have been established, with outposts along the eastern side, four of the latter being situated on the crest of the Carson range, which forms the eastern wall of the Tahoe basin. On the western side, outpost stations have been established thus far only in the Yuba basin in the northwestern part of the quadrangle.

The southern quadrangle should include all crest basins from the Merced or San Joaquin basin to the Tehachapi Pass, thus comprising the Kings, Keweah and Kern basins on the west and the long Owens basin on the east. Special attention must be devoted to the surveys in the complex Kern basin, which includes the long trough between the double crest of the high Sierra and the broad valley adjoining the Mojave desert. The Northern quadrangle will comprise probably the Feather, McCloud, Pit and upper Sacramento basins

TABLE X. SIMILARITY OF SEASONAL PERCENTAGES OF SNOW COVER IN ADJOINING BASINS

Season	Basins, Each Represented by One Central Station: Yuba (Summit Station)	Tahoe (Rubicon Peak)	Carson (Blue Lakes)	Walker (Cirque Mountain)
1917–18	82.5	90.6	96.4	
1918–19	107.1	95.5	96.8	97.0
1919–20	71.6	73.3	75.3	88.2

The average of the three crest stations, Ward Creek, Rubicon Peak, and Lake Lucile, is 104.7.

on the west and the two minor Honey Lake and Goose Lake basins on the east. The mountains are relatively low and without commanding crests, and outpost stations are difficult to obtain. However, the snow fields of Mount Shasta and Lassen Buttes may prove to be a factor of considerable proportions in helping to forecast the flow.

Foothill Streams—Forecasting the run-off in the foothill streams is a special problem, like forecasting the run-off from the San Gabriel mountains in southern California. It is complicated by the fact that these streams are fed by winter snow, which, although accurately measured in catch basins, is unstable in its melting, and by rains which begin to run off immediately. This forecast can be only short in its extent and subject to revision according to the rainfall and to the melting of the snow.

In inaugurating the snow survey of a basin or drainage area, the initial steps should be to determine the chief tributaries of the draining stream and to locate headwaters of Mary's River and North Fork. The courses planned for the larger streams in each group will serve probably for the smaller streams as well.

Since the two groups of courses are 80 miles apart, local observers should make the surveys in their respective localities. If the survey is made by one party, it should be made first along the northern feeders, where the watershed is not only lower but is gentler and faces the sun, rather than along the southern feeders, where the ridges are sharp and the slopes are protected. The feasibility of such a system has been proved by the establishing of as few as three courses in 1919 by the Nevada section of the U. S. Weather Bureau and the use of two of them during the past season in furnishing a satisfactory forecast of the April-July flow of the Humboldt basin.

An example of another type is the Bow River basin of Alberta, Canada, where the Canadian Meteorological Service inaugurated snow surveys in 1917. This basin is so alpine at its head in the Glacier National Park that a survey by the method of areas is physically impossible and even a survey by the method of seasonal percentage is difficult because of the difficulty of finding sites for stable courses. But an adjacent smaller basin of gentler contours has a snow cover closely representative of that in the larger basin. Consequently, the seasonal percentages in the smaller basin can be safely applied to the stream flow of the Bow River basin also.

In basins reaching far down from the crest of the snow survey courses at points of major flow. In this way a large basin can be served with a minimum of effort. For example, the Humboldt basin in Nevada has a length of 350 miles and a drainage area of 14,200 sq.mi. above Humboldt Lake, which receives its residual waters. But its run-off can be determined fairly well from four stations strategically placed in the Ruby and Charleston-Independence mountains, these being parallel ranges 80 miles apart which furnish approximately 90 per cent of the water of this basin.

The supplies from these two ranges bear approximately the ratio of 3:2 in favor of the higher and more rugged Ruby range. Of the feeders from the other mountains, Mary's River and North Fork furnish 84 per cent of the total run-off on that side, and of the three from the Ruby mountains, Lamoille Creek and South Fork furnish 86 per cent from their group. Furthermore, South Fork furnishes twice as much water as Lamoille Creek. On this basis, there should be four groups of snow courses: Two in the Ruby range, one each along South Fork and Lamoille Creek; and two in the Charleston-Independence mountains, along the range, crest and outpost stations should be established, the latter at a sufficient distance from the former to give a fair average of seasonal percentage at the two extremes of the basin.

Developing a Normal—In the absence of a normal for either snow cover or run-off, a simple process is to obtain data for the current snow cover and stream flow and apply them provisionally as a standard to the data obtained during the second and immediately succeeding years, until such time as a normal can be computed. Care should be taken to determine whether the run-off of this first or standard year has been abnormally affected by lack of normal precipitation or by other variable factors after melting began, for otherwise the resulting error would be perpetuated.

If rainfall measurements in the basin are not available, use should be made of those nearest or most reliable, for lack of rain sufficient to cause extreme variation in the run-off will be a general rather than a local phenomenon. If a satisfactory normal for stream flow is already at hand, so that the seasonal percentage of the first year is definitely known, this percentage can

TABLE XI. VARIATION BETWEEN RUN-OFF OF STREAMS ON OPPOSITE SLOPES OF SIERRA NEVADA, BUT HAVING A COMMON SUMMIT APRIL-JULY PERIODS

(Percentage of Normal)

Group	Basin	1909–10	1910–11	1911–12	1912–13	1913–14	1914–15	1915–16	1916–17	1917–18	1918–19
I—North	Tahoe[1]	73.85	172.29	55.76	67.68	151.60	88.76	111.20	127.40	62.61	81.99
	Yuba	66.67	146.10	56.58	68.10	112.61	117.27	111.87	104.93	47.67	70.82
	American	77.58	184.12	56.20	60.13	109.25	124.04	110.88	110.10	53.46	76.85
	Max. variation	7.2	26.2	0.8	7.6	42.4	35.3	0.3	22.5	14.9	11.2
II—Middle	Carson	64.14	176.70	42.43	57.18	162.95	93.33	125.71	128.65	61.31[2]	66.58
	Mokelumne	79.95	168.22	53.24	51.84	113.75	109.01	123.28	113.54	63.64	75.29
	Stanislaus	74.31	163.92	49.80	44.14	105.16	105.46	110.32	109.74	60.65	61.09
	Max. variation	15.8	12.8	10.8	13.0	57.8	15.7	15.4	18.9	2.3	14.2
III—South	West Walker	96.57	150.58	56.23	50.96			119.98	106.85	81.95	70.34
	Tuolumne	76.49	150.66	59.82	59.49	113.17	105.65	102.33	107.95	73.12	67.21
	Max. variation	20.1	0.1	3.6	8.5	...		6.7	1.1	8.8	3.1

[1] Corrected for rainfall on surface of the lake.
[2] At Clifton, 20 mi. below Empire, where measurements are usually taken. Correction, therefore, is probably +5.0 per cent.

be considered as that of the snow cover also, providing that no abnormal shrinkage in the former has occurred. From this percentage, the normal of the snow cover can be obtained at once.

A capital example of such pioneering is furnished by a recent experience in the Humboldt basin. The courses were one year old and some melting had occurred before the original measurements could be made. Further, the succeeding stream flow, measured by the U. S. Geological Survey, had not been announced. On the assumption that the melting was 3 in. of water (based on observations in the Sierra Nevada), the original measurements were increased by this amount and were then used as a standard of comparison for the present season. On this basis, the snow cover of the present season was found to be 76 per cent of that of the preceding season. On the other hand, there had been a probable shrinkage of 25 per cent in run-off the preceding season due to general lack of precipitation, which might not occur the present season. Consequently, a forecast of stream flow approximately equal to that of the preceding season was made, but owing to weather conditions this was reduced in the May forecast to 91 per cent.

Although no definite statement of the acre-feet available could be made, the comparison with conditions the previous season was even more comprehensible to the irrigationist, who still had a vivid recollection of its dryness. Later, the stream flow for 1918-19 (April-July) was announced as 115,690 acre-ft., or 49.6 per cent of normal The estimate for the present year was immediately changed to 45.1 per cent or 105,278 acre-ft. The actual run-off was 105,950 acre-ft. or 45.4 per cent.

A provisional normal can be based on as few as three seasons' measurements, providing the seasons are complementary. Thus, in the Tahoe basin the seasons 1909-12 and 1912-15 consisted of a heavy, an average and a light snowfall each, and their normals for crest and eastern outpost stations, measured in inches of water, bear the following close resemblance to each other and to the six-year normal:

	1909-12 (3 Years) In.	1912-15 (3 Years) In.	1909-15 (6 Years) In.
Crest	45.09	42.99	44.04
Eastern outpost	26.14	27.02	26.58

This rare occurrence has not been repeated and only recently is the average of the snow covers since 1915 approaching normal.

Years of very excessive snow cover or run-off should be omitted in forming a normal, unless the normal is based upon a very large number of years. Otherwise, the "reasonable expectation" will be set too high and chronically sub-normal years will result. For this reason, in all computations made in the Sierra Nevada surveys, seasons above 200 per cent have been omitted temporarily. Such high records include the rise of 225 per cent in Lake Tahoe in 1906-07 and the tremendous flows in the Kern River or 345.4, 302.7, and 390.3 per cent in 1905-06, 1908-09, and 1915-16 respectively. If the floods of the Kern are included in its normal, emotionalism must be considered as its normal habit.

Spring and Summer Precipitation Stations—In each basin, precipitation gages sheltered from the wind and of sufficient capacity to catch either snow or rain should be centrally located to determine the average precipitation over its area during the period of melting and late summer and autumn run-off. A gage at a central settlement will usually suffice, but occasionally a seasonal gage set farther into the basin will be more satisfactory.

Forecasts—Three forecasts of run-off each season will meet all ordinary needs, except when reservoirs are used for the dual purpose of flood catchment and irrigation storage. Then surveys and forecasts should begin with the first heavy snowfall and continue at intervals throughout the season. The first forecast is made early in April and represents merely the seasonal percentage of the snow cover at its maximum stage before melting has set in. The second is made early in May, when the probable effect of weather on the run-off can be anticipated and the estimate of probable run-off corrected for abnormal shrinkage. The third is issued early in June, when the run-off of April and May furnishes a clue to the balance available.

Additional snow surveys, made early in May and in June, indicate the relative amount of snow still unmelted and when a normal for melting has ultimately been obtained these surveys will furnish a check on the forecasts. These later surveys need be made at only a few central stations, but the courses should preferably be on level ground to indicate average conditions of melting at their altitude. Fig. 3 shows a snow survey party and Fig. 4 an observer weighing the water content of snow samples.

Temperature has such an immediate effect upon the run-off that it is always a disturbing factor in attempts to forecast the rate of run-off for any considerable period, although it has little effect on the ultimate net quantity delivered. In the case of reservoirs and lakes whose normal decrease from maximum stage due to evaporation is known, forecasts of available water for irrigation and power can be made with fair certainty until autumn when the new season's storms begin.

Organized Effort Essential

Single-basin surveying is sometimes unavoidable, but larger public service with increased accuracy and relatively decreased expense can be rendered by wide-area surveying with a central agency directing the work. In other words, organized effort or co-operation is more advantageous than individual effort. In this way overlapping can be avoided. Furthermore, early knowledge of the latent water resources of the range would permit power companies in deficient basins to make adjustments by "tying-in" with their more fortunate associates.

With the desire to conserve and harmonize its resources of land and water, the State of California, under the initiative of Major P. M. Norboe, chief assistant state engineer, has joined with Nevada and the Nevada section of the U. S. Weather Bureau (the last entering under the initiative of H. F. Alps) in establishing co-operative snow surveys throughout the two states, particularly in the part of the Sierra Nevada which is common to both. Power companies, such as the Pacific Gas & Electric Co. (the largest producer of power on the Pacific coast) and the Truckee River General Electric Co., are sharing in the work. Government bureaus and individuals also are rendering assistance.

To the Nevada plan of snow surveying has been added the California plan of the dual-use reservoir and the despatchership of streams. This involves the use of large catchment basins for the discordant purposes of flood control and storage for irrigation and power. The

combined plan will require a knowledge of snow storage and flood possibilities, initially to determine whether a reservoir in any particular season can be kept empty throughout the winter and yet be filled in the spring, but ultimately to determine how the reservoir can be used to full capacity, yet with safety against floods.

Cost of Snow Surveys—The cost of surveying a basin depends upon its number of courses and their accessibility. In the Tahoe basin, the "control" basin of the Central Sierra section, with its seven stations and a circuit from Reno of approximately 230 miles by train, auto, ski, sledge and motor-boat, the April survey requires the equivalent of thirteen days by a party of two persons, or proportionately less by the three parties that usually do the work. In the Yuba and Carson basins, four to six days are required. But in the Walker basin, ten days of strenuous effort and 100 miles of snowshoeing are necessary to cover the two forks and reach the almost inaccessible crest station between the Walker and Tuolumne rivers.

Surveys in May, because of their relative fewness, require far less time, being confined mainly to the crest stations in the Carson, Tahoe and Yuba basins. The maximum wages per day are usually $10 for chief of party and $5 for assistant, the amount being paid as a bonus to mountaineers who have other sources of income. Traveling expenses also are paid. The cost of maintaining a central precipitation station should not exceed $25 a month from April to November inclusive.

The present problem is to penetrate the higher basins of the Sierra Nevada sufficiently far to make an accurate determination of their snow cover, the proportions of which are indicated better by the winter run-off than by the winter rain or snowfall at the valley stations below. To accomplish this penetration, chains of refuge huts a day's march apart can be constructed and provisioned. The only requirement would be a preliminary winter reconnaissance to find sites where the snow lies sufficiently shallow to permit entering the cuts without effort.

Creosoted Wood Pipe in Use 28 Years

Creosoted wood pipe culverts put in place in 1892 by the Southern Pacific Railway Co. are still free from decay and the wood in perfect condition, according to a statement by E. J. Bartels in a recent paper before the American Wood Preservers Association.

Coal Cars of 120 Ton Capacity for Virginia Railway

TO HANDLE heavy traffic in coal for export the Virginian Ry. has adopted a type of steel gondola car having a load capacity of 120 tons, the rated load being 109 tons with the usual allowance of 10 per cent overload. These cars are operated only in solid trains and on the company's lines. As they are unloaded by car-dumping machines on the coal shipping docks no bottom doors or hoppers are provided and the sides are made smooth to give a uniform bearing in the unloader cradle. Stiffener angles and gussets are placed on the inside and the short end panels of the sides are recessed so that the ladders and grab irons do not project beyond the normal surface of the car.

COAL CAR OF 120-TONS CAPACITY FOR VIRGINIAN RAILWAY CAR-DUMPING MACHINES

In inside dimensions the cars are 49½ ft. long, 10¾ ft. wide and 7½ to 8½ ft. deep, giving a cubic capacity of 3,840 cu.ft. level full or 4,450 cu.ft. with coal heaped up at an angle of 30 deg. The empty car weighs a little less than 40 tons. Six-wheel trucks with 33-in. steel wheels are used, the truck frames being articulated over the middle axle to permit of vertical deflection. These cars were designed and built by the Pressed Steel Car Co., Pittsburgh, Pa., under the direction of R. E. Jackson, superintendent of motive power of the Virginian Ry.

The Traffic of New York City

A traffic survey made by the National Automobile Chamber of Commerce, facts gathered by the New Jersey Interstate Bridge and Tunnel Commission and some by the Department of Plant and Structures, New York City, set forth some astonishing statistics regarding the daily traffic into New York City, says a recent bulletin from the New York Municipal Reference Library. A total of 154,700 cars and trucks enter and leave Manhattan daily. The average number of passengers carried per car is 2.7 and the average load is 1.14 tons. The traffic across the bridges is very heavy, at some hours as high as 1,344 vehicles per hour, and even a greater proportion of truck travel is found on the Jersey ferries. During a 24-hr. count on 15 ferries the motor trucks numbered 7,482. It is estimated that 420,000 persons use automobiles to travel back and forth to the city, which is an equivalent of almost one-third of the travel daily on the Interborough subways. These figures do not include the passenger cars within the city borders.

Spring Valley Water Co. Purchase Strongly Recommended

IN a report submitted last December to the San Francisco Chamber of Commerce, but just made public, J. Waldo Smith, chief engineer of the Board of Water Supply of the City of New York, strongly recommends the purchase by the city of San Francisco of the works of the Spring Valley Water Co. In any event he urges that steps be taken to insure the earliest possible increase in the volume of water supply available since "San Francisco's life, health and progress are imperiled by the present condition of the water supply."

Mr. Smith considers as very fair to the city the value of $37,000,000 for the property of the company as placed by the Railroad Commission.

Regarding the water-supply needs of San Francisco and the reasons why the city should own the waterworks Mr. Smith says:

The stored water in the Peninsula and Alameda sources of the Spring Valley Water Co. has been reduced in the last five years of low rainfall, so that the recurrence of another dry season similar to that of 1920 will result in all the reservoirs being practically empty, a condition which would require the unthinkable remedy of rationing water—a hardship and a risk to which no one officially responsible should subject the people.

This menace is further emphasized by the fact that the water company has exhausted every expedient to reduce waste and to conserve its supply to the fullest possible extent. The slack is now all out, and the consumption is increasing at a normal rate. The present margin between safe available supply and demand is very narrow.

Within less than three years the consumption will be greater than the supply, and the storage reservoirs under average conditions will be continuously depleted. In other words, the water supply will have to be run on the faith that the rainfall will be above the average for an indefinite period. The condition is now such that more water is the only remedy, and this must be secured quickly.

The Alameda sources are the only ones immediately available, because:

(a) It is physically impossible to complete the construction work necessary for the first installment of Hetch Hetchy water, even under stress, in less than seven years.

(b) The unprecedented conditions created by the war, for which no one can be held responsible or to blame, have about doubled the cost of construction work. The sum now required to complete Hetch Hetchy is beyond the city's present financial resources, even if other equally necessary improvements are neglected.

Unless the grave conditions recited above are temporarily relieved by early copious rains, the city or the company must proceed with emergency work that can be completed within one year from date, and which will add 5 to 10 m.g.d. to the supply.

For a permanent remedy, the completion of construction of Calaveras reservoir, with a conduit leading to the city, must be promptly begun and additional water made available to the city as soon as possible.

The Alameda sources, when developed to their capacity and operated as a unit with the peninsular sources, will, in my judgment, at least double the supply now used by the city. This will allow the continuance of the development of the Hetch Hetchy from Moccasin Creek to the city only at a rate which will permit of the introduction of the first installment of Hetch Hetchy water when all the peninsula and Alameda sources are developed and used to their fullest extent.

The mountain division of the Hetch Hetchy, including Moccasin Creek power house and equipment, should be completed as soon as practicable, so that the project may become income producing at the earliest possible date.

The serious condition above set forth is largely, if not wholly, due to the fact that neither the city nor the water company has been charged with full responsibility.

The water company for many years, due to litigation, insufficient funds, and because it was not a free agent, has been unable to make the needed additions. The city has likewise been unable to meet the situation. A point has been reached where one of two things must be done and done quickly: (1) The city must purchase the property of the Spring Valley Water Co.; or (2) The company must be relieved of any interference on the part of the city, assured of an income sufficient to finance large capital investments, and be made to shoulder the full responsibility of maintaining at all times an adequate and generally satisfactory water supply to the community.

The answer is so plain as should leave no doubt in the mind of anyone interested in the progress and well-being of San Francisco, that the water supply, which is as necessary to the life, health and prosperity of the people of the city as the air they breathe, should be municipally owned and operated, for the following reasons:

1. Water supply is the one public utility concerning which no questions are raised as to the wisdom of municipal ownership and operation. There is now no other large city in this country which does not own its own water supply. It is safe to say that there is no city above 200,000 population where the supply is not municipal. In fact, a large proportion of all the water supplies in the country, both large and small, are municipally owned. In general, the municipality has rendered good service in the operation and maintenance of this utility.

2. It is the only way to end the present impossible condition of divided authority and consolidate the whole water question under one head (obviously the company cannot buy Hetch Hetchy), so as to secure an orderly development as a whole, and assure continuity of plan and purpose. This is particularly important, as the water supply, more than any public utility, requires looking far to the future. Plans must be made far in advance, in order that there may be no serious shortage in the supply.

3. If the city does not purchase now, it is certain to do so in the future, and at an increased cost. Much higher rates will also be required in order that the company may finance necessary capital expenditures for making available additional water. The Railroad Commission has practically indicated in its report that it will grant a rate schedule sufficient for the company's financial needs.

4. The valuation placed on the property by the Railroad Commission is extremely favorable to the city and is fair and reasonable.

5. The city is not asked to purchase an obsolete plant in a bad state of repair. The Spring Valley Water Co. is a going concern, capable of rendering good service, and its properties can be developed sufficiently to provide the city with water for many years. The system has been designed with skill, constructed with care and conscientious attention to detail. Structures have been well maintained.

6. It would be an economic crime and ultimately result in bankrupting all concerned for the city to construct a new distributing system paralleling the Spring Valley and build costly reservoirs within the city and on the peninsula, where the company has already utilized the best locations.

7. It can be said without fear of contradiction that all engineers who have given serious thought to the Hetch Hetchy project, from its earliest inception, have considered the Spring Valley works an indispensable part of San Francisco's water supply. Now is the time to secure them. The present city engineer, as well as his predecessors, has often voiced this sentiment.

Contents of Library of Congress

The Congressional Library on June 30, 1920, contained 2,831,333 books and pamphlets, 166,448 maps and charts (pieces), besides nearly 1,400,000 entries under music and prints, making a total of nearly 4,300,000 listed items. The gain in books and pamphlets during the year 1919-20 was 120,177.

Highway Council Plans Intensive Study of Subgrades

By H. G. Shirley

Secretary, Federal Highway Council, Washington, D. C.

Extracts from an address delivered before the American Road Builders Association, Feb. 9-12, at Chicago.

PAVEMENT failures which occur on soils of high bearing power amount to 17 per cent, whereas under the same climatic and traffic conditions, with the same thickness of surfacing made of the same materials, on soils of low bearing power such as clay and adobe, the failures reach 70 per cent. On stable gravel and sand soils the failures decrease to 2 to 3 per cent.

The most important problems of highway transportation and construction that face the country at the present time are the determination of the weight of the moving load that can be carried and the bearing power of the different types of soils of the sub-grade. When these two factors have been determined, by making a reasonable allowance for impact due to speed, we can design the surfacing with an assurance that it will carry the load that has been specified.

The subgrade committee of the Federal Highway Council is cooperating with the U. S. Bureau of Public Roads, leading universities and colleges, state highway departments and testing laboratories in an effort to arouse interest in these subjects. The problems listed by the Council are: (1) Securing samples of the sub-grade materials at points where the failures have occurred and samples where failures have not occurred in the same vicinity under similar conditions; (2) Developing field tests for bearing power of soils; (3) making studies in drainage, using experimental sections of roads; (4) a study of chemical methods of subgrade treatment for increasing bearing value or preventing absorption; (5) a study of mechanical methods of sub-grade treatment; (6) a study of freezing and thawing on the volume and on the supporting properties of soils; (7) a study of the effect of moisture on the volume changes in soils; (8) a study of the transmission of pressure to the sub-grade, through different thicknesses and different types of surfacing; (9) a study to ascertain the practical classifications of subgrade materials; (10) special problems.

Grade Separation Progress at Detroit

ELIMINATION of grade crossings at Detroit, Mich., is making relatively slow progress, partly owing to the small amount of work being done and partly to the increase in number of grade crossings. From a paper read before the Michigan Engineering Society by John W. Reid, engineer of grade separation in the Department of Public Works, the following information is taken, supplementing articles in *Engineering News-Record* of March 13, 1919, pp. 501 and 511; July 8, 1920, p. 93, and Aug. 12, 1920, p. 334.

Early in 1920 the city endeavored to induce the railways to increase their annual expenditures for the work to $1,000,000, instead of the $200,000 provided by the present arrangement. This attempt was unsuccessful, as no agreement could be made on the proportion of the expense to be paid by the city. Under these circumstances another method of securing a more progressive program would be to press grade separation on lines which are not covered by the existing contracts and which have about eighty grade crossings. It is unreasonable to assume that these crossings must wait until the others are completed.

One of the principal aims originally was to secure separation of grades at crossings having street car tracks, of which there were 22 in 1900. Only 7 of these have been eliminated, but in the meantime 25 new crossings have been added by the extension of the city limits and the extension of street car lines, making a total of 40 crossings yet to be handled. Further, the completion of the new municipal street railway lines will add 29 crossings, increasing the total to 69.

The long controversy over the Dequindre St. line of the Grand Trunk R.R. from the Brush St. station to Ferry Ave. was settled by the Public Utilities Commission in an order issued July 30, 1920, approving the city's plan for track depression from Jefferson Ave. to Gratiot Ave. New plans and estimates are now being prepared and must be submitted to the Commission before the final order is issued. In conjunction with work now being done by the railways at Lovernois Ave., Dix Ave. and Waterman Ave. the city will construct a subway at Military Ave. at a cost of $375,000 to extend this street across the Michigan Central, New York Ceneral and Wabash railroads at that point. As the city has directed the widening of Livernois Ave. from 66 ft. to 100 ft. it will pay about $100,000 for the additional expense due to this widening.

If the city could make an agreement with the railways for annual expenditures large enough to insure proper progress it might be wise to make this cover the entire city and to have the city assume a larger proportion of the cost. Such expenditures might be $2,500,000 or $3,000,000 annually for five years and $1,500,000 annually until the completion of the work. The reason for advocating so large an annual expenditure for five years is the great need of these improvements for safety and the relief of traffic conditions.

James B. Eads, Engineer-Architect, in Hall of Fame

AS a result of the fifth quinquennial election of members to the Hall of Fame located at New York University, New York City, James Buchanan Eads was chosen as an addition to the engineer-architect class. He received 51 votes against 11 for Henry Hobson Richardson, architect, and 12 scattering. Eads received exactly the number of votes (51) to elect him from the M. J. F. list (more justly famous). Otherwise 68, or two-thirds of the 101 possible, votes would have been required. Augustus Saint Gaudens (also marked M. J. F.) was chosen by 67 votes in the musician-painter-sculptor group. No one in either the scientist or the inventor class had a sufficient number of votes for election. The scientist vote stood: Samuel Newcomb (M. J. F.) 44; Benjamin Thompson (M. J. F.), 38; Samuel P. Langley and Matthew F. Moury, each 20; scattering, 18. For inventors the votes were: Cyrus H. McCormick, 43; Charles Goodyear, 16; John Ericsson, 10; scattering, 22.

In announcing the results of the vote the following biographical note relating to Eads was sent out by the Senate of New York University:

"James Buchanan Eads, American engineer, was born in Lawrenceburg, Ind., May 23, 1824, and died in Nassau, New Providence, March 8, 1887. He began life as a clerk in a dry goods house in St. Louis, Mo., in 1833 and then secured work on a Mississippi steamboat in 1839. He early designed some useful boats for raising sunken steamers, and in 1861 when called to the aid of the Federal Government, he constructed within 100 days eight ironclad steamers for use on the Mississippi and its tributaries. He afterward built a number of other ironclads and smaller boats which were of considerable service to the North. He built an arched bridge across the Mississippi at St. Louis in 1867-74. His work for improving the South Pass of the Mississippi Delta was successfully completed in 1875-79; and his great plan for deepening the river as far as the mouth of the Ohio by piers or jetties has been demonstrated to be entirely practicable. A later suggestion for the construction of a ship-railway across the isthmus of Tehuantepec attracted much attention. In 1884 he received the Albert medal of the Society of Arts, being the first American citizen to whom this honor had been awarded."

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

The Personal Pronoun Again

Sir—I should like to second the protest of Mr. Brady in your issue of Jan. 20 against the use of "the writer" or "the speaker" in place of "I." In spite of the practice of such famous engineers as Milo S. Ketchum, who avoids "I" whenever possible, authorities on technical writing are fairly well agreed that to say "the writer" in a signed article is really more self-conscious and affected than to say "I." T. A. Rickard, for instance, in his "Technical Writing," encourages a moderate use of "I."

If a writer begins saying "the writer," he must keep it up, to be consistent in that particular article, or else he must refer to himself as "he" and must refer to the party of which he was a member as "they." I remember once editing an article describing a trip to South America. The manuscript began somewhat like this: "The writer and his four assistants left New York on October 1. In three days they touched at Havana, where they secured a map of the island." Is it not silly to refer to the party of which one was a member as "they." Yet it is what follows when the third person is once begun by saying "the writer."

Some writers avoid "I" by using the passive and resorting to other awkward devices. Thus one engineer wrote: "The following report of the plant was made." This is indefinite. Did the engineer himself make the report, or perhaps his asistant, or someone else? When anyone talks of himself or writes his own opinions why not say "I"?

New York City, Jan. 21. P. B. McDONALD,
Assistant Professor of English,
College of Engineering, New York University.

Textbook of Iron and Steel Founding

REVIEWED BY DR. RICHARD MOLDENKE
Consulting Metallurgist, Watchung, N. J.

LEHRBUCH DER EISEN- UND STAHLGIESSEREI: Verfasst Fur Den Gebrauch Beim Unterricht, Beim Selbststudium Und in Der Praxis. Von Bernhard Osann, Ordentl. Professor An Der Bergakademie in Clausthal, Geh. Bergrat, Ehrenmitglied Des Vereins Deutscher Giessereifachleute. Vierte, New Bearbeitete Und Erweiterte Auflag. Leipzig, Germany. Wilhelm Engelmann. Paper; 7 x 10 in.; pp. 672; illustrated. Paper; 42m bound 54m.

The fourth edition of this standard work on foundry practice for Continental Europe is fully up to expectations so far as the information contained therein is concerned. The material is not conveniently arranged, the sequence of things the foundryman looks for in reading up the subject being very faulty. There is a wealth of foundry facts—some of them obsolete but still instructive. American practice has been drawn on freely with due credit given. Probably only in molding sand preparation will Europe be found ahead of us.

The usual topics are discussed; such as pig iron, coke, sand and supplies. The several melting processes, mixture-making, molding proper—with a big chapter on molding machine, the cupola, air furnace, crucible and open hearth—with the converter for steel—are gone into quite fully. The most interesting parts of the book are to be found in the discussion of the physical characteristics of cast iron, such as the shrinkage phenomena, chill, strength, fluidity, density, and the like. Similarly, the chemical side of the metal problems is well illuminated, and particularly the evil effects of oxygen cited. The author is weak in drawing comparisons betwcen cupola and blast furnace methods for the foundry, as he himself is rather a blast furnace man.

The steel casting, then the malleable casting, foundry appliances, the foundry layout and foundry costs form the latter portion of the book, with a chapter on the metallography of cast iron to close it. On the whole, the book is well worth adding to the library of the foundryman and engineer able to follow the German text with understanding.

Unique Written Debate on Housing

THE HOUSING FAMINE: How to End It; A Triangular Debate Between John J. Murphy, Edith Elmer Wood, Frederick L. Ackerman. New York: E. P. Dutton & Co. Cloth; 5 x 8 in.; pp. 246. $2.50.

The participants in this unique triangular debate on the housing problem present much food for thought, but having each debater write three times on each of eight topis results in much repetition. The book would be far more useful if the entire argument were first summarized in about thirty pages. The detailed debate might then be presented in much more compact typographical form than is used in the book, with a great saving of time for many readers, as well as expense to publisher and purchaser.

Summarized briefly, Mr. Murphy, formerly tenement house commissioner, New York City, believes that relief for the housing famine may and should be secured by removing tariff and other taxation that raises the cost of building construction in general and by shifting much at least of the taxation from buildings to land. Mrs. Wood, who has given much study to housing, advocates state action in behalf of wage earners and particularly those receiving the lower rates of wages. This action would include study by federal, state, and city commissions; long-term loans at low interest rates to working men for house-building purposes; and federal and state construction of houses for the lower paid wage earners. She urges that Mr. Murphy's plan would be cf little benefit to the wage earners who are in such dire need of housing and would increase the profits from all sorts of building operations. Mr. Ackerman, an architect who has devoted much time to city planning and to housing, places the whole blame for the housing shortage, high rents and many other ills on our industrial system, which, he says, is devoted to profit and not to production. He thinks the proposals of the other two debaters are at best mere palliatives in place of which he wishes to strike at the root of the whole evil. The other debaters repeatedly point out that this sort of talk has no bearing whatever upon the present housing situation since to put Mr. Ackerman's plan into effect would require a revolution of society and industry, which it would take many years to accomplish by the peaceful educational method that Mr. Ackerman seems to have in mind.

Marine Borers in Piling

REPORT ON THE SAN FRANCISCO BAY MARINE PILING SURVEY—By a Committee of the American Wood-Preservers Association. Published by the Committee: F. D. Mattos, Chairman, care of Southern Pacific Co., Oakland, Cal. Paper; 6 x 9 in., pp. 140; folding map, line cuts and half tone plates. $2.

Recent and unprecedented activity of marine borers in parts of San Francisco Bay led the American Wood Preservers Association to appoint a committee of 20 members to study borers and borer action there. The committee was composed largely of engineers and included representatives of railroads, the State Harbor Commission, the United States Forest Service, the United States Army and Navy, the University of California, companies engaged in timber preservation and engineers in private practice, as well as members of the Wood Preservers Association. The resulting report, based on four months of study late in 1920, reviews the subject under three heads: Hydrographic, biological and engineering. Of these the biological phase is justly given the lion's share of the space and illustrations. A distinctive feature of the report is that it uses the engineering instead of the zoological or biological viewpoint in describing how the several varieties of borers accomplished their destructive work, how the young travel to new fields and under what conditions they thrive. The many half tones showing the different borer species and their work will be welcomed by engineers who deal with timber structures in salt or brackish water.

Much of the report is chiefly of local interest because of the desire to deal with the San Francisco situation specifically. Here and there the committee shows a tendency to favor creosoted piles in preference to other materials. It would hardly be expected that a committee with a considerable percentage of its members engaged in timber preservation could do otherwise, and such phases of the report are only incidental and do not detract from the value of the facts presented. The report is a valuable addition to the scanty technical literature on marine borers.

Engineer, Author, Educator and Artist

SILVANUS PHILLIPS THOMPSON (D.Sc., LL.D., F.R.S.) HIS LIFE AND LETTERS. By Jane Smeal Thompson and Helen G. Thompson, B.Sc. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 372; illustrated. $7.50.

The biographers of the late Professor Thompson—presumably his daughters—have written a well-rounded and interesting life of a leading British electrical engineer who at the same time was notable as an author of a number of basic treatises and monographs on electrical engineering, and on sound and allied subjects, besides being throughout his entire mature life one of the foremost technical educators, an eagerly sought lecturer, and a draftsman and artist whose work attracted attention outside as well as within technical fields. In addition to his well-known "Elementary Lessons in Electricity and Magnetism," "Dynamo Electric Machinery," and "Calculus Made Easy" (the latter published anonymously until just before his death), Professor Thompson wrote lives of Philip Reis ("Inventor of the Telephone"), Faraday, and Lord Kelvin. He made various translations, wrote many technical papers and literary and religious essays and delivered numerous addresses. For many years and until his death he was principal of the Finsbury Technical College, London. He took a large part in reforming technical education in England. As a physicist, engineer, educator and devoted Quaker he kept in touch with American leaders in the same field. Professor Thompson's activities were many, his sympathies were broad, his culture notable. Altogether his life is a worthy addition to the altogether too small number of lives of engineers.

Practical Aspects of the Labor Problem

LABOR'S CRISIS: An Employer's View of Labor Problems—By Sigmund Mendelsohn. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 171. $1.50.

It is a hopeful sign of the times when an employer of labor writes so thoughtful and sympathetic an essay on current labor problems as this one.

The author argues against reduced hours of labor, except as this results in increased efficiency, and he also expresses himself against "a legislated minimum wage." He favors profit-sharing, better housing and labor welfare work, reasonably conceived and conducted. He thinks the present labor unrest "will, among other revolutionary changes, restore as a productive factor the importance of the factory village and small industrial town" and "lessen the drift from the rural district to the large labor centers."

Modern Medicine and the Public Health

The late Prof. W. T. Sedgwick's address, "Modern Medicine and the Public Health," delivered at the centennial celebration of the Medical College of the University of Cincinnati, Nov. 6, 1920, is printed in *Public Health Reports* (Washington, D. C.) for Jan. 28.

Publications Received

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS: Transactions, Vol. XII, Part II, 1919. New York: D. Van Nostrand Co. Cloth; 6 x 9 in., pp. 263; illustrated. $5.

CANADIAN MUNICIPAL STATISTICS: Report on Cities and Towns Having a Population of 10,000 and Over. Prepared by Lt.-Col. J. R. Munro, in charge of Finance Division of the Bureau. Ottawa, Can.: Dominion Bureau of Statistics. Paper; 7 x 10 in., pp. 57.
Returns from 53 cities giving population, assessed valuation, tax rates, miles of paved and unpaved streets, water-works, fire and police and financial data.

CANADIAN RAILWAY STATISTICS, 1919. Ottawa, Can.: Bureau of Statistics. Paper; 7 x 10 in.; pp. 267.

CAMS: ELEMENTARY AND ADVANCED—By Franklin DeRonde Furman, M.E., Professor of Mechanism and Machine Design at Stevens Institute of Technology, M. Am. Soc. M. E. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 234; illustrated. $3 postpaid (16/6 net.)
A combination of Prof. Furman's "Elementary Cams," published in 1916, and a new work, the "chief original features" of which are "the development or use, or both, of the logarithmic, cube, circular, tangential and involute base curves, the establishing of cam factors for such of these curves as have general factors, and the demonstration that the logarithmic base curve gives the smallest possible cam for given data."

CAUSES AND PREVENTION OF FIRES AND EXPLOSIONS IN BITUMINOUS COAL MINES—By Edward Steidle. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 75; illustrated. 20c. from Superintendent of Documents.

CHARCOAL IRON—By Dr. Richard Moldenke. Lime Rock, Conn.: Salisbury Iron Corporation. Leatherette; 4 x 7 in.; pp. 64; illustrated. Limited number of copies available upon request.
Historical review and list of active furnaces.

STATISTICS OF CHINESE GOVERNMENT RAILWAYS, 1919. Peking, China: Ministry of Communications. Paper; 9 x 13 in.; pp. 50; illustrated.

CHRONOLOGY OF IRON AND STEEL—Compiled by Stephen L. Goodale, Ph.B., E.M., A.M., Professor of Metallurgy in the University of Pittsburgh; Edited by J. Ramsey Speer, S. B., Massachusetts Institute of Technology, Chairman of the Board, Pittsburgh Iron & Steel Foundries Co. Pittsburgh, Pa.: Pittsburgh Iron & Steel Foundries Co. Leatherette; 4 x 7 in.; pp. 294.
Contains interesting information regarding the manufacture of iron and steel and the progress of invention and industry affecting the demand for those materials, arranged chronologically from the earliest times to the close of 1919. Running back for several centuries there is at least one item recorded for nearly every year while for more than a hundred years past the yearly entries are generally numerous. The usefulness of the book is much increased by an extensive index.

COMPARATIVE RAILWAY STATISTICS, UNITED STATES AND FOREIGN COUNTRIES, 1916. Washington, D. C.: Bureau of Railway Economics. Paper; 6 x 9 in.; pp. 66.

CONCRETE WORK: A Book to Aid the Self-Development of Workers in Concrete and for Students in Engineering—By William Kendrick Hatt, C.E., Ph.D.; M. Am. Soc. C. E.; M. Am. Soc. T. M.; M. Soc. Prom. Eng. Ed.; President, American Concrete Institute, etc., and Walter C. Voss, B.S., Assoc. M. Am. Soc. C. E.; M. Am. Soc. T. M.; M. Am. Con. Inst.; Head, Department of Architectural Construction, Wentworth Institute, Boston, Mass., etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 8 in.; pp. 451; illustrated. $4.

CRAIN'S MARKET DATA BOOK AND DIRECTORY: Class, Trade and Technical Publications. Chicago, Ill.: G. D. Crain, Jr., 417 S. Dearborn St. Cloth; 6 x 9 in.; pp. 462; illustrated.

EFFECT OF TANNIC ACID ON THE STRENGTH OF CONCRETE—By Duff A. Abrams, Professor in Charge of Laboratory, Chicago, Ill.: Structural Materials Research Laboratory, Lewis Institute. Paper; 6 x 9 in.; pp. 31; illustrated.

ELEMENTS OF MECHANISM—By Peter Schwamb, S.B., Professor of Machine Design (retired), Massachusetts Institute of Technology; Allyne L. Merrill, S.B., Professor of Mechanism, Massachusetts Institute of Technology; Walter H. James, S.B., Assistant Professor of Mechanical Engineering Drawing, Massachusetts Institute of Technology. Third Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 372; illustrated. $3.50.

The first edition was reviewed in the Engineering Literature Supplement of *Engineering News*, Dec. 15, 1904, by Charles R. Pratt. This edition embodies many changes suggested by instructors who have used the second edition during the last 16 years.

EMPLOYMENT METHODS—By Nathan W. Shefferman, Consultant in Personnel and Employment Management; Formerly Personnel Director for Lycoming Foundry & Machine Co., etc. New York: The Ronald Press. Cloth; 6 x 9 in.; pp. 573; illustrated. $5.

FEDERATION OF BRITISH INDUSTRIES: Export Register, 1920. London, Eng.: The Federation of British Industries. Cloth; 7 x 10 in.; pp. 312; illustrated.

Members' names are first listed alphabetically, followed by list of products, home office and agents. Products are listed alphabetically, with names of makers of each following. Much of the space is filled with advertisements—members only.

FIRE TESTS OF BUILDING COLUMNS: An Experimental Investigation of the Resistance of Columns, Loaded and Exposed to Fire or to Fire and Water, with Record of Characteristic Effects by Associated Factory Mutual Fire Insurance Companies. The National Board of Fire Underwriters and the Bureau of Standards, Department of Commerce. Chicago, Ill.: The National Board of Fire Underwriters. Paper; 6 x 9 in.; pp. 389; illustrated. Paper $2; cloth $2.50.

GOVERNOR OF PORTO RICO: Report to the Secretary of War, 1920. Washington, D. C.: War Department. Paper; 6 x 9 in.; pp. 574; illustrated.

A HANDBOOK OF ARCHITECTURAL PRACTICE. Issued by the American Institute of Architects for Use in Connection with Its Standard Documents. Washington, D. C.: The Institute. Cloth; 8 x 11 in.; pp. 204.

HYDRAULICS OF THE MIAMI FLOOD CONTROL PROJECT—By Sherman M. Woodward, M. Am. Soc. C. E.; M. Am. Soc. M. E.; Consulting Engineer of the Miami Conservancy District; Professor of Mechanics and Hydraulics, State University of Iowa. Technical Reports, Part VII. The Miami Conservancy District. Dayton, Ohio: The District. Paper; 6 x 9 in., pp. 343; illustrated. $1.

Describes hydraulic problems involved in selection of the types of improvement and in the final design of the works under construction.

HYDRO-ELECTRIC DEVELOPMENT IN ONTARIO: A History of Water-Power Administration Under the Hydro-Electric Power Commission of Ontario—By E. B. Biggar, Author of "Canadian Railway Problem," Former Editor of *Canadian Engineer*, etc. Toronto, Can.: The Biggar Press, Ltd. Cloth; 5 x 8 in.; pp. 202; illustrated. $2.

IDAHO DEPARTMENT OF PUBLIC WORKS: Report, 1920, Part I: Introduction, Capitol Construction, Capitol Maintenance, Bureau of Supplies, Heyburn Park; Part II: Bureau of Highways. Boise, Idaho: The Department. Paper; 6 x 9 in., pp. 221; illustrated.

LABOR MAINTENANCE: A Practical Handbook of Employees' Service Work—By Daniel Bloomfield, of Bloomfield & Bloomfield, Consultants in Employment Management and Industrial Relations; Author of "Employment Management," etc. New York: The Ronald Press Co. Cloth; 6 x 9 in., pp. 530; illustrated. $5.

MECHANICAL WORLD YEAR BOOK, 1921. Manchester, Eng.: Emmott & Co., Ltd. Cloth; 4 x 7 in., pp. 319; illustrated. 2/6 net.

New sections in the present edition of this annual deal with cast-tooth gearing and ball and roller bearings. There is also new matter on friction and lubrication, chain gearing and saturated steam, besides various revisions.

MUNICIPAL ACCOMPLISHMENT IN CITY PLANNING: Published City Plan Reports in the United States. Edited by Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University, Honorary Librarian, American City Planning Institute. From Information Assembled Largely by the Detroit City Plan Commission. Boston, Mass.: National Conference on City Planning. Paper; 6 x 9 in., pp. 79. 40c.

Based on returns from 87 cities. Contains digest of planning work and list of planning reports for each city.

PHILIPPINE ISLANDS: Report of the Governor General to the Secretary of War, 1919. Washington, D. C.: War Department. Cloth; 6 x 9 in.; pp. 216.

POSSIBILITIES OF STEAM RAILWAY ELECTRIFICATION. Simla, India: Chief Engineer, Railway Board. Paper; 8 x 13 in., pp. 84; illustrated. 4 Annas.

Although issued by the Railway Board of India the paper is not an "official" publication, but consists of three papers. The first on the feasibility of electrifying the suburban area of the Eastern Bengal Railway, by Messrs. Merz and McLellan; the second, a reprint of an article in the *Railway Gazette* and *Railway News* on "The Possibilities of Steam Railway Electrification," by Calvert Townley; the third, a report by A. R. Gundry, electrical engineer, Eastern Bengal Railway, on the electrification of various railways in England.

THE PRODUCTION OF IRON AND STEEL IN CANADA, 1919—By John McLeish, B.A., Chief of the Division of Mineral Resources and Statistics. Ottawa, Can.: Department of Mines. Paper; 7 x 10 in.; pp. 45.

THE PRODUCTION OF WHOLESOME WATER FOR MUNICIPALITIES—By L. O. Bernhagen, A.C., Editor, Texas Water-Works Association. Austin, Tex.: The Association. Paper; 6 x 9 in.; pp. 63; illustrated.

Designed for operators of filtration and disinfection plants without regular chemists or bacteriologists. Covers sources of supply, sampling and analysis, apparatus and methods of treatment.

PROGRESS OF PURCHASE OF EASTERN NATIONAL FORESTS: Under Act of March 1, 1911 (The Weeks Law); Prepared by National Forest Reservation Commission. Paper; 9 x 11 in.; pp. 26; illustrated.

"The Weeks law," the report states, "was designed primarily for affording protection to the headwaters of navigable streams" by "the maintenance of forests."

PROPOSED CLASSIFICATION OF TITLES AND POSITIONS IN THE CIVIL SERVICE. Report of the City of Rochester, N. Y. Prepared for the Common Council's Special Committee on the Standardization of Salaries. Rochester, N. Y.: Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 173.

QUALITY OF GASOLINE MARKETED IN THE UNITED STATES—By H. H. Hill and E. W. Dean. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 275; illustrated. 30c. from Superintendent of Documents.

RELATIVE ADVANTAGES OF MODERN STEAM AND ELECTRIC LOCOMOTIVES—By John E. Muhlfeld, M. Am. Soc. M. E., M. A. I. E. E. Address as Presented at the Joint Meeting of the Railroad, Metropolitan and New York Sections of the Mechanical and Electrical Engineering Societies. New York: Railway and Industrial Engineers, 25 Broad Street. Paper; 6 x 9 in.; pp. 65.

An abstract of this paper appeared in *Engineering News-Record*, Oct. 28, 1920, p. 853.

RUDIMENTS OF ELECTRICAL ENGINEERING—By Philip Kemp, M. Soc. Tech., M. I. E. E., Author of "Alternating Current Electrical Engineering," etc. New York: The Macmillan Co. London: Macmillan & Co., Ltd. Cloth; 5 x 7 in.; pp. 255; illustrated. $2.

THE SLIDE RULE: A Practical Manual—By Charles N. Pickworth, Whitworth Scholar, Editor of the *Mechanical World*, etc. Seventeenth Edition. New York: D. Van Nostrand Co. London: Emmott & Co., Ltd. Cloth; 5 x 7 in.; pp. 133; illustrated. 3/6.

Some new slides rules are described. "Slight revisions" have been made in this edition.

STANDARDS FOR GAS SERVICE. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 140. 20c. from Superintendent of Documents.

Résumé of state and city regulations of gas service, with discussion of technical requirements and recommended rules and ordinance forms. Earlier editions appeared in 1912-13-15.

STATE MINING LAWS ON THE USE OF ELECTRICITY IN AND ABOUT COAL MINES—By L. C. Ilsley. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in., pp. 53; illustrated. 10c. from Superintendent of Documents.

STENCHES FOR DETECTING LEAKAGE OF BLUE WATER GAS AND NATURAL GAS—By S. H. Katz and V. C. Allison. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 22; illustrated. 5c. from Superintendent of Documents.

THE ST. LOUIS TRANSIT SYSTEM, PRESENT AND FUTURE—By Harland Bartholomew, Engineer, City Plan Commission, St. Louis, Mo.: The Commission. Paper, 7 x 10 in.; pp. 36, folding maps.

STORAGE BATTERY LOCOMOTIVES: Preliminary Investigations, Specifications, Laboratory Tests, Permissible Schedule—by L. C. Ilsley and H. B. Brunot. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 35; illustrated. 10c. from Superintendent of Documents.

STUDY RELATING TO THE WATER RESOURCES OF MISSOURI—By T. J. Rodhouse, Professor of Hydraulic Engineering, University of Missouri. Columbia, Mo.: Engineering Experiment Station, University of Missouri. Paper, 6 x 9 in., pp. 57, illustrated.

TEXAS STATE HIGHWAY COMMISSION: Report 1918-20. Austin, Tex.: The Commission. Paper; 6 x 9 in.; pp. 104; illustrated.

TRADE ASSOCIATIONS: Their Organization and Management—By Emmett Hay Naylor, Secretary-Treasurer of the Book Paper, Cover Paper, Tissue Paper, and Writing Paper Manufacturers Associations; President, American Trade Association Executives. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 398; illustrated. $5.

Discusses purpose, structure and procedure of trade associations; also competition, co-operation, fair prices, and service rendered, has bibliography and also list of associations.

TRAINING INDUSTRIAL WORKERS—By Roy Willmarth Kelly, Manager of Industrial Relations for the Associated Oil Co. of California. Sometime Director of the Harvard University Bureau of Vocational Guidance; with an Introduction by John M. Brewer, Ph.D., Associate Professor of Education, and Director of the Bureau of Vocational Guidance, Harvard University. New York: The Ronald Press Co. Cloth; 6 x 9 in., pp. 437, illustrated. $5.

UTILIZATION OF BLACK WALNUT—By Warren D. Brush, Specialist in Forest Products, Department of Agriculture. Washington, D. C.: The Department. Paper; 6 x 9 in., pp. 89; illustrated. 20c. from Superintendent of Documents.

WASHINGTON STATE RECLAMATION BOARD: Report to the Governor and Legislature, March, 1919 to December, 1920. Olympia, Wash.: The Board. Paper; 6 x 9 in., pp. 135, folding map.

WYOMING STATE HIGHWAY COMMISSION: Report, 1919-20. Cheyenne, Wyo.: The Commission. Paper, 6 x 9 in., pp. 121, illustrated.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worthwhile letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Engineers and Political Appointments

Sir—Have with pleasure and approbation read the editorial in your issue of Jan. 27, p. 146, on the N. Y. State Governor's appointment to the office of Commissioner of Highways. It would be ideal to have merit and qualifications the only grounds for political appointments and for argument's sake I suggest that if some well qualified engineer had been as active politically as the appointee, the Governor might have seen his way to appoint the engineer. Our political parties are not built on any other procedure than that to the victor belong the spoils, and necessarily the captains and lieutenants see to it that the reward is commensurate with efficiency shown in a campaign. Take away the prospect of a fat political job as reward, and political organizations would soon go to pieces, as no one in the ranks is a bit interested in principles, no matter how much speakers are shouting about economy and business administration before election.

Look around a little and you will find the same conditions everywhere. Here in Cleveland the men at the head of the two construction departments are a lawyer and a clothing salesman. Therefore, under existing conditions, if engineers desire the administrative offices they will have to become prominent in politics, as it is only in that way—not as engineers—that they may hope for such appointments, however efficient and prominent they may be as professional men.

Your Governor is not to blame—he is only carrying out the wishes of those who elected him. It is not good politics to do otherwise, as witness the Democratic party, which in a good many places had no organization, because the President in some of his appointments ignored the local organization.

EDWARD HARRISON.

Cleveland, O., Jan. 31.

Another Illinois City Almost Scored a Typhoid Epidemic

Sir—An editorial, entitled "Leaky Cross Connection Kills Fifteen," in *Engineering News-Record*, May 13, 1920, p. 939, comments upon the typhoid epidemic at the Chicago & Alton R.R. shops at Bloomington, Ill., caused by a cross-connection between the city supply and a polluted industrial supply. As is customary, all possible publicity was given to this epidemic, and the usual effort was made to bring it before public officials in Illinois in order that they might learn from the sad experience of others. An article under the heading, "Will Cities Ever Learn from the Experience of Other Cities How to Protect Their Public Water Supplies?" appearing in *Illinois Health News* for April, 1920, and describing the cross-connection and epidemic was widely distributed.

Perhaps some cities have learned their lesson from Bloomington, but one more city in Illinois has had to learn from its own experience. This time it was Maywood, which has a population of about 12,000. The conditions were favorable for Maywood to make as good a score as other municipalities that permit dangerous cross-connections, but fortunately the result has been only about 75 cases of dysentery and no deaths. Nevertheless, the lesson was sufficiently severe for Maywood to profit by it, and now Maywood is a much safer place in which to live.

Maywood has an adequate supply of good water obtained from deep drilled wells near the center of the city. Located a few blocks from the pumping station on the banks of the highly polluted Des Plaines River is a power plant of the Public Service Co. of Northern Illinois. In the company's plant an interconnection with the city water-supply system existed, so that the company could use either city water or the polluted river water furnished from its own pumps. The river receives the sewage from several communities located from two to ten miles upstream. On Oct. 4, 1920, people residing on streets near the plant of the Public Service Co. noticed disagreeable tastes and odors in the water and reported them to the waterworks officials, but not until about 25 cases of dysentery had occurred the next day were complete investigations made, as a result of which the cross-connection was abandoned. In all about 75 cases of dysentery resulted, many of which were serious but fortunately did not develop into typhoid. All were located on three streets near the plant of the Public Service Co.

Maywood has learned its lesson, has gained some publicity and another report has been filed. Public and waterworks officials are advised in so far as possible of the dangers from such connections, but judging from past experience we can only wonder what city which permits cross-connections to continue will be the next to learn its lesson from its own epidemic.

HARRY F. FERGUSON,
Acting Chief Engineer, Department of Public Health.
Springfield, Ill., Jan. 25.

Am. Soc. C. E. Committee Chairman Picked on Merit

Sir—I note in your issue of Feb. 3, 1921, a letter from A. T. North, M. Am. Soc. C. E. of Chicago, asking for the reasons for the appointment recently of the chairman of "two very important committees by the Board of Direction of the American Society of Civil Engineers—the Committee on Constitutional Amendments and the Committee on External Relations."

While it is obvious that the board cannot undertake to answer general questions of this sort, it is perhaps proper that I, as the member of the board responsible for the suggestion of General Marshall as chairman of the second committee, should give my reasons for the selection, particularly as Mr. North implies a motive for the selection of these two men which did not exist.

Speaking first with reference to the Committee on External Relations, undoubtedly there are other men in the society who were perhaps available and would have made equally competent chairmen. I did not chance to think of them. General Marshall did occur to me as being a man of the type desired—well balanced, capable and energetic. He had made a splendid record for himself amongst engineers in his work in the Construction Division of the Army during the war, had demonstrated great ability as an administrator, had shown a very progressive and discriminating spirit and, what was much desired, had a large acquaintance amongst the younger, as well as the older, engineers of the country, which would enable him to gather information and conflicting points of view as rapidly as possible. The fact that he was a new member of the society and therefore not in touch with the recent issues within its membership, combined with the qualities stated, seemed to make him a very desirable choice. He knew nothing about his selection until he was appointed and asked to serve by the Board of Direction, and as a matter of fact was a good deal embarrassed by the request, as other pressing matters lay before him.

From the few comments which the writer has heard from members of the committee that served with him, as well as from members of the society generally, he has been led to believe that the choice was a fortunate one. In any event, it is to be regretted that any member of the society should call into question the motive in the appointment, or the character of the service rendered, as the appointment of this committee, and of its personnel, was directed solely by a desire to aid the incoming board with such constructive suggestions as might emanate from a group of men actively interested in the affairs of the society, in close touch and sympathy with the younger men of the society.

As to the appointment of the Committee on Constitutional Amendments, the writer is not advised, but from his knowledge of the fair mindedness, the experience and ability of the chairman selected, he feels the utmost confidence in his judicial approach to the very important work entrusted to him and in the outcome of the investigations of the committee. It must certainly have been apparent to all who attended the annual meeting of the society that this committee was deserving of full confidence and cordial support.

It is an unfortunate fact that lack of information on the part of the members of the American Society of Civil Engineers concerning the care and fidelity with which the Board of Direction approaches, investigates and acts upon its problems has led often to suspicion and unfair criticism. The conscientious manner in which the directors meet their obligations, busy men as they are, many of them coming long distances to attend the meetings at substantial personal sacrifice, is deserving of better recognition and support. Constructive criticism is always welcomed by the board, whatever may be the attitude of individuals on different questions. From five years of active service upon the board, recently ended, the writer has come to have a great respect for its methods of procedure and collective judgment and feels that the distruct of motive which has cropped out from time to time has generally been due to lack of intimate knowledge of its personnel, functions and procedure. It is to be hoped that with the composure of past differences effected at the last annual meeting of the society there may enter an era of better co-operation.

Boston, Mass., Feb. 9, 1921. LEONARD METCALF.

County and Township Bridges Under Motor Trucks

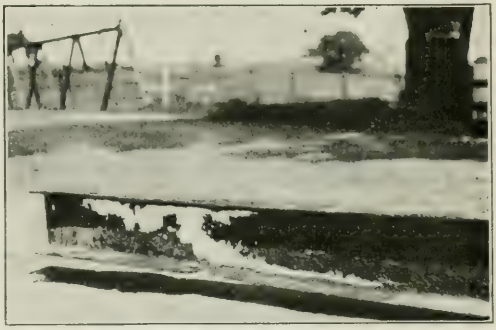
Sir—The presentation of the case of highway bridges by M. W. Torkelson, bridge engineer of the Wisconsin Highway Commission in *Engineering News-Record* of Jan. 13, p. 61, is worthy of commendation. Conditions depend on localities, however, and while Mr. Torkelson may be justified in his contentions concerning the safety of bridges within his jurisdiction, the writer feels that he has shown a tendency to minimize the menace presented by the general run of highway bridges.

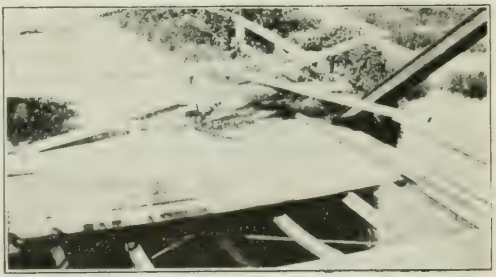
Structures designed thirty to forty years ago to carry the loads of horsedrawn vehicles might be safeguarded by the use of capacity signs, but such signs confront the motor-truck driver with the prospect of a long detour, and in many instances he will take the chance and pay no heed to the warning. To make matters worse he will accelerate his speed on approaching the bridges with the hope that, in case of failure, his inertia will carry him beyond danger. Such conduct is responsible for many bridge failures and accidents, and the only way to avoid them is to make all structures strong enough to carry the loads that may come upon them. The bridge is an integral part of the highway and should be capable of functioning with the same degree of safety.

State bridges form a very small percentage of all, and by far the greatest burden falls upon county officials, who as a rule are handicapped by lack of funds and have inadequate bridge departments. At the present time state highway routes throughout the country are in the course of construction and this throws the heaviest possible traffic on county and township roads, the average live-load capacity of whose bridges is about 5 tons. When we consider that motor trucks having a gross weight of 15 and 18 tons are rather the rule than the exception the danger of such conditions is easily appreciated. By-roads may at any time and with little or no warning be called upon to act as main roads for a temporary period.

A few cases from practice may be cited to support my contention that highway bridges offer a serious problem, and that their menace must be removed at the earliest possible moment.

Where a bridge is at the foot of a steep grade and the designer thought it best to constrict the right-of-way at the bridge site the narrow width combined with the unfavorable grade has often been the cause of unfortunate accidents. One of these instances is illustrated by Fig. 1.





SERIOUS CONDITIONS IN COUNTY HIGHWAY BRIDGES

Upper—Culvert narrower than highway. Motor truck ran over the wing wall, knocking it down. Middle—One of a lot of corroded stringers taken from a 100-ft. truss span. Only by merest chance was their condition noticed and the stringers removed before an accident happened. Lower—Stringers too weak and not stayed; they buckled and tipped over under a truck, but the lower laterals held them up.

Incredible corrosion is sometimes found in the floor system of bridges that from the deck seem to be in perfectly good condition. The beam shown by Fig. 2 was taken from a 100-ft. span truss bridge, in which the trusses were in such an excellent state of preservation that it was possible to apply a concrete floor and asphalt-block pavement after the stringers were replaced, and remove any limitations to the allowable load. Without a well-organized bridge maintenance department such defective stringers may go unnoticed, especially where the under side of the bridge is not conveniently accessible, and sooner or later may result in the loss of life and property.

Bridge abutments are also a source of grave danger. They are subject to a variety of stresses and disruptive agencies, and unless properly designed and constructed will fail from scour, frost action, earth pressure or inadequate foundations. In a recent case in this county the abutment of a steel truss bridge was not only undermined by scour

but also pushed forward by the hydrostatic and earth pressures exerted by saturated fill subjected to frost action. It fell and dropped the end of the span into the water. A related defect of old highway bridges is inadequate waterway, and failures from this cause are too numerous to require any further comment.

Lateral weakness of stringers of the kind represented by Fig. 3 has proved troublesome in a number of instances in this county. The floor failure, due to overturning of the stringers, is chargeable to the lack of ties between stringers and insufficient connection to the floor beams. Of course the stringers themselves were too weak to carry the load safely, but if properly tied together they might have borne an overstress without buckling. The sway rods in the bottom chord bracing helped to support the buckled stringers and keep the truck on the bridge.

In view of the abundance of facts illustrating the glaring danger in our drainage structures, the writer feels that it behooves us to recognize the menace of our bridges, and to work earnestly and without abatement to make them adequate to meet the demands of modern vehicular transportation.

MORRIS GOODKIND,
Assistant Engineer of Bridges, Mercer County.

Trenton, N. J., Jan. 25.

More on Bulking of Sand

Sir—Referring to the discussion by Mr. King in the Jan. 20, 1921, issue of the *Engineering News-Record* of a paragraph headed, "Wet Aggregates Make Concrete Too Strong," which appeared in an earlier issue, the writer, because of his connection with the original tests and the preparation of the paragraph in question, would offer the following comment.

The writer is familiar with the very extensive and valuable investigations relating to mortars carried on by M. Feret, as well as similar work done by later investigators, and agrees that the fullest credit should be accorded. However, the paragraph referred to was one of many brief statements made monthly describing the studies underway in the concrete laboratory. Without going into detail readily apparent conclusions are briefly mentioned and where evident the relation to field practice is emphasized, but no attempt is made to furnish a full discussion of results or of the work of previous investigators, as is customary in a formal publication. The bulking effect of moist sand is so fully covered in the more recent treatises on concrete that no investigator at this date would imply such information to be a "discovery," nor should any reader familiar with the literature of concrete infer that such an idea were implied. The paragraph as written was based upon tests of concretes as they would be made on the job, and should serve to emphasize to inspectors on concrete work that there may be times when the most rigid specification may properly be modified.

As to the paragraph contradicting the headline the writer cannot agree, although perhaps the word "requires" might have been replaced by the phrase "will result in the use of."

A discussion of Feret's work in connection with cement mortars brings up another point which is worthy of discussion, that is, the improper application, by later investigators and experts, of the results of Feret's work to the production of concrete without verification of the propriety of such application by tests of the resulting concretes. As found by Feret a coarse sand is usually better suited for use in a mortar than a fine sand, which led to the adoption of various specifications for sand limiting the amounts permitted to pass the various sieves. As a result many engineers have been given the wrong impression of the necessary qualities a sand should have, and many first-class sands have been barred from use. As late as a year ago at least one state highway commission still persisted in testing sands in mortars to determine their fitness for use in concretes. Within rather wide limits the fineness of a sand may be increased beyond that grading found to be most desirable in mortar tests, and yet produce concretes of equal or better quality.

It would be interesting to learn Mr. King's authority for his statement that "Wet aggregate . . . require less cement per cubic yard of concrete . . . because of the consequently less surface area of the aggregate." The writer has found for Potomac River aggregates that the sand may be regraded to have approximately double the surface area per unit volume of the regular run sand, and yet produce a concrete of slightly higher strength when the two concretes have the same amount of cement per cubic yard; also that with concretes of the same cement content a 50-50 sand-gravel ratio produced concrete equal in compressive strength and superior in "working" quality to a concrete in which the sand-gravel ratio was the customary 33-67, the regular run grading being used in both. The square inches of surface area per gram of cement in the 50-50 combination is about 100 per cent more than in the latter.

In view of such test results it is difficult to understand how any controlling relation can be derived for surface area, cement content, and compressive strength within the widest practical working limits.

G. M. WILLIAMS,
Professor of Civil Engineering,
University of Saskatchewan.

Saskatoon, Sask., Jan. 28.

Blighted Chestnut Better Than Healthy Wood

Sir—Edward A. Lambert asks about the propriety of using chestnut-blighted wood, in your Dec. 30 issue, p. 1197. While I have never used chestnut piles I think the facts which I will present show that blighted chestnut would be an improvement over healthy chestnut.

At the outbreak of the blight in New York State the disease was carried into Pennsylvania, near my home, by bales of hay used at the mobilization camp at Mt. Gretna, Pa., during the Spanish-American War. But several years previous it had fallen to my lot to be the first recorded discoverer of the blight in Pennsylvania at a spot in the Pocono Mountains. I seemed to stand alone in my belief that the blight was going to be a calamity when I was asked to speak on the subject at the convention called by Governor Tener of Pennsylvania to consider the blight. The time of the convention was wasted largely in trying to solve the origin of the blight and its habits, and when I got on my feet and advised the body to get busy and find use for the chestnut wood, and predicted that in 15 years there would not be a healthy chestnut tree in Pennsylvania, I felt that my remarks were not taken seriously.

Feeling that probably the circumstances which brought me in contact with trees in my early life gave me a better and clearer knowledge of tree life than was possible to get from books, I believed that some day the question might be raised as to the effect of blight on the life or durability of the product of the blighted trees. Even anticipating this question would come up at the governor's convention, I, in connection with Robert Conklin, then state forestry commissioner, cut from my 500-acre tract of chestnut trees near Mt. Gretna three carloads of chestnut-blighted cord wood and had the wood tested for its tannic acid contents. My prediction that the blighted wood would show up stronger in tannic acid was verified by this test, so we paved the way for at least one source of utilization and were prepared to kill any wild statements that might have influenced the acid men to reject blighted wood.

Anticipating that farmers might refuse to buy chestnut-blighted fence rails and posts we built a blighted fence. We also cut and set up 30 telegraph poles of blighted trees and furnished the Cornwall & Lebanon R.R. Co. with a number of blighted railroad ties. Until the late World War the U. S. Forest Service made annual inspection of the blighted fence, telegraph poles and railroad ties. Their observation, as well as my own, support my theory that the tannic acid in chestnut and oak trees is the preserving element, and the blight by increasing the acid adds to the decay resistance enjoyed by normal chestnut. Some years ago Mr. Nellis, of the Forest Service, sent me a

photograph of a blighted post, showing a blight spot projecting beyond the present surface of the surrounding wood. The unblighted wood had been wasted away by the weather, producing an embossed effect, showing that the blight had made the wood more weather-resisting.

These experiments have helped the farmer, the telegraph companies and the railroads, but this is my first opportunity to present the facts to a brother engineer. I would say to Mr. Lambert that if chestnut has been used for piles in the past use it in the future if the tree has not been dead so long as to suffer from natural decay.

To owners of chestnut groves and telegraph and telephone companies and even farmers I would say: Cut your blighted wood as soon as possible, bark the trees, spray with carbolineum or any other cheap grade of creosote or even gas tar, and put your future supply in storage (off the ground), for there is no wood to take the place of chestnut. It is practically the only universal wood that reproduces itself in one man's lifetime, generally about 40 years from the cut stump. Cutting and regenerating have gone hand in hand in the past, keeping up an even balance. Now the cutting or the dying is taking place not as needed, but as a holocaust.

EDGAR A. WEIMER,
Lebanon, Pa., Jan. 15. Consulting Engineer.

Useful Dodges in Surveying

Sir—It was not my intention when writing paragraph 7 in the article, "Useful Dodges in Surveying," in your issue of Dec. 16, 1920, p. 1164, to revive an ancient controversy between the plane-table and the transit-and-stadia method of topographical surveying.

Lyman E. Bishop, consulting engineer of Denver, Col., wrote an article on "Speed of Topographic Surveys" for the *Engineering Record*, Sept. 19, 1914. Briefly his work averaged as follows, using the transit-and-stadia method: Stadia shots, 473; number of rodmen, 3.8; readings per Rodmen, 126; readings per acre, 0.70.

The acreage covered in 8 hr. was 682 at a total cost of 12c. per acre.

Since writing that article Mr. Bishop has completed several hundred thousand acres of topography and consistently used the transit-and-stadia method in preference to the plane-table. He claims by that method to be able to do better work and to carry it out regardless of weather conditions and at a lower cost than by the use of the standard plane-table. I can agree with Messrs. Hogan and Roberts of the N. Y. Water Power Investigation (see Jan. 6 issue, p. 41 and Jan. 13, p. 88) in regard to the advantage of the plane-table on small scale maps, such as used by the War Department and by the Geological Survey, but must disagree with them in their claims of plane-table superiority under all conditions.

No proper comparisons of the efficiency, speed and cost of the various methods of topographic mapping can be made unless there is a similarity of scale, contour interval, and topography. In the record quoted in my article we used a scale of 400 ft. to the inch and a contour interval of 5 ft. The location of the mapped area was a fairly rough section of irrigable land along the Little Wood River of southern Idaho. The completed maps were so accurate that office locations of all irrigation ditches and other works were made on them prior to construction.

In detail the party and procedure were as follows: The party was composed of a transitman, who was the responsible topographer, a recorder, who acted as assistant topographer and four stadia rodmen armed with 14-ft. self-reading stadia rods. A mule skinner who drove the party to work acted as extra rodman when so required.

A level party had preceded the topographic party and established vertical control by leaving benchmarks on all section corners. The transitman carried his horizontal control with him by careful traverse which was plotted on the field drawing board by latitudes and departures.

The transitman set up his instrument and directed the movements of at least four stadia-rodman. Horizontal angles were read to the nearest 5 min. and vertical angles were read to the nearest 2 min.; the rod was read to the nearest 0.1 ft. The recorder, who was seated near the transit, plotted (with a large semicircular paper protractor which had the map scale marked off along its diameter), the angles the instant they were called out by the transitman; as soon as the transitman could read the rod and vertical angle they were reduced by slide rule and plotted on the map.

In regard to the Beaman stadia arc would say that in my case it would not have been the means of saving any time, since the recorder could always keep up with the transitman and the transitman could not always keep up with the rodmen. Since it takes just as much time to read the Beaman attachment as it does to read the vertical circle there could be no saving in time for the entire party. However, I will admit that the Beaman attachment is a time-saver for the slower plane-table method

Summarizing the advantages of using the drawing board in the field with the transit topographer as compared with the plane-table we have the following:

Control carried accurately in the field; transit steady—does not need frequent level adjustment as in the case with the plane-table; speed of turning transit and locating rodmen is greater; transit stands 2 ft. higher than the plane-table, which has a low visibility; recorder plots just as fast as the stadia shots are read, while with the plane-table the topographer has to stop and scale out and plot the distance after each sighting; paper can be kept cleaner.

In drawing contour lines both the transitman and recorder can work at the same time. The transitman, having directed the rodmen, can delineate the lines expressively, and if enough shots have been taken it makes no difference if the map appears wooden, since if the contour in the field is where it is plotted on the map, that is all that is required. Expressive delineating is only of advantage when protraying geological features on small scale maps or to attempt to mask the inaccuracies of a map plotted with an insufficient number of shots.

I am surprised at the extraordinary relation between scale and contour interval as adopted by Mr. Roberts. The country which can be properly mapped with a scale of 2,000 ft. to the inch and a contour interval of 1 ft. must be as flat as a putting green. The writer is well acquainted with the field scales as adopted by the U. S. Geological Survey. They are as follows: 1:192,000; 1:96,000; 1:48,000; 1:31,680; 1:24,000, and 1:12,000. The contour intervals adopted are 5, 10, 20, 25, 50, 100, 200 and 250 ft. In no case would the Survey use a 1-ft. contour in connection with a scale of 1:24,000, as used on the N. Y. water power investigations. What possible use could be made of a map having a very small vertical error and a very large horizontal error, as there must be on a scale of 2,000 ft. to the inch with a 1-ft. contour interval?

My own rule for topographic scales is as follows: For very mountainous country, such as around the Pike's Peak district, the scale should be ten times the contour interval. For a medium rough country having small buttes, knolls, ravines, pot-holes, and varying in elevation several hundred feet to the mile, the scale should be 100 times the contour interval. For very flat country, such as desert land without any knolls, ravines, etc., the scale should be 1,000 times the contour interval. Moreover, the distance between shots should average a distance in feet equal to the scale of the map in feet per inch.

If we apply the above rule to Mr. Roberts' record it is no wonder that he could map 1,000 acres per day with two rodmen. We Westerners, like the Swiss, rather pride ourselves on our topography, and I for one have no use for the plane-table when a map of serviceable scale is desired.

H. L. THACKWELL,
Denver, Jan. 20. Hydraulic Engineer.

British Transport Institute Growing

According to a recent announcement made by the secretary of the British Institute of Transport, there are now 306 members, 293 associate members, 99 graduates and students, making a total affiliation of 698.

HINTS FOR THE CONTRACTOR

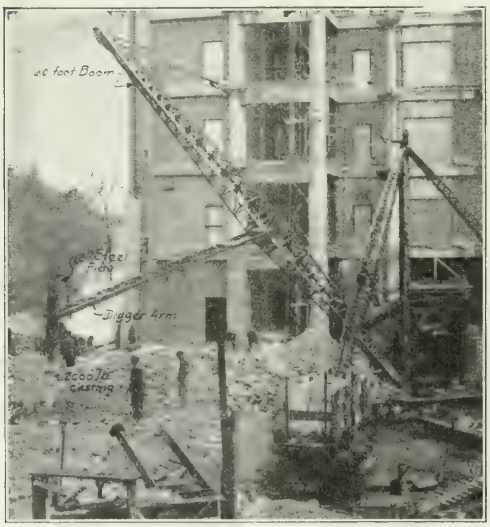
Rock Excavated by Improvised Digger Fixed to Stiff-Leg Derrick

By Paul P. Suiter
Engineer, Ferro Concrete Construction Co., Cincinnati

In placing the foundation in the north half of the new unit for the Baldwin Piano Co. plant in Cincinnati the Ferro Concrete Construction Co., general contractors, found it necessary to excavate approximately 1,100 cu.yd. of rock. The rock consisted of strata of hard blue shale about 2 to 3 ft. thick, separated by 4- to 10-in. layers of blue limestone. The excavation varied for different footings from 5 to 12 ft. in depth.

In the south half of the building dynamite was used for breaking up this rock and under ordinary conditions would have been used in the north half, but because of the interruption to building and danger to traffic on two busy thoroughfares its use was deemed inadvisable. The use of feather and wedges with sledging was of course possible, but was rejected as being too costly.

In order to handle this particular case economically it was necessary to develop special equipment, which the contractor's superintendent on the job accomplished in the following manner: He had on the site a stiff-leg steel derrick equipped with a three-drum engine and 60-ft. boom. To this boom he attached a digger arm, shown in the photograph, which held at its outer end a 12-in. steel pipe about 12 ft. long. The closing line



NOVEL METHOD OF EXCAVATION COSTING LESS THAN DYNAMITING

was fastened to the top of this 12-in. pipe, allowing it to be raised or lowered at will. This pipe acted as a sleeve or guide through which a 2,000-lb. casting with a digging tool on the bottom end was operated by a load line. By raising or lowering the boom and digger arm it was possible to cover an area of approximately 2,200 sq.ft. without moving the derrick.

To operate this equipment required one engineer and two laborers. In excavating, the digger was swung over the footing, and the pipe sleeve lowered and held in position by ropes in the hands of two laborers. The 2,000-lb. weight was raised with the load line and allowed to drop, the force of the blow struck depending, of course, on the distance the weight fell, which in this case varied between 5 and 10 ft. In operating, the crew would dig through the stratum in one footing and then swing around to other footings while the broken rock was being removed. Owing to local conditions which required that all excavation be kept on the site for use as fill in raising the floor level it was impossible to open very many footings at one time. On this account the machine could not be operated steadily more than about one-third of a working day. For this reason also the highest number of footings worked at one time was seven. Requiring only thirty minutes to couple up or remove, the use of the digger did not interfere with the ordinary work of the derrick, the clamshell bucket or logchain being attached and used whenever needed.

The results obtained by the use of this machine were highly gratifying. In one footing 24 x 10 ft. a stratum of hard blue limestone 10 in. thick was completely broken up in thirty minutes, ready for handling without any sledging. The broken rock shown in the photograph gives a good idea of the machine's efficiency in reducing rock to sizes suitable for handling. Besides breaking this rock more thoroughly than dynamite would have done, the time used was less than that necessary for drilling holes for dynamiting. In addition the use of this machine was much safer and did not interfere with work on the job, as blasting would have done. In spite of the fact that conditions, previously explained, permitted the operation of this machine only a portion of each day, although paying the engineer for full time, our costs for breaking up and removing the rock using this equipment were less than one-half the cost of removing the rock in the south half of the building, where dynamite was used. It is believed that by making several changes in the machine, increasing its flexibility, it will be possible to make still further reductions in the cost of rock excavation.

This equipment is shown with a 60-ft. boom, but by using different lengths of digger arms it would be practical to use 80- and 100-ft. booms, which would increase the digging area to approximately 3,700 and 5,900 sq.ft. respectively. Also, by giving the digger arm an adjustment range of 10 ft. in length it would be possible to dig closer to the derrick mast and also operate in deeper holes.

The use of this equipment, moreover, is not limited to rock excavation, for, by using a cap in place of the digging tool, it could be readily adapted to driving wood, precast or sheet piling and similar work. As the cost of driving a small number of piles with regular pile-driving equipment is almost prohibitive, this apparatus, attachable as it is to any derrick, would enable the contractor to handle small piling jobs economically.

NEWS OF THE WEEK

New York, February 17, 1921

Blames Strathmore Collapse on Poor Bond

Vibration Also a Factor in Fall of Nine-Story Apartment, Says Report of R. P. Miller

In a final report on the collapse of the Strathmore apartment house, 52nd St. and Broadway, New York City, Dec. 1, just rendered by the superintendent of buildings of Manhattan Borough, R. P. Miller, to the borough president, the collapse is ascribed to no single definite cause such as overloading, fracture of a structural member, or negligence in conducting the alteration work in progress, but to the generally poor structural state of the old building, shattered condition of the brick work, lack of anchorage of the floor joists, and the possible effects of vibration. "I am of the opinion," says Superintendent Miller, "that the accident was due to a combination of circumstances such as weak masonry construction, lack of anchorages between the floor and wall constructions, unusual and insecure support of the floorbeams on the walls, and other conditions."

East Wall Buckled

As stated in an account of the collapse given in *Engineering News-Record*, Dec. 9, 1920, p. 1155, the conclusion was reached by the chief inspector of the Bureau of Buildings, F. C. Kuehnle, who was on the ground within a few minutes after the collapse, that the east wall of the building failed by outward buckling at about the fourth floor level, possibly due to overloading of floors by material required for reconstruction of the building, then in progress. Superintendent Miller finds, however, that there was not enough material on the floors to cause collapse if all else had been safe. The alteration operations also are not found responsible.

The building, which was erected in 1880 as a nine-story apartment to house sixteen families, is described as being found in unsatisfactory condition. Of the brick work of the walls Mr. Miller says, "When the plastering was removed it was found that the masonry was badly cracked in numerous places. This was especially true in the exterior wall along Broadway where cracks had developed over the arches of nearly all the windows. The brick piers on the interior of the building, it was found, were more or less cracked particularly in about the fifth, sixth and seventh stories, the appearance being that of overloaded brickwork, the overloading being inherent in the construction and not due to any excess load

(Continued on p. 316)

Road Builders Convention Awakens New Interest

Papers of High Technical Value Presented, But Discussion Lags—Contractual Relations a Live Topic—Equipment Exhibit Large and Varied

Renewed interest in the American Road Builders Association was plainly indicated at the annual meeting and exhibition held Feb. 9 to 12 in Chicago. From 100 to 200 members were in regular attendance at the sessions for the reading and discussion of technical papers. This revival of life was the outstanding feature of the meeting. Generally the formal papers and discussions were of high character, though discussion from the floor was lacking. The plan of separate sessions devoted to design and construction, traffic, finance and contractual relations helped to maintain interest. Finally, the exhibition of equipment and materials was varied and excellent and was highly successful in respect to the volume of business transacted.

Technical Meetings

High water mark in interest was reached at the sessions devoted to consideration of subgrade design and research, highway finance and relation between engineers and contractors. The technical facts of chief interest will be reviewed in an early issue of *Engineering News-Record*. Speakers of exceptional importance led the discussion on all the general topics.

Enumerating the failures due to unstable subgrade, H. G. Shirley of the Federal Highway Council, outlined the investigations of subgrade being made and planned. Following him F. H. Eno, Ohio State University, listed the principal problems in road drainage which require investigation and in particular spoke of the moisture studies of clay soils being conducted at the university laboratories. In his discussion of both papers Clifford Older, state highway engineer of Illinois, outlined methods and results of subgrade studies in Illinois covering substantially the information given in his article in this journal, Feb. 3, 1921, p. 210.

Importance was given to the paper on highway finance by the position of its author, H. C. Sylvester, Jr., vice-president of the National City Co., which is virtually the bond department of the National City Bank of New York. Stressing two facts, first, the life term and, second, the investment attractiveness of bonds, the author outlined policies in financing highways as viewed by the banker.

Contractual relations were the subjects of ringing addresses by W. A. Rogers, president, Bates & Rogers Construction Co.; R. G. Collins, Keystone Construction Co., and A. R. Hirst, state highway engineer of Wisconsin. These addresses will be summarized in a later issue. The close agreement of thought by the engineers and contractors who spoke aroused an enthusiasm in discussion which was unequalled at any session of the convention. Here again the virility and forcefulness of the speakers contributed largely to the success of the proceedings.

Business Transacted

Convention business consisted largely of the presentation and discussion of resolutions. Besides formal resolutions of thanks for services rendered, the association placed on record resolutions (1) urging a 25 per cent reduction in railway rates on materials for highway construction; (2) advising producers of materials to get into step with dealers in other commodities in reducing prices; (3) favoring legislation having in view the reduction of automobile accidents on highways; (4) petitioning the United States Senate to pass promptly the Federal-aid House act appropriating $100,000,000 for 1921 highway construction; (5) urging a continuation of Federal aid on the basis of present laws and practices; and (6) urging the removal of state highway departments from political changes, liberal appropriations for developing permanent organizations and an increase in salaries sufficient to secure and retain experienced and qualified engineers in all grades of state highway service.

No formal action was taken in respect to the next place of meeting, but informal comment and particularly the discussions in the lobbies favored a return to Chicago, whose central location and means for accommodating both delegates and exhibits were felt to have contributed largely to the success of this year's convention.

Exhibits and Attendance

Both size and variety characterized the exhibits. To the student in highway research the working exhibits of testing apparatus and processes by the U. S. Bureau of Public Roads was the notably interesting item. Along the same line of educational service were the large exhibits of the various road construction materials associations, the

Board of Local Improvements of Chicago, and the American Association of Engineers. The machinery exhibits embraced an unusual number of large units such as motor trucks, tractors, locomotives, sand and gravel plant equipment, locomotive cranes and large paving mixers.

The attendance was large; it embraced more particularly contractors and subordinate highway officials. Few state highway department engineers were at the convention. Activity in securing a greater attendance of these leaders in carrying out highway improvements will be a task of the directors of the association for the present year.

Federation Chooses Secretary

Lawrence Wilkinson Wallace of Baltimore, president of the Society of Industrial Engineers and member of the American Society of Mechanical Engineers, was unanimously elected secretary of the Federated American Engineering Societies at the meeting of the American Engineering Council at which Herbert Hoover presided, held in Syracuse, N. Y., Feb. 14. A biographical sketch of Mr. Wallace will appear in next week's issue.

To Begin Borings for Tunnel Under Narrows

Request has been made of the War Department by the transit construction commissioner of New York City for permission to make borings in the channel of the Narrows in preparation for the design of a tunnel for rapid transit between Brooklyn and Staten Island. The tunnel projected is to connect with the Fourth Ave. subway in Brooklyn, at either 67th St. or 95th St.

No Prospect of Joining International Road Congress

Upon the initiative of Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, the Secretary of Agriculture some time ago asked the State Department to lay before the President a proposal urging Congress to authorize membership for the United States in the Permanent International Association of Road Congresses. It was hoped that if the President and Congress acted favorably the United States would extend to the association an invitation to hold the next congress, in 1922, in this country.

The State Department has now informed the Secretary of Agriculture that the President does not deem this an opportune time to present to Congress the matter of membership in the association. Accordingly there will be no action during this session of Congress and, the time limit set by the association having expired, it will not be possible for the United States to invite the Congress of 1922 to come here. Accordingly the road congress now automatically goes to Rome, the Italian Government having formally invited the congress, with the proviso that Italy would step aside in case a formal invitation were received from the United States.

Publicity Conference Speakers Are Announced

For the engineering publicity conference which is to be held Feb. 25 at the Congress Hotel, Chicago, under the auspices of the American Association of Engineers the following speakers are announced: Richard H. Waldo, formerly chairman of the publicity committee of the Chamber of Commerce of the United States and now general manager of the Inter-Racial Council; F. M. Feiker, vice-president, McGraw-Hill Co.; Ivy L. Lee, director of publicity for the Interborough Rapid Transit Co., N. Y; C. S. Darling, managing editor, *Factory*; R. W. Crum, chairman, publicity committee, Iowa Engineering Society; J. G. D. Mack, Wisconsin state chief engineer; W. J. H. Strong, president, Lake Breeze Motor Co.

Among the topics for round-table discussions are the following: Engineering news service, technical news service, a national clipping service, news syndicates, publicity possibilities of the technical press, how publicity helps a community, the qualifications of a publicity man, how publicity helps a local society and engineering publicity from the standpoint of the public.

Spirited Bidding Noted in New York Highway Work

In approximately $3,000,000 worth of road contracts awarded last week by the New York State Commission of Highways successful bidders were an average of 12 per cent under the estimates made by the engineer. For the twenty projects advertised there were eighty-three bidders, there being two projects that drew nine bids each, and three projects seven bids. The aggregate cost of the twenty projects was, according to the engineer's estimate, $3,200,291; but that figure has been reduced, through low successful bids submitted, to $2,837,932. The analysis of the bids is given in the accompanying table:

Bid Number	Milenage	Number Bidders	Engineer's Estimate	Contract Price	Contract Price Expressed in Per Cent of Estimate	Difference in High and Low Bid
1	3.49	3	$153,789	$149,106	97½	$3,453
2	2.48	7	104,500	89,568	85½	14,138
*3	4.13	9	241,011	219,379	91	21,430
4	2.70	4	121,584	109,684	90	5,940
5	6.98	1	221,723	220,227	99½	
6	3.54	4	121,389	111,574	92	4,324
7	3.25	2	110,490	102,844	92½	1,244
8	2.60	5	82,897	73,081	89	6,893
9	3.48	2	123,197	114,434	92½	722
10	3.25	7	118,855	109,694	92½	8,877
11	5.35	9	177,830	153,451	86½	23,959
12	4.09	2	202,314	191,898	94	10,044
13	10.57	3	550,548	525,501	95½	11,725
*14	2.80	3	118,330	108,730	91½	6,550
*15	4.52	2	203,285	196,508	96½	5,127
*16	3.62	2	133,069	131,956	98½	2,113
17	1.38	3	60,070	57,446	95	6,976
18	4.47	4	164,355	156,133	95	11,617
19	1.91	4	147,771	133,571	90½	6,277
*20	0.59	7	43,284	36,818	84	
Totals	75.20	83	3,200,291	2,837,932		
Average	3.76	4+	160,015	141,896	88+	

* Contract not yet awarded—only low bid shown.

Seattle To Vote on Bond Issue

The Seattle city council at a recent meeting voted to submit to the voters at the March 8 election a proposition of issuing bonds in the sum of $750,000 for the construction of the proposed Montlake bridge across the Lake Washington Canal. The council also voted to place before the voters a $200,000 issue for playgrounds and park boulevard repairs. The bonds will bear 6 per cent interest and will be payable in twenty years.

Bridge Bills Before Congress

Bills in Congress extending the time for the construction of bridges over navigable streams include one for a bridge across the Columbia River two miles west of Cascade Locks, Ore., and one for the Castleton, N. Y., bridge of the Hudson River Connecting R.R. Corporation (New York Central R.R. proposed cut-off by-passing Albany and Schenectady). Favorable reports on both bills have been made by the War Department, and the Committee on Interstate and Foreign Commerce has recommended the passage of both bills. In connection with the Castleton bridge, however, a minority report has also been made by the committee supporting the Albany claim that the bridge should provide a 1,100-ft. channel span in order to provide for future improvement of the river to carry ocean traffic to Albany.

Strathmore Building Collapse

(Continued from p. 315)

placed on the floors. The brickwork showed little bond." Of the connection between floors and walls he says, "The floor construction was not anchored to the masonry walls, so that there was a looseness between the floors and the walls, which I feel confident was in a large measure a contributing cause of the collapse."

The report describes the support of the heavy and closely spaced joists of the floors (3 x 8 timbers, spaced 3¼ in. on centers in a large part of the building) at the walls as being accomplished by resting the beams on corbel courses of the brickwork, the beams entering only a short distance into the wall masonry and having no connection to the walls by metal anchors. It then continues "With the loose construction of the building and the condition of the building due to the shoring and work of alteration it seems natural to suppose that vibration of some kind in the structure started the collapse. Investigation, however, has failed to find any evidence of a disturbance of that kind at the time of the collapse." Supplementing the written report Mr. Miller states that street traffic is the most probable source of vibration acting to disintegrate the loose structure of the building, and that progressive separation of floor and wall at the insecure corbel connections probably occurred.

The New Administration of the Am. Soc. C. E.

In this and succeeding issues of Engineering News-Record *will appear brief biographical sketches of the newly elected officers and directors of the American Society of Civil Engineers, as announced in the issue of Jan. 20, p 140, following the annual meeting.*

Edward E. Wall, Vice-President

Edward E. Wall, vice-president, has served since 1911 as water commissioner of St. Louis, Mo. He was born in Saline County, Mo., Aug. 15, 1860, and was graduated from Missouri State University in 1884 with the degree of C. E.

He engaged in railroad surveys and construction in Missouri, Kansas, and Nebraska from 1884 to 1888 and became U. S. assistant engineer on secondary triangulation of the Upper Missouri River in 1889. In 1890 he entered private practice in St. Louis, and two years later joined the St. Louis Water Department as assistant engineer. He was promoted to first assistant engineer of the St. Louis Sewer Department in 1895 and had charge of all construction and reconstruction of sewers, directing a large portion of the designing. Here he served until 1903, when he was named principal assistant engineer of the St. Louis Water Department.

EDWARD E. WALL

In 1906 he was promoted to become assistant water commissioner, designing and directing reconstruction of settling basins and conduits, and installing machinery and apparatus necessary to put in operation a scheme of clarifying and purifying the Mississippi River water by coagulation and simple sedimentation. During this period Mr. Wall designed and built additional basins, conduits, and other facilities for increasing the capacity of the waterworks.

In 1911 he was appointed water commissioner, a position which he still holds. He made an exhaustive report to the Board of Public Improvements on the water supply of St. Louis in 1912, recommending a comprehensive plan for enlarging and increasing the capacity of the existing water-works to a capacity sufficient to supply the city until 1926, and outlining a plan for new water-works to be located on the Missouri River.

His recommendation for enlarging the existing works has been carried out substantially as planned. It included the construction of the Chain of Rocks filters, with a rated daily capacity of 160,000,000 gal., the largest rapid-sand filter plant in the world.

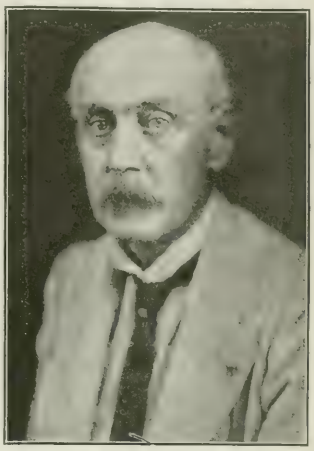
The plan for new works on the Missouri River was closely studied and worked out in considerable detail before being presented to the Board of Public Service in 1915. A committee of the Engineers' Club approved the scheme and steps are now under way to purchase the necessary land for the new plant.

Mr. Wall is a past-president of the Engineers' Club of St. Louis, a member of the American Water-Works Association, the American Public Health Association and the New England Water-Works Association. He was awarded the Thomas Fitch Rowland prize by the American Society of Civil Engineers in 1908, was a member of the nominating committee in 1911-12, and director from District 9 in 1918-20.

Andrew M. Hunt, Vice-President

Andrew M. Hunt, vice-president, has long been identified with a variety of engineering work, much of it on the Pacific Coast, and is now a consulting engineer with offices in New York City. He was born in Sioux City, Iowa, in 1859, and was graduated from the U. S. Naval Academy in 1879. Until 1894 he served in the Engineer Corps of the Navy, when he resigned to enter private practice in San Francisco as a member of the firm of Hasson & Hunt. While a member of this firm he was identified with many important hydro-electric projects on the Pacific Coast. In 1898 and 1899 he went to Alaska and built four steamers for the Alaska Commercial Cable Co. for service on the Yukon River. He returned to San Francisco in 1899 and until 1904 engaged in private practice, specializing in the development of hydro-electric power. In 1905 the firm of Dillman & Hunt, consulting engineers, was established in San Francisco.

In 1915 Mr. Hunt moved to New York City and became president of the Peyton-Hunt Co., consulting engineers. He served during the war as a member of the Naval Consulting Board and on the ship protection committee of the U. S. Shipping Board. During the period of the Panama-Pacific Exposition at San Francisco Mr. Hunt served as chief of the department of machinery. Among other recent projects upon which he has been called into consultation is the Hetch Hetchy water project for San Francisco. Prior to his election to the vice-presidency of the society Mr. Hunt served on the Board of Direction.



ANDREW M. HUNT

Civil Engineers Discuss Heat, Light and Power

Continuing its series of meetings devoted to the consideration of the outstanding engineering problems affecting the metropolitan district of New York, the New York Section of the American Society of Civil Engineers devoted its meeting of Feb. 9 to the subject of heat, light and power. Members of the local sections of the mechanical, electrical and mining engineering societies were invited by the civil engineers to attend the meeting.

The opening address was by Col. William Barclay Parsons, consulting engineer, New York City, who discussed the power needs of the metropolitan district, dealing specifically with central station development, New York State's potential resources in water power and the possibility of generating power in stations at coal mines.

Ten-minute discussions were presented by the following engineers: J. W. Lieb, vice-president, New York Edison Co.; Frank Smith, vice-president, United Electric Light & Power Co.; Farley Osgood, vice-president, Public Service Electric Co. of Newark, N. J.; George Otis Smith, directtor, U. S. Geological Survey; H. E. Skougor, consulting engineer, New York; George Gibbs, consulting engineer, New York; William Cullen Morris, engineer of construction, Consolidated Gas Co.; F. O. Blackwell, consulting engineer, New York; and W. S. Murray, chairman, Super-power Survey.

House Passes Federal-Aid Road Bill

Sells' Measure Authorizes $100,000,000 for Next Fiscal Year—Only 58 Opposing Votes

Only 58 votes were cast against the Sells' roads bill when the House of Representative voted on the measure Feb. 7. The bill, as passed by the House, provides an appropriation of $100,000,000 for continuing the federal-aid road policy during the next fiscal year.

The opposition to the bill was led by Representative Dunn, of New York, chairman of the committee on roads. He contended that the present financial situation of the country is such that the expenditure of $100,000,000 should not be authorized when there still is a large balance in the Treasury of federal-aid money. He argued that $117,000,000 of the balance of $200,000,000 has not been allotted under the agreements between the U. S. Bureau of Public Roads and the individual states. Mr. Dunn reasons that with a $200,000,000 balance plus the 135 per cent which the states must appropriate there is some $500,000,000 available for future construction—more than could be accomplished in ten years.

Mr. Sells submitted statistics, however, showing that ten of the forty-eight states already have contracted for the expenditure of their entire allotment, and that at the present rate of progress thirteen additional states will be without funds for new contracts at the close of the current fiscal year. Only eight states, he said, will have an unallotted balance to their credit at the close of the calendar year. He declared it to be unfair to say that there is an unallotted balance of $117,000 000.

Grand Trunk Arbiters Bar Costs of Reproduction Value

The Grand Trunk Arbitration Commission by a vote of 2 to 1 Feb. 7 decided against the admission of evidence of physical value and cost of reproduction in the settlement of the controversy of reparation to stockholders. Hon. William Howard Taft dissented from the opinion which was supported by the other two commissioners, Sir Walter Cassels and Sir Thomas White.

Tie Producers Adopt Standards

The National Association of Railroad Tie Producers at the third annual convention, Jan. 27-28 at San Francisco, adopted standard specifications for railway cross ties understood to be practically identical with those to be recommended at the annual convention in March of the American Railway Engineering Association by its tie committee. The producers' specifications cover material, physical requirements, design, manufacture, inspection, delivery and treatment.

American Specification Institute Plans Maturing

A new organization, the American Specification Institute, has been launched in a tentative way by a small group of architects and engineers. These men feel that there is a lack of means for collecting and distributing information concerning specifications and their preparation. That the specifications are now the product of individual effort and as such vary in many features that can be conventionalized thus eliminating a needless duplication of study, research and labor on the part of specification writers.

The plan and scope of the organization which will hold an organization meeting early in March is as follows:

To increase knowledge concerning and improve the methods of writing specifications. The kinds of specifications included are those for buildings, engineering structures and all works whatsoever in which materials of construction and labor are used; for the installation and use of mechanical and sanitary apparatus and equipment; for the fabrication and installation of all furnishings and furniture; for all ornaments and ornamentation, both interior and exterior; for paving, planting, embellishing and improving of grounds and waterways; and for such other things as are produced or sold on specifications.

The Institute is intended not to interfere with any of the present organizations such as the American Society for Testing Materials, kindred national and local architectural and engineering societies, manufacturers and trade associations, but will endeavor to carry forward the activities of such and give additional assistance to specification writers. Membership will be composed of active members, persons who devote their entire time or a part to the writing of specifications; associate members, persons who employ specification writers; and honorary members, testing and laboratory engineers and instructors in specifications writing in architectural and engineering schools.

Scope of Work

The work of organization will consist of (1) study of materials and (2) methods of writing specifications. Items under the first subject will be the production and physical properties of raw materials; methods of manufacturing, fabrication and finishing; relative value based on appearance, initial cost and maintenance, effect of combinations with other materials and proper materials for various types of buildings of varying grades.

Under (2) a study will be made of the means of accomplishing complete co-operation between the drawings and specifications and determining what methods of construction and installation should be used, what the drawings should show or indicate and what should be omitted for inclusion in the specifications; the development of an outline or checking list; the general contract conditions; specific requirements governed by local conditions; use of standard specifications of materials as prepared by societies and manufacturers; the arrangement of specifications so as to conform to the sequence of construction and installation of the work; the writing of specifications that are clear, concise, coherent and that can be understood by the courts; the principles of contract law as it affects the writing of specifications.

More Specifications Submitted to Standards Association

According to recent announcement of the Engineering Standards Committee, the National Electrical Code of the National Board of Fire Underwriters, 1920 edition, as well as three specifications of the American Society for Testing Materials, have been submitted to the committee for approval as tentative American standards. The three specifications cover a test for toughness of rock, a method for distillation of bituminous material suitable for road treatment, and a method for sampling coal.

New Standardization Work

At a conference held in New York, Feb. 2, under the auspices of the Engineering Standards Committee to consider the standardization of insulated wires and cables, the conclusion was reached that unification of specifications for wires and cables (for other than telephone or telegraph use) should be undertaken as a single general project. The work under discussion relates to quality, stranding and sizes of the conductor; rubber insulation; varnished cloth insulation; impregnated paper insulation; enamel, cotton and silk covered magnet wire; asbestos and other fibrous coverings; sheath and armor; and standard make-ups.

Revised specifications for Portland cement, agreed upon by Committee C-1 of the American Society for Testing Materials and the government interdepartmental committee on cement, have received the approval of the American Engineering Standards Committee.

States Want Army to Turn Over Road Equipment

Representative C. Frank Reavis, of Nebraska, announced last week that he will endeavor to have his bill, which directs the Secretary of War to turn over to the forty-eight States automobiles, tractors and mobile shop units needed for the construction of highways, attached to the army appropriation bill in the Senate.

The appropriation bill passed the House Feb. 9 with a rider attached by Representative Anthony, of Kansas, directing that the machines should be sold on the open market. The Anthony rider was subject to a point of order in the House, but as no point of order was taken, an amendment to the rider is now in order in the Senate.

In the meantime, telegrams and letters are pouring in on Congress from highway officials in every State from Maine to California, demanding that the machines be made available to the states at once so that construction of highways need suffer no further delay.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Convention, March 15-17.

The Arkansas Engineering Society, at its annual meeting Jan. 17, voted to become a chapter of the American Association of Engineers. An engineers' license bill has been prepared for submission to the state legislature at this session.

The Portland (Ore.) Section, Am. Soc. C. E., at its annual dinner Jan. 14, elected the following officers: President, M. E. Reed; first vice-president, Samuel Murray; second vice-president, Ben S. Morrow; secretary, C. P. Keyser and treasurer, Charles J. McGonigle.

The Colorado Society of Engineers at its annual meeting Jan. 19, elected the following officers: President, F. C. Dreher; vice-president, R. M. Hosea; secretary, C. M. Lightburn. Three addresses were given as follows: "Engineers Problem of the West" by Fred J. Lucas; "Transportation" by John Crook and "Engineers' Liscense Law" by Senator Walter O'Brien.

The Engineers' Club of the Youngstown (Ohio) District at its December meeting elected the following officers: President, C. S. Robinson, vice-president and general manager, the Youngstown Sheet & Tube Co.; vice-president, W. C. Coryell, consulting engineer, the General Fireproofing Co.; directors, two year term, E. F. Vogel, Mark Pendleton, Howard Bishop; trustees, two year term of office F. E. Kling and E. T. McCleary.

The Washington Irrigation Institute at its two-day session held recently in Spokane elected the following officers: President, R. K. Tiffany; first vice-president, William O'Brien; second vice-president, J. L. Keller.

The Southern California Section, Am. Soc. C. E., at its annual meeting in December elected the following officers for the year 1921: President, H. W. Dennis, chief engineer of construction, Southern California Edison Co.; first vice-president, R. J. Reed, chief engineer, Union Oil Co.; treasurer, E. R. Bowen, consulting engineer; secretary, F. G. Dessery, consulting engineer.

A Buffalo Section, Am. Soc. C. E. was organized Jan. 25. The following officers were elected: President, A. L. Johnson; vice-president, George B. Bassett; secretary-treasurer, Bruce L. Cushing. The annual meeting will be held April 5.

The Spokane (Wash.) Section, Am. Soc. C. E., at its recent annual election, named E. G. Taber, president and Charles E. Davis, secretary treasurer.

The Associated Engineers of Spokane, at the annual meeting Jan. 21, elected the following officers: President D. F. Henderson; secretary-treasurer, A. D. Butler.

The Providence (R. I.) Engineering Society, at its fifth annual banquet, Feb. 1 was addressed by Prof. William J. Cunningham on "Federal Control of Railroads." This subject was discussed also by Arthur P. Russell, vice-president of the New York, New Haven & Hartford R.R.

The Jamestown (N. Y.) Engineering Society was organized at a recent meeting with the following officers: President, Walter F. Shaw; vice-president, E. C. Dollard; secretary, H. G. Garlock; treasurer, F. A. Irvine.

The United Engineering Society, New York, at its annual meeting Jan. 27, elected the following officers: President, J. Vipond Davies; first vice-president, Calvert Townley; second vice-president, W. L. Saunders; secretary, Alfred D. Flinn; treasurer, Joseph Struthers; assistant treasurer, George H. Pegram.

The Webster City Engineers Club, Webster City, Ia., has been organized as one of the sectional clubs of the Iowa Engineering Society. At its first regular meeting Jan. 29 it was decided to take an active part in all local affairs and not confine itself to engineering activities.

The Iowa Engineering Society directors have elected Lloyd A. Canfield, Des Moines, secretary-treasurer to succeed John H. Dunlap who was named president at the annual meeting Jan. 20.

The Rochester (N. Y.) Engineering Society announces the following meetings: Feb. 18, special meeting, a four reel moving picture on the manufacture of leather belting provided by the Charles A. Schieren Co. of New York; March 11, "Power Development of Niagara Falls" by John L. Harper; April 8, "Industrial Electric Heating" by C. F. Hirshfeld; Feb. 23 luncheon, "The Arguments for the St. Lawrence Waterway" by C. P. Craig.

The Topeka Engineers Club, at its annual meeting Jan. 31, elected the following officers: President, M. W. Watson; first vice-president, A. B. Griggs; second vice-president, F. W. Epps; secretary, P. J. Carter; treasurer, Roy Finney.

The Detroit Engineering Society, at its Feb. 18 meeting, will be addressed by L. P. Alford, on "The Engineer in Industrial Reconstruction."

Personal Notes

J. T. CARROLL has organized the Carroll Contracting Co., New York.

CHARLES B. HAWLEY, for seven years assistant hydraulic engineer, Aluminum Co. of America, has entered private engineering practice with offices in the Munsey Building, Washington, D. C. He will specialize in hydro-electric development and steam power plants. During his connection with the above firm he had charge of the design of several of the largest water power developments in this country. He has also made extensive hydraulic investigations abroad.

C. B. SMITH, editor of the *Professional Engineer*, official organ of the American Association of Engineers, has accepted a position with the Chicago Bridge & Iron Works as publicity man and editor of the *Water Tower*.

HOLBROOK, WARREN & ANDREW have purchased the business of Miller, Holbrook, Warren & Co., Decatur, Ill., and will continue the structural and municipal engineering business organized by the latter company. Frank D. Holbrook and Capt. Clarence R. Andrew were formerly with the Government on Ohio River improvements and Willis D. P. Warren has been engaged in engineering work, principally municipal projects, in Illinois for seventeen years.

F. P. JOYCE and S. J. WILLIAMS, formerly in the county engineer's office, Indianapolis, Ind., have opened an office as consulting engineers in Indianapolis.

W. T. HOGG, for three years connected with the engineering department of the Dock Board at New Orleans, La., has been appointed chief draftsman.

R. C. MARSHALL, JR., former head of the Construction Division, U. S. A., was nominated on Feb. 10 to be brigadier general in the Reserve Corps. Gen. Marshall is now actively engaged as the general manager of the Associated General Contractors.

CAPT. W. J. WILSON has been appointed to the newly created office of assistant chief engineer in the engineering department, Port Commission, Seattle, Wash. George F. Nicholson is chief engineer.

ALEXANDER MURDOCK, chief adjuster, U. S. Emergency Fleet Corporation, has been appointed city engineer of Chicago. He ranked first in a recent civil service examination for the position held for more than a year under temporary appointment by P. S. Combs. Mr. Combs ranked second in the examination. Mr. Murdock was graduated from the University of Pennsylvania in 1882. His early experience includes tunnel construction on the Wilkesbarre & Scranton R.R. Co. and

for the Stricker Water Tunnel Co., Colorado Springs. For three years he was assistant city engineer of Reading, Pa., and from 1900 to 1903 was city engineer. From 1905 to 1918 he was connected with surety companies and bonding contractors. In the latter year he became vice chairman, later chairman of the claims board of the Emergency Fleet Corporation.

C. B. FREEMAN, recently chief engineer of the Walter S. Newhall Co., Cleveland, Ohio, is now actively interested in the contracting firm of Lane & Freeman, incorporated last summer to engage in the construction of bridges, industrial buildings and heavy concrete structures with offices in St. Louis and Cleveland.

BURR H. SIMPSON, for several years field engineer with the Portland Cement Association, has resigned to become sales engineer with the Kentucky Rock Asphalt Co., Louisville, Ky., with headquarters at Buckhannon, W. Va.

R. F. MCDOWELL, of the Cleveland division of Morris Knowles, Inc., and formerly principal assistant engineer to R. Winthrop Pratt, has been appointed county engineer of Cuyahoga County, Ohio. He will retain his position as division engineer in the Knowles organization, but will give most of his time for the next few months to organizing the new department, created to design and construct water and sewer systems for Districts 1 and 2, upon which a preliminary report was submitted by MacDowell & Garvin in June, 1920.

LOY E. SNEARY, formerly principal assistant engineer of Davenport, Ia., has been appointed city engineer of East Moline, Ill.

WILLIAM J. SHEA, formerly Major of Engineers, U. S. A., in charge of the procurement, storage and issue branch, Office of the Chief of Engineers, Washington, D. C., received his discharge Jan. 1 and has been appointed construction engineer, Department of Public Works, Bureau of Highways, Brooklyn, N. Y.

C. DEL VALLE ZENO has resigned his position as manager and chief engineer for Riera, Toro & Von Twistern, New York, to open a consulting engineering office in Havana. He will also establish a New York office in the near future.

MAJOR CLYDE V. TAYLOR, late of the Corps of Engineers, U. S. A., who has been with the U. S. Indian Irrigation Service for several years, both before and since the war, has resigned from that service and will be associated with his brother, L. H. Taylor, consulting engineer, at Reno, Nev.

THOMAS L. WILKINSON, for ten years in charge of the operating department of the Intermountain Railway, Light & Power Co., has retired from that department to resume his consulting work. He will specialize in the design and construction of power and industrial plants, investigation, operation and reports on public utilities, appraisals and valuations. His office will be in Denver.

COL. FREDERICK STUART GREENE, formerly New York State Highway Commissioner, announces that he has opened an office in New York City as consulting engineer on highway construction, highway department organization, waterproofing, pier, dock and concrete construction.

L. C. HERRICK, of Norwalk, Ohio, has been appointed State Highway Commissioner of Ohio, to succeed A. R. Taylor. The new commissioner has served three terms as engineer of Huron County, Ohio. He has also served as city engineer of Norwalk, assistant engineer of Mansfield, and for three years as assistant engineer in the maintenance of way department of the Big Four.

ALFRED J. CLEARY, chief assistant engineer of San Francisco, has resigned to enter private practice as consulting engineer in that city. He has opened an office in the Mills Building and will undertake general construction work with special attention to the hydroelectric field. Mr. Cleary entered the employ of the city engineering department twelve years ago as an inspector and worked up through various grades. During the years in which the Hetch Hetchy project has been under construction Mr. Cleary has been in entire charge of that work, reporting to M. M. O'Shaughnessy, city engineer.

G. LEWIS TAYLOR, assistant chief engineer of the McClintic-Marshall Co., Pittsburgh, Pa., has been appointed chief engineer of that company, succeeding the late Paul L. Wolfel. Mr. Taylor who held the position of assistant chief engineer for the past twelve years, was graduated from the University of Pennsylvania in 1900. His connection with the McClintic-Marshall Co. dates from a period shrortly after the inception of that company, and his experience includes a prominent part in the construction of most of the great bridges and other structures erected by the company.

NELSON A. ECKART has been appointed chief assistant city engineer of San Francisco, succeeding Mr. Cleary. Mr. Eckart has been in the employ of the city engineering department about seven years. For some time he was in charge of design and construction on the municipal railway and in recent years has been construction engineer on the Hetch Hetchy project with headquarters at Groveland, Cal.

LOUIS C. BOONE, of Rowesville, S. C., has been appointed engineer of Orangeburg County, S. C.

T. OWENS has been appointed city engineer of Port Angeles, Wash.

OBITUARY

EDWARD C. BARNARD, commissioner of the International Boundary Commission, which is engaged in defining and marking the boundary between the United States and Canada, except on the Great Lakes and the St. Lawrence River, died in Washington, Feb. 6. He was born in New York City, 1863, and was graduated from Columbia University School of Mines in 1884. In that year he joined the U. S. Geological Survey as topographer and geographer and since 1887 has had independent charge of this work. He took a prominent part in the map making work of the survey and mapped sections of Virginia, Tennessee, Kentucky, New York, Washington, Montana, Oregon and California, also sections of Alaska. In 1901 he was detailed by the Secretary of the Interior to examine and make report on the Northwest Boundary line between the United States and Canada and, in 1915, he was appointed commissioner to represent the United States in the establishment of the boundary with Canada.

EDWARD C. BARNARD

JAMES F. FISHER, former engineer of Williamsport, Pa., died Feb. 5 at Muncie, Ind. He was born at Wapakoneta, Ohio, in 1866 and was a graduate from Ohio State University. He served as city engineer of Williamsport from 1903 to 1909. At the time of his death he was practising in Indiana.

FREDERICK W. SHEPPERD, founder and for thirty-three years proprietor of the journal that subsequently was named *Fire and Water Engineering*, died at his home in Brooklyn, N. Y., Feb. 8. For a brief period in 1886 Mr. Shepperd was employed on the business staff of *Engineering News*.

Seattle Announces 20 Per Cent Wage Cut

After various conferences between the executive committee of the Seattle Master Builders Association and representatives of the employees, an agreement has been reached whereby the wages of all men employed in building trades have been decreased 20 per cent, a new wage scale becoming effective Feb. 1. The reduction furnishes the basis of the minimum wage for 1921, the contractors being pledged not to reduce wages further this year. The reduction has been made in the hope of stimulating building construction.

Railway Labor Board Opposes Wage Cuts

In a decision rendered in Chicago, Feb. 10, the Railway Labor Board, denied the plea of the carriers for immediate abrogation of national working agreements and for setting aside of basic wage rates for common labor, substituting prevailing local rates of wages. Following the decision the executives announced that the roads would now proceed individually to request conferences with unskilled employees on wage reductions to bring the cases before the Labor Board in the form of definite controversies between men and management.

The Railway Labor Board, in its decision, took the position that it could not render a decision abrogating existing contracts, although made during the period of federal control, without further hearings of the case. As to the financial dilemma of the railroads the chairman of the Labor Board declared this to be within the jurisdiction of the Interstate Commerce Commission.

Wisconsin Proposes Law Providing Unemployment Insurance

A bill to compel employers to pay an insurance benefit to their workers, when unemployed, has been introduced into the Wisconsin Legislature by Prof. John R. Commons of the department of economics of the University of Wisconsin. The proposed bill would require employers to form mutual insurance companies and pay benefits to the workers they discharged at the rate of $1.50 per day for adults and 75 cents a day for boys and girls between the ages of sixteen and eighteen years.

Benefits would be obtainable by employees provided they had worked at least twenty-six weeks, on the basis of one week's benefit for every four employed. Workers idle as a result of strikes or lockouts would not be entitled to benefits, nor would farm labor. The author of the bill asserts that the fear of unemployment is the greatest deterrent to the amicable adjustment of industrial relations. He also asserts that such a bill would have the effect of making employment continuous in any industry, the employer avoiding slack time through fear of penalties.

Prevailing Rate of Wages Ordinance Repealed at St. Louis

After a half year of contention at St. Louis, Mo., over payment of the "prevailing rate of wages" on all city work, the board of aldermen has repealed its ordinance on the subject, generally known as Board Bill No. 28, that has held up city construction work for some months past. The ordinance was passed in June, 1920, and provided, among other things, that on all work done by the city of St. Louis, either through direct forces or by contract, there should be paid the prevailing rate of wages, which was the rate established by the city in its own maintenance operations, and which had been uniform with the trade-union scale for similar services.

After the passage of the bill the city of St. Louis in advertising bids on several contracts discovered that in each instance the contractors failed to bid, inasmuch as they would be forced to pay a fixed rate which was slightly in excess of the open market. The situation was taken in hand by the board of public service in November, 1920, which body recommended the repeal of the labor ordinance to the board of aldermen, indicating that it would be impossible for the city to secure bids on either sewerage or paving jobs to be paid for by special tax as long as the ordinance remained in effect.

After various conferences in which both the general contractors and the labor unions took active part, the ordinance was repealed. Repeal becomes effective in March.

Wanaque Contract Review Refused

A writ of certiorari to review an award by the North Jersey District Water Supply Board for a dam on the Wanaque watershed to W. H. Gahagan, Inc., of Brooklyn, has been denied by Justice Gummere of the Supreme Court of New Jersey. The application for a writ was made in the name of the Rollin Construction Corp., New York, an unsuccessful bidder, and Andrew H. Scott, a taxpayer.

The argument for the application of a writ was based upon the contention that the advertisement contained the words "to the lowest, best qualified bidder," whereas the law requires the wording to be "to the lowest responsible bidder." The Rollin people contended that the manner in which the advertisement was prepared gave too much authority to the commission to determine the comparative competence of bidders.

The Rollin Construction Corp. submitted the lowest bid, being approximately $8,000 below the engineer's estimate and the bid of the successful contractor. As explained in *Engineering News-Record*, Nov. 18, p. 1013, the successful bidder, W. H. Gahagan, Inc., had on a cost-plus basis, whereas the Rollin corporation bid on a straight unit-price basis.

Cement Production 100,000,000 Barrels in 1920

According to estimates prepared under the supervision of Ernest S. Burchard of the United States Geological Survey, the production of portland cement within the United States in the year 1920 amounted to 100,302,000 bbl. and the shipments to 96,329,000 bbl. Compared with 1919 this figure represents an increase of 24 per cent in production and 13 per cent in shipment. The average factory price in bulk at the mills for the whole country was $2.01 a barrel in 1920 as compared with $1.71 in 1919, an increase of 17.5 per cent. The statistics compiled by Mr. Burchard include reports from practically every manufacturer of portland cement and are based upon records for the first eleven months, plus estimates for December.

Marine Equipment Manufacturers Organize

Representatives of forty-five marine equipment manufacturers recently met in New York City to form the Marine Equipment Manufacturers Association, an organization designed to promote good will between those who buy and those who sell marine equipment and supplies; to promote and supervise exhibits; and to co-operate with other associations in the marine field to the end that their efforts in the advancement of the designing, building and operation of ships shall be most productive. It is planned to have the manufacturers association closely resemble the Railway Supply Manufacturers Association, serving the marine field as does the latter organization serve the steam railway field. The temporary officers of the new association are: Acting president, Edward A. Simmons, *Marine Engineering*, and acting secretary, K. L. Ames, Jr., American Steel Foundries.

Alpha and Cement Securities Plan Consolidation

A committee composed of the large stockholders of the Alpha Portland Cement Co., Easton, Pa., and the Cement Securities Co., Denver, Colo., have prepared a plan for the consolidation or merger of these two companies, and have recommended its adoption to the other stockholders of the two companies. The Alpha Portland Cement Co. has cement mills in New York, New Jersey, Pennsylvania, West Virginia, Ohio, Michigan and Illinois, with executive offices at Easton, Pa., and Chicago, Ill. The Cement Securities Co. controls mills operating in Colorado, Utah, Montana, Nebraska and Oklahoma.

If the stockholders of the two companies approve the plan of consolidation, the new company will be one of the largest manufacturers of portland cement in the United States, having an annual capacity well in excess of 12,000,000 bbl.

To Bid on Pennsylvania Roads

Pennsylvania will receive bids Feb. 18 on 104 miles of highways, mostly of reinforced concrete. This mileage is divided among twenty-one projects.

Ohio to Let Road Contracts

Highway and bridge improvement contracts involving estimated construction costs of close to $1,500,000 are announced by L. C. Herrick, State Commisssioner of Highways of Ohio. Bids will be opened Feb. 25 at Columbus. There are nine federal-aid projects and seven other sections of highway on the program. Among the types of surfacing called for are bituminous macadam, waterbound macadam, bitulithic, brick, plain and reinforced concrete and Kentucky rock asphalt.

Nominating Committee of Building Congress Named

The nomination committee of the New York section of the National Congress of the Building and Construction Industry, provided for in a resolution passed at the recent preliminary organization of the New York section, as noted in *Engineering News-Record*, Feb. 3, p. 239, has been named by the chairman. The members of the nominating committee, whose duties will include the selection of an organizing committee to perfect the New York district organization, making it a permanent body, is composed of the following: Electus D. Litchfield, architect; F. M. Feiker, managing editor McGraw-Hill publications; Ronald Taylor, sub contractor; John Lowry, Jr., general contractor; Andrew J. Post, steel contractor, and Alexander M. Bing, investing builder.

New England Road Builders Form Organization

At a meeting of Massachusetts highway contractors in Boston Jan. 18 a permanent organization, under the name of the New England Road Builders' Association, was formed. The objects of the organization are to protect and promote the interests of highway contractors and to establish better relations with public officials.

The officers of the association are: Ransom Rowe, president; John F. Coleman, vice-president; Joseph A. Tomasello, treasurer, and Frederick Hoitt, secretary.

Relief for Contractors Operating Under Supervising Architect

Contractors who failed to submit their claims in time to take advantage of the act of Aug. 25, 1919, relieving them from losses caused by war conditions practically have been assured of reimbursement by the action of the House committee on public buildings and grounds in recently reporting favorable legislation to that effect. The legislation applies only to those contractors who are engaged in the construction of post offices and other buildings under the supervising architect.

Foreign Building Materials Appear in Local Markets

Persons representing themselves as European brick manufacturers' representatives have been in the New York market offering foreign made brick in competition with American made products at a delivered (duty) price below that of domestic brick at wholesale. Belgian steel and glass have also been offered at prices which are considerably below the levels governing domestic products of this sort. The latest and what is considered by the Dow service daily building reports as the most aggressive foreign building material sales drive, is that centered around German cement. Norwegian lumber has also been offered in competition with Douglas fir from the Pacific Coast. Shipping interests have found it more or less convenient to return from European ports with such cargoes as building materials, inasmuch as the falling rates of exchange have made it rather difficult for bottoms to return with anything in their holds but sand and gravel.

Knight Law Held Unconstitutional

A decision handed down Feb. 2 by the Court of Claims of New York declares unconstitutional the Knight law, designed to reimburse those highway contractors who incurred losses because of the increased cost of labor and material during the war. Claims which were filed with the Court of Claims under the provisions of the act totaled almost $5,000,000. The law was passed in 1919 when $3,000,000 was appropriated to meet these claims. Last year an additional $4,000,000 was appropriated. The prevailing opinions, written by Judges Moreschauser and Ackerman, were handed down in the case of the Dale Engineering Co., which sought to recover $27,405. In holding the act unconstitutional the Court of Claims declares that it is imperfect in that it allowed extra compensation to a contractor and further violates the constitution in that it audits and allows private claims against the state.

Employers Commend Efficiency of Journeymen Bricklayers

Believing that injustice had been done the journeymen bricklayers in the frequent publication of articles calling attention to the general inefficency of labor the Mason Contractors Association of the United States and Canada, in its recent annual convention in Detroit, came to the defense of the bricklayers. In resolutions passed at the convention the mason contractors expressed the conviction that, except in isolated cases, journeymen bricklayers were now producing an amount of work that compares favorably with that of pre-war years, and that they were cooperating with the mason contractors in endeavoring to give the public the best of service.

Contracts Awarded on 57 Per Cent of Permits Issued

According to an investigation made by the Southern Pine Association permits were issued during 1920 for all classes of buildings for a total value of $4,527,245,900, whereas actual construction was undertaken upon permits granted amounting to only $2,564,582,000. Of the contracts awarded upon these permits during 1920, 22 per cent was for residence construction.

Southern Lumber Exporters Ask Standard Contract Form

In order to avoid the further cancellation of expert contracts which have caused serious losses to Southern exporters since the war, a committee of the Southern Lumber Export Association has been appointed to draft a standard form of contract. The form of contract, which it is hoped will improve the lumber export business from New Orleans to the West Indies, is to be submitted to American and Cuban lawyers and bankers, after which it is to be returned to the exporters for final approval.

Indictment Returned Against Cut Stone Contractors

The extraordinary grand jury of New York County considering the criminal evidence growing out of the Lockwood committee's investigation of the building industry in New York City on Jan. 25 handed down a blanket indictment involving certain members of the Bronx Cut Stone Contractors Association. The accused are charged with violation of the Donnelley anti-trust laws.

Roller Company Cited for Unfair Competition

Upon application for the issuance of a complaint the Federal Trade Commission has cited the Buffalo Springfield Roller Co., Springfield, Ohio, in complaint of unfair competition in the sale of road building machinery in interstate commerce. Public officials and employees of customers, it is set out in the complaint, are given gratuities by this company to influence the purchase of its machinery and expenses of inspection trips are paid.

Settlement Made in Newark Building Trade Dispute

Building operations in Essex County, N. J., halted two weeks ago when the lockout of 8,000 building trades employees occurred because of their support of journeymen painters in resisting a reduction in wages from $9 to $8 a day, were resumed Feb. 4. The agreement, which resulted in all building trades operators returning to work, is that the painters will receive $9 a day until Feb. 12, when a new agreement fixing $8 a day until April, 1922, will be signed. The other trades resumed work at the same wage they received before the lockout.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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A New Way to Build Stadiums

REMARKABLE CONFIDENCE in the stability of a fill placed hydraulically behind sheerboards was displayed in the construction of the Seattle Stadium, described on another page. In the largest of the filled stadiums, the Yale Bowl, the engineers would not venture a concrete structure of any sort on the new fill, but at Seattle the concrete stepped seats were not only placed directly on the earth but were put there immediately after the fill itself was placed; as soon, in fact, as the sheerboard stakes could be removed and the concrete placing machinery moved along. So far there has been no sign of any movement in the fill or crack in the concrete which would indicate an early settlement in the fill. If stability is assured, as it appears to be, the method offers many attractive features for stadium building, an activity which seems now to be reviving after some years of desuetude. The detail which is most essential to this process of filling, that is the stepped sheerboards, is made a part of the stadium structure, whereas in dams and regrades, where the method has been heretofore used, these steps have to be cut down or covered up. The step structure being automatically formed, as it were, the production of the concrete seats and the steps themselves becomes simple and cheap. At Seattle speed requirements were so great that cost records are not very informing but the simplicity of the method, the apparent stability of the concrete covering of the fill (on which a year from now we will have better evidence) and the construction speed possible demonstrate that where proper material and topography are available the process is worth considering.

Motor Vehicle Registration

FOR HIGHWAY ENGINEERS the American Automobile Association's figures on the registration of motor vehicles in the United States in 1920 (see p. 330) furnish a definite, and therefore an exceedingly valuable, index of the growth of traffic during the past year. They supply, also, a basis of forecasting, by comparison with statistics of former years, the magnitude of the problem which road builders face if the rate of increase in the number of passenger and commercial cars is to continue in the future as it has in the past. The total of 9,180,316 automobiles and trucks using the public highways during 1920 represents a record gain of 2,114,870, or about 30 per cent in a single year, giving the United States one motor vehicle for every 11 persons. These facts are of immediate concern to state and county highway organizations. One very important indication of the statistics is the rapid increase in the commercial vehicle registration. Last year the total number of trucks was 945,826, as compared with 750,000 reported for 1919 by the National Automobile Chamber of Commerce. This means, of course, a greatly increased tonnage over previous years and consequently that the roads are being called on to perform a heavier duty. The statistics serve to emphasize the importance of the traffic problem and the obligation of keeping pace with reasonable demands. Another clear inference from the statistics is the need in every state for legislation which, without unreasonably impeding the development of motor vehicles, will place restrictions on weights, sizes and speeds so that a comparatively few enormously heavy trucks may not destroy a capital investment running into millions of dollars.

F. A. E. S. Under Way

NOT merely because the federation at its Syracuse meeting last week elected its secretary, is one prompted to say that the Federated American Engineering Societies is now under way. The election, it is true, was the concluding part of the organization work. That which gave at Syracuse a stronger sense of substantial progress was the virility of the council meeting. There was a definiteness of purpose, a clearness of conception and a determination that left little doubt in the minds of those present that the handling of the organization will be such as to secure widespread approval. Necessarily its policies are largely unformed, its work has hardly been begun, but so far as the signs in a budding organization are indicative they are decidedly hopeful.

Local Society Strengthening

ONE of the outstanding features of the Syracuse meeting was the strong emphasis repeatedly placed upon the need for decentralizing the engineering organizations of the country and of building up, not half a dozen strong centralized organizations, but rather many strong local bodies. This crystallizing sentiment will, we know, be received with hearty approval in the profession. It will secure especially strong endorsement among the civil engineers, for much of the recent controversy in their national organization has centered about the efforts of those who believe that the greatest future of the society lies in making it strong in every part of the country. Moreover, those who successfully fought the entrance of the civil engineers into the federation maintained stoutly that the influence which the engineering profession needs with the public is to be exercised chiefly through local and state action. In fact, in the course of the discussions there was strong endorsement of the idea of local and state councils which would handle all but a very few problems. These few, being of national scope, would pass to a central body, which, having but limited functions, could be run at small expense, thus avoiding the building up of a large overhead organization which, as the opponents contended, would be going into the highways and byways to find work for itself. The decentralizing policy is an entirely sound one and it is gratifying to find

in the early meetings of the federation's council a strong sentiment directed toward such a functioning as will enable the federation to be of chief service by building up and strengthening local societies in every part of the country. Incidentally, we feel that if this policy be followed it will be a strong factor in the early conciliation of the civil engineers toward the federation movement.

Grouping Railroad Systems

PERMISSIVE consolidation of existing railroad companies into a limited number of large competitive systems is one of the functions of the Interstate Commerce Commission under the Transportation Act. The subject has attracted much attention in financial circles during the past few months and rumors have been rife. Moreover, it is a matter that concerns engineers in the light of possibilities for improved terminal arrangements through unified operation. Therefore, the difficulties being encountered in England during preliminary negotiations for grouping the railroads into a few large systems are of more than passing interest. As noted elsewhere in this issue, the principal of grouping has been accepted by the British companies, but there is strenuous objection to some of the measures for refinancing and compulsory consolidation. At the same time it is intimated that grouping of some kind will actually be effected in 1924, three years after the companies will have passed from government operation. Although conjecture as to consolidations here has been a popular pastime for some months, the indications are that some time will be required actually to carry them out. In the meantime we may well profit by England's experiences.

The Concrete Institute

AT its very successful meeting at Chicago last week the American Concrete Institute justified its existence. There were gathered there a number of men from each of the groups whose joint knowledge and experience are needed to make a success of any concrete job—the research man who studies behavior and properties, the engineer who designs and superintends the structure, the contractor who builds it and the material man who furnishes the elements out of which it is formed. It is the peculiar function of the institute at its annual meeting and in its committees to bring these men together in cordial co-operation and with mutual understanding, and this function is no part of any other society. Each one of the groups has its own organization and some of the national societies include two or three, but nowhere else may be expected a conjunction of all those concerned with concrete work. The proper development of concrete needs just this co-operation. In spite of its extensive use it is a strange material whose properties are none too well known and whose peculiarities are none too widely appreciated. Individual work and study of the material itself and the structures into which it goes are good and necessary, but the experimentation and the theory and the practice of its use are so closely interwoven that it is only when they are studied together that the most useful results may be expected. The institute is doing a unique and necessary work for one of the two foremost building materials and in so doing it deserves the aid and co-operation of every one interested in that material.

Road Builders' Convention

THE American Road Builders' convention at Chicago week before last was a gratifying success. Compared with the convention a year ago at Louisville it exhibited a marked revival in interest and attendance. This result has required hard work. Continued effort must be made by the association's leaders if the gain made in 1920 is to be retained during 1921. They should have more help from highway engineers. The attendance and active participation of a greater number of men prominent in planning and directing highway development is needed. At Chicago few of the leading state highway officials were present. In absenting themselves these men missed the only opportunity which they have in public convention of carrying educational work to contractors, manufacturers of equipment and materials producers. Incidentally, they neglected an opportunity for acquiring information furnished by a notable exhibition of road-building machinery and materials. For years there was much strongly expressed dissatisfaction with the association. Nevertheless, despite its loose management and lack of virility, the association has remained the only agency in the field to bring together the various related highway interests. That being the case its convention deserves larger support, to the end that it may grow into a body that will fully and satisfactorily co-ordinate all the agencies pertinent to the design, building and maintenance of good roads.

The Engineer—Key Man of Industry

FAVORABLE COMMENT was made in these columns recently on the reception accorded to an economic paper presented by Francis H. Sisson before the annual meeting of the American Society of Civil Engineers. An equally enthusiastic reception will be given, we are sure, to the paper in this issue by Herbert Hoover. The other address was to an extent a detached presentation, that is to say, it gave a picture of the effect of the economic situation on the individual. Mr. Hoover's angle is exceedingly direct. He fits the engineer into the picture, and shows him how and why he is in a position to improve the whole economic functioning of the nation. Seldom has the engineer's place in the economic structure been delineated in such strong lines, seldom has the vision been broader.

In the very introduction Mr. Hoover sets forth the reason for the engineer's strategic position and the platform on which his public work is to be done. Engineers penetrate "every industrial avenue and thus possess a unique understanding of our many intricate economic problems and an influence in their solution not equalled by any other part of the community. Wanting nothing from the public, either individually or as a group, they are indeed in a position of disinterested service."

Following those statements comes the thesis of the industrial survey, the first great public work of the Federated American Engineering Societies, "*to visualize the nation as a single industrial organism.*"

The survey is just beginning. It is a big and a difficult task. It will take the best brains of the profession to pull out of the data gathered a plan or suggestions that are so patently workable that they will appeal to employers and employees and so eventuate with reasonable speed in practical results. But Mr. Hoover has never been known to terminate his efforts in

theorizing. He is above all a man of action. Despite the largeness of the task, therefore, his leadership is a guarantee that there will be fruitful results.

Such a task well carried through would do much to crystallize in the public mind the place that the engineer occupies in the industrial structure. We know that that structure is built on the engineer and his works, but we have never made our position so dramatic that the public has caught the fullness of the idea. That is what the federation's work promises to do.

A Construction "Get-Together" at Philadelphia

PARTICIPANTS in the conference of all the elements in the construction industry, held last week in Philadelphia, and whose deliberations are recorded in the news section of this issue, not only had the advantage of getting the other fellow's point of view, but unanimously subscribed to a program which, if vigorously followed, should revive and stabilize construction work and re-establish the public confidence in the construction situation. The conference was sponsored by the industrial relations committee of the Philadelphia Chamber of Commerce, and to it were invited *and did come*, bankers, materials manufacturers and employees and employers in every skilled building trade.

Every element in the industry was given the opportunity of explaining its particular situation. Each was the target of criticism from other elements: The banker on account of the difficulty and expense of financing house construction; the materials manufacturer, for excessive costs; the employer, for an unintelligent labor problem; the laborer, on account of inefficiency and high wages. But every man carried away an understanding of the other fellow's position and a realization that only through co-operative effort to "cut the corners" in construction costs, could the present stagnation be overcome.

The conclusions reached by the conference were: That neither building materials nor wages had deflated proportionately to other commodities; that costs of first and second mortgages were excessive; that every element in the industry must, for the moment, submerge its personal advantage. In other words, the manufacturer must, for the emergency, sell at cost. The contractor must forget his profit. The laborer must consent to wage reduction.

Certain salient facts were brought out: That construction—outside of public works construction—was practically at a standstill; that the laborer was surely worthy of his hire; that $1,800 a year was a minimum wage for the skilled mechanic; that the average working year of the mechanic was 200 days; that unemployment in the building trades was large, and that many contractors were doing jobs at cost in order to keep their organizations intact. The employees' attitude was that, because of the short working year, they could not now afford a reduction in wages. But it was apparent that, if other elements were willing to make sacrifices, labor would do its share. A start was made by the promise of a brick manufacturer to forget even the interest on his $500,000 plant in selling stocks in hand, and of an investing builder that he would build 100 six-room, two-family houses at cost if the mechanics would do the financing.

Detailed conferences are to follow, and immediately, in which the shaving in costs all around, it is hoped, will be accomplished. The various elements now know each other. They can now get together "with their feet under the same table."

Philadelphia has a golden opportunity. It has the chance to point the way in co-operative construction, not merely as an emergency arrangement, but as a permanent condition. It has brought the employer, employee, manufacturer, dealer, banker togeth Common aims have been found, and the ground work laid for a harmoniously co-operating building industry. The result will be awaited with interest.

Railroad Wages Upsetting to All Industry

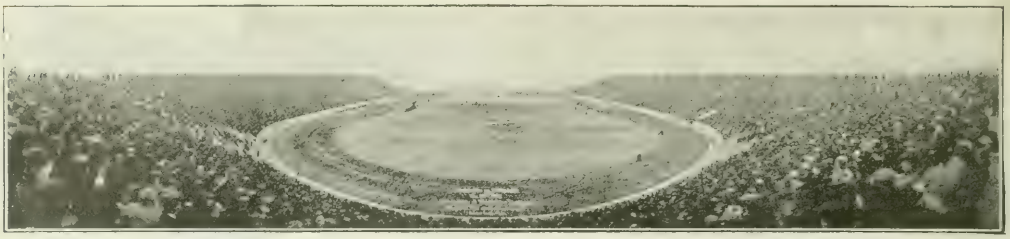
THERE is an aspect of the railroad working agreements and of railroad wages, the first of which are now in controversy before the Railroad Labor Board at Chicago, on which sufficient emphasis has not been laid, namely, that they are a disturbing element to every single industry. Railroad wages were standardized for the whole country during the war, and the wages for a given duty were fixed in order to be adequate to the living expenses in our largest cities. As a consequence, the railroad employees in smaller communities find themselves enjoying wages in excess of the prevailing rate. Naturally, railroad wages, having government sanction, are used as an argument for resisting wage decreases by other workers and thus constitute a disturbing and seriously conflicting element in the wage deflation that must, if a proportionately high efficiency cannot be obtained, be deflated with living costs. In this way railroad wages are of very direct concern to every industry. Contractors will probably feel their pressure when work opens up.

It is not to be expected that the railroad wage levels will be successful in preventing declines in all lines, but they will be a constant source of soreness among workers and of friction with employers In the long run railroad wages cannot stand materially above the general level, but, fortified by national agreements made by an administration notorious for its indulgence toward the railroad employees, they will present a strong resistance to recession.

No less disturbing than the wages themselves are some monstrous provisions of the working agreements. They are demoralizing to the men themselves and to all neighboring workers. The heavy payments for overtime encourage the stretching out of work, while under certain conditions idle time is paid for beyond any reason. It is conceded that the working conditions in railroad employ present variables, due to vicissitudes in handling trains and variations in traffic, not present in employment in factories. These must be cared for in setting wages, but government control was made the instrument for securing entirely unwarranted concessions. Among the glaring concessions was the substitution of straight time for the piecework system in shops.

Put in a word, the railroad agreements ignored entirely the doctrine of payment for results. Time only has been the consideration.

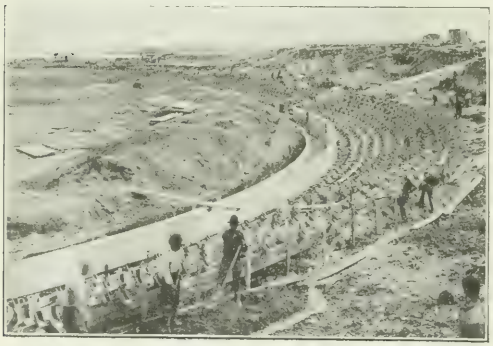
If the public generally can be given a true picture of what has happened in the field of railroad employment its pressure can be counted on in helping to bring about a reasonable adjustment of conditions that place a heavy burden on both the railways and the public.



Build Large Earth-Fill Stadium by Sheerboard Method

Novel Structure for Students of University of Washington Has Concrete Steps Placed Directly on Earth Formed to Proper Shape Behind Sheerboards — Will Have Concrete Superstructure

ATHLETIC stadiums of large size are becoming quite common; hardly a university of any pretension but what has one in service or projected and many municipalities have built them for general use. Most of these structures—all of any size except the Yale Bowl and the San Diego Municipal Stadium—have been of reinforced concrete with grandstands supported on framed bents. There has just been completed at Seattle, Wash., for the University of Washington, a stadium of radically different structural detail; a hydraulic fill of earth shaped by means of sheerboards with the reinforced-concrete steps placed directly on the earth. The site of the stadium was a barren waste on May 17, 1920, when work was started. The intersectional Dartmouth-University of Washington footfall game was held in it on Nov. 27, 1920, and the view of the game herewith shows a completed structure seating approximately 28,000 persons. No little part of the interest in the structure is due to this rapidity of construction.



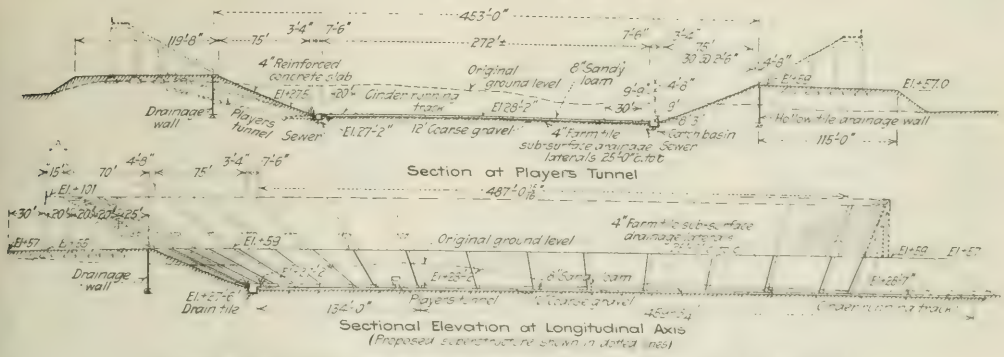
SHEERBOARDS IN PLACE FOR FILL AT END CURVE

The University of Washington stadium is horseshoe shape with a slight bend toward each other of the long sides in order to give that impression of crowd unity which is peculiar to completely curved structures such as the Yale Bowl. It is open at one end in order to provide space for long distance straightaway running and also to take advantage of the view of Lake Washington on the bank of which the stadium is located. The playing field is from 268 to 293 ft. wide and 487 ft. long measured from the middle of the curved end to the end of the seat section. The seats themselves are on an approximate 1 on 2½ slope, extend back 75 ft., so that with the distance assigned to the "moat," which surrounds the field, the out-to-out width of the top seat banks of the stadium is 474 ft. Eventually there will be built on the top of the present slope additional seats of the conventional reinforced-concrete frame type. When these are added the seating capacity will be 60,000.

Surrounding the field and separating it from the seats is the moat just mentioned. This is a passageway lined with reinforced-concrete walls 6 ft. wide inside and about 4 ft. below the playing field level. It is entered under the stands by a reinforced-concrete tunnel and serves during the games to keep the spectators off the field and to permit any one to get to any part of the field without crossing it. When the stands are emptying temporary wooden bridges can be thrown across to permit people to get out onto the field. Normally, however, the stands are entered and left from the top, which, as will be noted, is not very much higher than the surrounding country. When the additional stands are built there will be the usual passages and stairways leading in from the present fill level.

The seats are reinforced-concrete slabs 4 in. thick, reinforced with longitudinal and transverse ⅜-in. rods spaced 8 in. center to center. They are in sections approximately 45 ft. wide on the sides and 29 ft. at the end separated by a 3-ft. aisle in which the steps are

FORMS FOR SHEERBOARDS IN PLACE AFTER FILL HAS BEEN MADE



SECTIONS THROUGH NEW UNIVERSITY OF WASHINGTON STADIUM AT SEATTLE

built with shorter risers than in the seat banks. The seat banks vary in riser height from 11 in. at its bottom to 14 in. at the top, but have a uniform tread width of 2 ft. 6 in. This gives a curve of slope which was worked out with the intention of making all parts of the field visible to all spectators. Particular attention was paid to making it possible for everyone to see the feet of a runner on the cinder track which is close to the parapets of the moat. On these concrete seat banks there are special benches made up of timber plank bolted to special cast-iron frames. These timbers, of Oregon fir, 2 x 10 in., dressed four sides, are given one treatment of hot oil. In the curved section of the stands the planks forming the seats are curved also.

Expansion in the concrete steps is provided for by a construction joint at the center of each bank. Here a groove is cut into the earth fill and the concrete of the steps returned into this groove, the steel reinforcement being turned down into the groove and the concrete poured there against a separation board. The seat banks are laid and poured in groups of three steps vertically, a separation joint being made along the riser of every third step.

Especial attention is paid to drainage of the steps. Each step is sloped from the front toward the back and a groove made in the tread against the riser, this groove sloping from nothing at the middle of the bank to its full depth of about an inch at the aisle. Water drains back to the groove and down to the aisle which are sloped outward. The drainage then reaches the moat through the openings in the parapet at each aisle and flows through catchbasins into the sewer below the moat, which sewer leads to the lake.

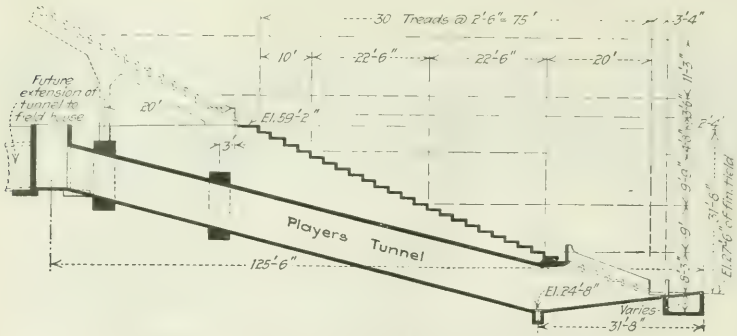
The field itself is underlaid with 4-in. drain tile in cross-laterals 25 ft. center to center. These are placed in a coarse gravel. There is then placed a light covering of hogged fuel, that is, the refuse from saw-mill plants, and a 9-in. layer of sandy loam, on top of which is placed the top soil which will be grass covered, except for the cinder running track.

Groundwater is fairly high at the site, so it was thought necessary to cut it off from reaching the field proper. To do this a drainage wall made up of 6 x 12 x 12-in. hollow tile was built continuous around the field and on a line with the top of the seats. This wall rests in a trench filled with gravel surrounding drain tile and open joints. All groundwater back of the wall will be intercepted by the wall and led in by the drains to the sewer which empties into the lake. Part of this wall, about 320 ft. in length, was put in after the fill was placed by excavating a trench, laying up the wall and filling in afterward with puddled earth. The remainder was laid up with the hydraulic fill construction.

As has been stated, the fill was placed by the sheerboard method which had been perfected by Lewis, Wiley & Morse and was used in a Portland regrade and on the Ochoco dam particularly. The latter use has been described in *Engineering News-Record*. Messrs. Lewis and Morse, who have been instrumental in developing the method, are now connected with the Puget Sound Bridge & Dredging Co., the contractor who built the University of Washington stadium.

The stadium site was a barren area immediately adjacent to the campus of the University of Washington and facing Lake Washington. It is of irregular elevation, the high point being perhaps 42 ft. above the

PUMPING FILL ON FIRST SIDE TO BE BUILT



SECTION THROUGH STADIUM AT PLAYERS' TUNNEL

low point. The material is a gravelly clay with very few large-size rocks.

The layout of the stadium was made so as to approach as nearly as possible to a balanced cut and fill, the intention being to excavate by hydraulic giants the earth in the playing field area and to sluice it into place to form the mound for the seat banks, extending this mound, of course, far enough back so as to carry the prospective reinforced-concrete seats. This involved the removal and transportation of 159,319 yd. It was not possible to exactly balance the cut and fill and it was found necessary to bring in 67,994 yd. of truck from steam-shovel excavations about 1,500 ft. away from the site. Nor was it possible to excavate the entire playing field area by hydraulic giants. Toward the end of the work about 26,000 yd. at the open end of the stadium was taken out by steam shovel.

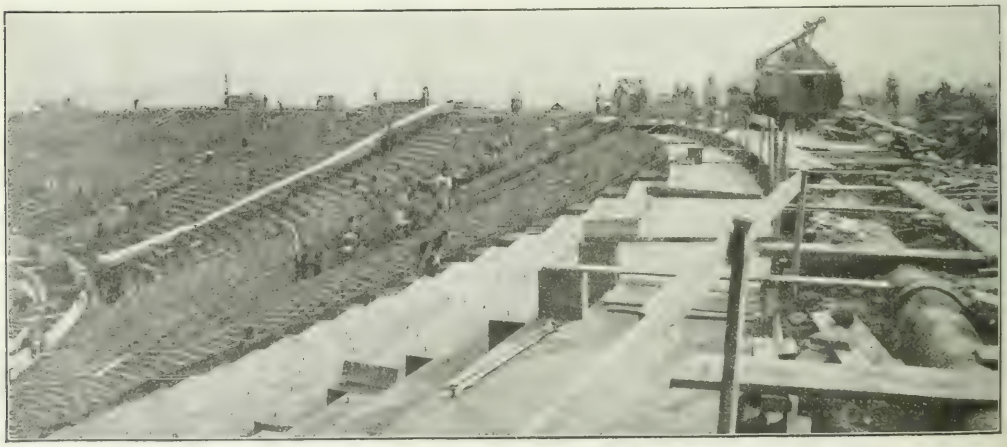
The sheerboard method of fill, as described in the previous articles noted, consists in building up the hydraulically deposited fill stage by stage behind parallel shallow walls of boards, the function of which is to lead the liquid fill in fixed lines at such a rate as to cause it to deposit the carried sand and clay, and also to permit the gradual disperson of the transporting water to a point where it is led away.

Construction on hydraulic fills was started as soon as equipment was installed and enough of main drain constructed to act as waste for booster pump. The next step was to construct the moat with its sewer, which was to carry away during construction the water of the fill. Then hydraulic giants were set to work in the playing field tearing down the ground there and into a pipe leading to a single-stage, 12-in. sand pump, which pumped the material through a 12-in. pipe line on the upper level of the fill. The discharge from this line was then directed into the lines of sheerboards. As the fill was built up the pipe was raised.

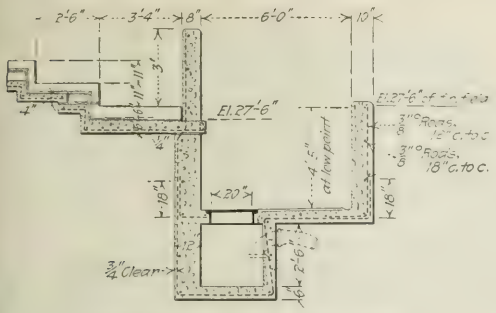
Water for these operations was pumped from a nearby canal by two 5-stage centrifugal pumps of a combined capacity of 6,000,000 gal. per day, these two pumps being direct connected to and driven by a 650-hp. motor. Each pump has a 10-in. discharge delivering water direct to a 24-in. pipe line at 90-lb. pressure, on which were mounted the 4 to 4½-in. hydraulic giants. The views show the nature of the sheerboards. As the fill is built up, 2 x 4-in. stakes, about 5½ ft. long are driven into the ground and are cross-braced the width of the seat benches, that is, 2 ft. 6 in. apart, by small wooden bridges. On the side of the 2 x 4-in. stakes, then, are nailed the 1-in. sheerboards to the exact height of the required rise of the steps.

The fill builds up in the trough formed between the sheerboards, each one of which is the proper height above the one next below it to make the proper rise in the steps, and when the fill has reached the bottom of the sheerboards the next higher sheerboard is placed. The final stage of this operation is reached when the top of the fill is made. At that time the bridging is removed and the stakes pulled by a small tripod stump puller, but the sheerboards themselves are left in place to serve as forms for the concrete steps.

The fill so placed was almost immediately solid. In fact the workmen could walk on it while it was being



COMPLETED SEATS IN FOREGROUND—CONCRETING IN PROGRESS IN BACKGROUND



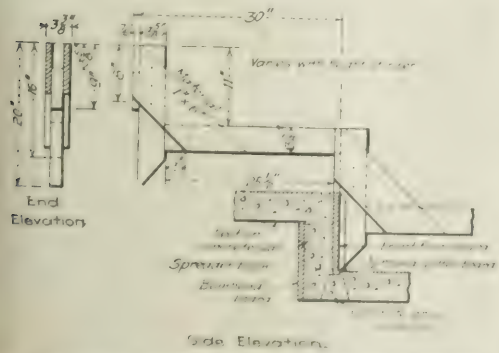
DETAIL OF MOAT AND FIRST STEPS

placed and it showed practically no water content the day after the water is taken away from it. It is so solid that it was possible to follow immediately behind it, that is at a minimum interval of 3 to 6 days, with the concreting. An instrument check shows that no settlement took place in the hydraulic fills after the placing of the concrete.

The procedure here was first to lay the $\frac{3}{8}$-in. reinforcing on the earth fill continuous for the three steps which form a unit and bent over into the construction joint at the middle of each bank. A concrete mixer movable clear around the stadium was then mounted on the top of the fill and material brought to it by trucks on the upper level. From this mixer, mounted as shown in one of the views, chutes are run down the incline and the concrete poured continuously from the bottom to the top, portable light forms being used for the outside form of the riser. The tread, of course, can be screeded off.

An accompanying sketch shows the method used in placing the front forms on the seat bank section and the method of bracing. These braces or jacks are readily removable and can be used on other portions of the work. The front form board is set on small concrete pedestals resting on the earthfill tread. There the jack or brace is placed between two cleats nailed to the form and a spreader block inserted between the front and back form boards, the back form board being the original bulkhead board. This spreader is removed as the concrete is tamped in place, but the concrete grade pedestals for the front form boards are cast into the slab.

At the same time the anchor bolts for the seat

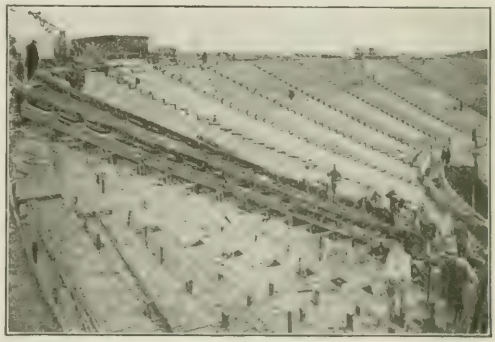


DETAIL OF FRONT FORM FOR CONCRETING TREAD

frames were placed so that as soon as the concrete has received sufficient set, a minimum period of 24 hr. being allowed, the vertical forms could be stripped, the stakes pulled and the benches put in place.

The outside slopes of the mound and the curved end slopes were left in steps formed by the sheerboard method, but the sheerboards were pulled at these locations and the whole surface spaded down by hand into an even slope.

This method of placing gives a remarkably accurate forming to the steps. In fact in only a few cases was it necessary to make any change whatever to the earthwork in order to accommodate it to the proper design shape and slope. In the case of the aisles, however, where the steps are different than on the seat slope, it was necessary to cut out the earth fill by hand. This was quite readily done and the steps cut to the proper section for the concrete.



REINFORCEMENT IN PLACE ON NEW FILL

The idea for a stadium of this sort was originated by the students of the University of Washington and was financed by the Associated Students, an undergraduate body. A special campaign for raising funds, in which long-time season tickets played an important part, proved to be very successful. Then general design for the stadium was in the hands of Bebb & Gould, architects of Seattle, with Henry Bittman, of Seattle, consulting engineer. The construction was entirely in the hands of the Puget Sound Bridge & Dredging Co., the sluicing department of which is the former firm of Lewis, Wiley & Morse. For this company William H. Lewis was manager and W. C. Morse chief engineer. To them is most of the credit due for the particular type of structure.

Airplanes and Forest Fire Control

Of the 196 forest fires sighted and reported in 1920 by airplanes out of Sacramento, Cal., 33 per cent were located within a quarter of a mile of the area determined later by surveys on the ground. Ten per cent of the total number of fires were discovered by the air patrol before the rangers were aware of them. Forty-two per cent were reported by radio, while the planes were in the air. The planes were also used to direct fire fighting operations and to patrol fire lines which were built but needed watching. If the planes reported a line to be clear, fire fighters were kept elsewhere, but if the observer reported that the fire had broken away a force of men could be rushed to the spot at once.

Motor Vehicles in United States Number 9,180,316

OFFICIAL figures compiled by the American Automobile Association indicate that there were 9,180,316 passenger and commercial motor vehicles registered in the United States during 1920, of which approximately 8,234,490 were for passenger use and about 945,826 were commercially employed. During the same period 271,230 motorcycles were also registered. The total receipts from registrations amounted to $99,141,097.

In two states, namely, California and New York, the figures given in the accompanying table cover only the first 11 months of the registration year ending Feb. 28, 1921. The total registrations for the year will therefore exceed 9,300,000 cars and receipts will probably reach $100,000,000.

MOTOR VEHICLE REGISTRATION IN UNITED STATES IN 1920

	Passenger	Commercial	Total	Motor-cycles	Gross Receipts
Alabama	61,941	12,696	74,637	1,035	832,980
Arizona	30,559 (a)	4,000 (a)	34,559	750	191,577
Arkansas	55,582	3,500	59,082	.....	590,820
California (f)	534,814	34,078	568,892	20,047	5,554,265
Colorado	121,212	7,728	128,940	3,364	818,775
Connecticut	95,150 (a)	23,950 (a)	119,100	4,375	1,852,591
Delaware	16,500 (a)	1,800 (a)	18,300	674	329,980
Dist. of Col. (b)	44,855	6,826	51,681	2,648	223,588
Florida	64,185	10,439	74,624	1,275	554,695
Georgia	132,000 (a)	14,000 (a)	146,000	1,382	1,918,512
Idaho	48,850 (a)	2,000 (a)	50,850	763	882,271
Illinois	504,240	64,674	568,914	10,368	5,780,612
Indiana	300,226	32,481	332,707	8,823	2,029,103
Iowa	407,030 (a)	30,000 (a)	437,030	4,000	7,487,830
Kansas	268,159 (a)	26,000 (a)	294,159	2,972	1,399,272
Kentucky	99,417	13,258	112,675	1,546	815,941
Louisiana	65,000 (a)	5,000 (a)	70,000	500	400,000
Maine	55,600	7,600	63,200	1,590	820,000
Maryland	100,313 (a)	12,000 (a)	112,313	5,194	2,124,925
Massachusetts (c)	253,245	51,386	304,631	15,143	3,860,232
Michigan	366,946	45,771	412,717	8,011	5,494,486
Minnesota (d)	204,300 (a)	19,400 (a)	223,700	7,550	1,067,737
Mississippi	60,000 (a)	4,000 (a)	64,000	.....	425,000 (a)
Missouri	273,308 (a)	23,700 (a)	297,008	3,954	2,111,697
Montana	59,450 (a)	1,200 (a)	60,650	675	416,245
Nebraska	200,000	19,000	219,000	2,100	2,039,330
Nevada	9,963 (a)	500 (a)	10,463	140	103,318
New Hampshire	30,240	4,440	34,680	2,542	542,457
New Jersey	204,125	23,612	227,737	11,041	3,503,936
New Mexico	16,100	6,000	22,100	219	200,000
New York (f)	559,521 (e)	124,398	683,919	69,349	8,817,709
North Carolina	127,405	13,455	140,860	1,418	1,765,000
North Dakota	88,385	1,455	89,840	898	681,059
Ohio	538,000	82,600	620,600	19,400	6,400,000 (a)
Oklahoma	204,000	9,000	213,000	1,600	230,000
Oregon	93,790 (a)	10,000 (a)	103,790	3,517	2,085,000
Pennsylvania	521,835	48,329	570,164	23,981	8,090,873
Rhode Island	40,768	9,563	50,331	2,223	451,062
South Carolina	83,618 (a)	9,200	92,818	908	527,868
South Dakota	113,000	9,000	122,000	560	768,000
Tennessee	90,214	11,638	101,852	1,151	1,214,000
Texas	397,693	30,000 (a)	427,693	4,251	3,500,000 (a)
Utah	37,012	5,692	42,704	1,115	366,371
Vermont	28,706	2,916	31,622	946	555,384
Virginia	103,000	13,670	116,670	2,233	1,850,000
Washington (g)	154,350	25,864	180,214	4,969	2,828,896
West Virginia (h)	69,862	10,802	80,664	1,659	1,223,448
Wisconsin	277,095	16,205	293,300	8,002	3,127,073
Wyoming	22,926	1,000	23,926	327	267,179
Total	8,234,490	945,826	9,180,316	271,230	99,141,097

(a) Approximate.
(b) For fiscal year ending June 30, 1920.
(c) For registration year ending November 30, 1920
(d) For the three year period ending December 31, 1920.
(e) Includes 3,560 dealers' licenses.
(f) For first 11 months of registration year ending January 31, 1921.
(g) From March 1 to December 31, 1920
(h) For 18 months ending December 31, 1920.

It thus appears that there is now one motor vehicle for about every 11 persons. The gain in registrations over 1919 amounts to 2,114,870, which is the greatest increase ever recorded in a single year.

Receipts from registrations and licenses showed a gain of $34,443,842, or 53 per cent over 1919, the greatest increase ever recorded in a single year. The registrations include in a few cases, notably in Maryland and the District of Columbia, duplicate registrations, but these do not materially affect the grand total.

The race for supremacy between New York and Ohio in the number of motor vehicles is again in New York's favor; New York scored 683,919 motor vehicles and Ohio ran second with 620,600 for the entire year. Pennsylvania occupies third place with 570,164 cars; Illinois, fourth, 568,914; California, fifth, 568,892; Iowa, sixth, 437,030; Texas, seventh, 427,693.

In receipts from registrations, New York State leads with $8,817,709. Pennsylvania comes second with $8,090,873; Iowa, third, $7,487,830; Ohio, fourth, $6,400,000; Illinois, fifth, $5,780,612.

A Question of Ethics—

Gratuitous Professional Advice

THE committee on professional practice of the American Institute of Consulting Engineers recently rendered a decision, which has been approved by the council, in the case of a question of ethics involving the extent to which an engineer should give gratuitous advice. The question and the decision are given below:

Statement—A civil engineer specializing in a certain branch of professional work is requested, through an explanatory circular, enclosing a blank form for reply, issued by the official board of an important public enterprise, to express his views as to the design and construction of a proposed public work, in line of his special practice. No retainer or compensation is suggested and obviously none is intended. The request comes from a distant city and relates to an enterprise with which the engineer has no actual present or prospective professional or personal connection. He declined to reply in the manner requested, but called attention to the fact that there are a number of experts in this country capable of giving them sound professional advice.

Questions—(1) Was such a reply warranted and proper from an ethical point of view under the conditions named?

(2) Recognizing that engineers, like the members of other professions, owe to the public as specially qualified good citizens a certain amount of gratuitous advice and assistance in the planning and administration of works and affairs affecting the public welfare, what general principles or rules should guide their conduct in such matters?

Answers—(1) Such a reply was warranted under the circumstances recited.

(2) It is difficult, if not impossible, sharply to define the character or extent of the professional services that the engineer properly may or should contribute to the public without pecuniary compensation therefor. It may vary with conditions and circumstances in each individual case. The patriotic and public spirited citizen will construe his duty in this respect liberally in favor of nation, state, civic organizations and community. Like the members of other professions the engineer is frequently called to serve on public commissions, committees and civic organizations where his specialized knowledge and experience enable him to render services of great public value for which no monetary compensation is provided or expected. Service of this character within proper bounds is to be commended and encouraged.

As a general rule, gratuitous professional service may properly be limited to information, advice and assistance of a general nature relating to the inception, principles involved, or the development of contemplated public enterprises. Specific recommendations, plans, details, specifications and estimates for definite projects, involving professional investigation and study should be regarded as the province of the formally retained and compensated engineer.

These functions are essentially professional in character, and involve special labor and responsibility, which the prudent engineer, acting in his capacity as a citizen only, may not care, and should not be expected or required to assume without the usual professional recognition and compensation. The interests of the profession as well as his own, suggest that his generous impulses be not allowed too great latitude, particularly in cases like the one cited in which he has no public or community interest.

New Ocean Outfall and Screens for Los Angeles Sewage

Slightly Condensed from a Paper by W. T. Knowlton, Engineer of Sewers, Los Angeles, Cal., before the Los Angeles Chapter of the American Association of Engineers, November, 1920.

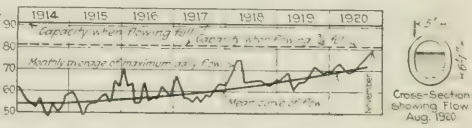
ACCORDING to the recent census, Los Angeles in January, 1920, had a population of 576,673, which is an increase of 81 per cent over its population of 319,198 in 1910. Although this rate of growth may not continue indefinitely, the caring for the increasing population is becoming a problem for the different departments of the city government. The matter of water supply for such a population was wisely provided when the city built its aqueduct which carries water from the Owens River intake 240 miles to Los Angeles.

Present Outfall Sewer — The flow in the main outfall sewer of the city is approaching such a condition that within two or three years it will flow full during even the dry season. During the winter season it has been noted that rain water has found its way into the sewerage system in spite of repeated efforts to prevent its entrance, and has caused the outfall sewer to overflow. The outfall sewer was designed to carry 90 sec.-ft. when flowing full. At the present time the maximum recorded daily flow is about 81 sec.-ft., which fills the sewer for 75 per cent of its vertical diameter. This depth of flow is as much as the sewer should properly carry and leave space for ventilation. It is anticipated that the sewage flow will reach the maximum capacity of the outfall before 1924.

It is considered necessary to submit to popular vote in the near future a bond issue for the construction of a new outfall sewer which would intercept the larger part of the flow in the present outfall sewer, as well as provide for a large area west of the city which it is expected will soon become annexed thereto, and for several residential sections in the westerly portions of the city, which must otherwise depend on cesspools. The proposed new outfall would be laid from a point in the southwesterly part of the city along the lowland to the north and west of the so-called Baldwin Hills and thence southwesterly by tunnel to the Hyperion property of the city on the coast. This would serve all sections lying between Los Angeles and those cities on the west coast which are north of the present outfall sewer, including the Palms and Sawtelle districts, which are at the present time within the city boundaries, and the Sherman, Beverly Hills, and South Hollywood districts, outside of the city, which are rapidly growing. Provision for sewage from Inglewood and those sections to the north and west of Inglewood is also made. Along the west coast the sewage from Santa Monica, Venice and the district adjoining Playa del Rey has been given attention, but it is thought that the sewage of these beach cities can best be cared for by direct treatment within their own limits, or arrangements made for pumping their sewage to the Hyperion site where proper treatment can be given to not only the sewage of greater Los Angeles, but also to that of all the beach cities on the west coast from Santa Monica southerly to and including Redondo.

This proposed north outfall sewer is designed for the removal of sewage from an area of 127 sq.mi., extending from the Los Angeles River westerly to the west coast cities, and from Manchester Ave. northerly to the mountains north of Hollywood. It will have a diameter varying from over 11 ft. to 4 ft., and capacity sufficient for a population of approximately 2,000,000 people. At a point about two miles west of its easterly end, a branch sewer will intercept all sewage coming from that portion of Los Angeles between Jefferson St. and Manchester Ave. and west of the Los Angeles River.

In addition to the proposed north outfall and the branch sewer, it is proposed to construct an intercepting sewer along Slauson Ave., from a point on the westerly boundary of that section of the city which is now sewered, to a point south of the City of Vernon, where the intercepting sewer will turn to the north and be laid along the east side of the Los Angeles River. This East Los Angeles interceptor will discharge its flow into the present outfall sewer at the point where the latter crosses Slauson Ave., and will provide for the removal of all sewage from that part of Los Angeles east of the Los Angeles River. The East Los Angeles sewer is proposed to be laid as far north as the junction of the Los Angeles River and the Arroyo Sec. and so planned that it may later be extended northerly along the Los Angeles River to intercept the sewage from the cities of Glendale and Burbank to the north of Los Angeles, also the Lankershim district. The extension of this intercepting sewer will also provide an outlet for the sewage of the San Fernando valley.



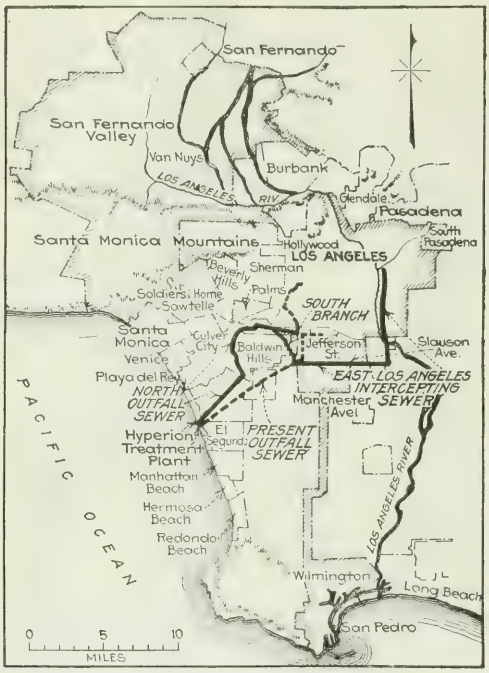
FLOW IN LOS ANGELES OUTFALL SEWER, 1914 TO 1920

The area which would be served by the East Los Angeles interceptor is estimated at 259 sq.mi. The population now tributary to this sewer is estimated at 100,000 but its capacity is designed to provide for a population of approximately 1,000,000 people, which will include the future population of these cities and sections north of the City of Los Angeles.

The plan designed for these proposed sewers provides for the future of Los Angeles as it is estimated to be in 1950. At that time, the population of Los Angeles may be 3,000,000 and the combined capacity of the present outfall sewer and the proposed north outfall sewer is planned for such a future population. In contrast with this plan, it may be noted that the population for which the present outfall sewer was planned did not exceed 750,000. The estimated cost of these new sewers in the preliminary design is $12,850,000, which includes the cost of sewage works at Hyperion. The total length of the proposed sewers is approximately thirty miles.

Sewage Treatment — During the past six years, the constantly increasing amount of sewage discharged into the ocean at the lower end of the present outfall sewer has caused a protest to be made by the residents of the beach cities on the west coast and especially by those of Manhattan Beach, Hermosa Beach and Redondo. The residents of these cities complain that the sewage is washed ashore in the vicinity of the bathing resorts. In the fall of 1915, the city engineer of Los Angeles made plans for sewage works to intercept solid material, and in the spring of 1916 a bond issue for such a plant was submitted to the voters. This bond issue receiving but 44 per cent of the total number of votes cast, another attempt was made in the following year to secure the necessary 67 per cent which was required before bonds could be issued for the installation of a sewage treatment plant at Hyperion. The election in 1917 was no more successful than that of 1916. In the following two years, no attempt was made to present the matter to the voters again on account of war conditions. In the fall of 1919, it was considered that some action should be taken to relieve the undesirable conditions at the Hyperion outfall. The amount of sewage was constantly increasing and injunction suits against the city were threatened. The city engineer, in the budget for 1920, secured appropriations to pay for the right-of-way required for the north outfall sewer.

Earlier plans for sewage treatment had included settling tanks and sludge beds as being best adapted to the conditions at Hyperion. Owing, however, to the increased cost of labor and material, it was thought that other types of treatment could be installed which would cost much less than settling tanks, and the different types of sewage screens were accordingly considered. After investigation it was decided that fine screens of the drum type would prevent the [illegible] and other floating materials from being discharged into the ocean. [The present outfall at Hyperion extends 2,000 ft. from the shore and discharges at a depth of about 20 ft. below mean tide.]



LOCATION OF OLD AND PROPOSED NEW OCEAN OUTFALL AND TREATMENT PLANT, LOS ANGELES SYSTEM

Tests of the ocean water in the vicinity of the different outfall sewers near Los Angeles have shown sufficient oxygen to neutralize to some extent the putrescible matter contained in the screened sewage. Bacterial analyses of the ocean waters at varying distances from the mouth of these outfall sewers indicate that there is also a corresponding reduction in the number of bacteria.

Plans proposed for the treatment of the Hyperion sewage have accordingly included the installation of eight drum screens which will provide for the treatment 60 m.g.d. As the flow increases, other screen units can be installed at an expense which can be met by an appropriation from the yearly budgets, and the cost of such additional units would not be great.

Irrigation—At various times during the past few years, reference has been made by different persons to the use of the Los Angeles sewage, or sewage effluent, after treatment, for irrigation purposes. This method of disposal at first thought seems desirable, but it would require a number of years to properly develop. In contrast with the disposal into the ocean, the disposal on land would require a high degree of purification which would necessarily involve considerable time in selecting the proper type of treatment, lands, and the equipment incidental thereto. Furthermore, the cost of disposal on land would be more at the beginning, even if later this method should be successful.

On account of the nuisance now existing at Hyperion, it is necessary that the sewage discharged into the ocean be screened at the earliest possible date. The beach cities have justly complained of this nuisance, and should relief therefrom not be given within a short time, it is probable that court action against the city of Los Angeles may be instituted. It is accordingly considered that the screening proposed at Hyperion should be installed without waiting to plan for the disposal of the sewage on land.

The opinions above outlined meet with the approval of the sanitary engineering department of the State Board of Health. It is believed by the sanitary engineer of the board that the suspended and floating solids in the sewage are solely responsible for the condition objected to by the beach cities, and screening is accordingly recommended, being less expensive than sedimentation.

The department named also considers that screening plants are less difficult to maintain free from nuisance than are settling tanks as they treat the sewage more quickly and minimize the chance of its becoming stale in the plant. Plans for the disposal of the screenings are being considered which will tend to offset the cost of maintenance.

John A. Griffin is city engineer of Los Angeles.

Industrial Conditions in Soviet Russia

(From Engineering News-Record's Berlin Correspondent)

CONDITIONS in Soviet Russia are an enigma even to her immediate neighbors. Most of what transpires from Russia appears in the shape of rumors and is very contradictory. Fugitives report disastrous conditions, which remind one of countries in the lowest stage of civilization. Soviet emissaries on the other side are eager to spread rosy views. Of Russian newspapers very few find their way abroad, and as they are edited under the strict control of the Bolshevist authorities, their contents are highly flavored. Still they form the only source of news, as verbal reports can rarely be trusted. It seems unnecessary to dig deeper for news because what the Bolshevist newspapers are allowed to print is sufficient to confirm the worst apprehensions of the country's interior conditions. They are chaotic and only a slight pretence of order is maintained. The Bolshevist Government, with surprising energy from the side of the leaders, has made strong efforts to effect improvements, but it is easy to recognize that instead of progress the process of dissolution is continuing.

This view is upheld by a number of German radical leaders who have visited Russia on the invitation of the Bolshevist Government and who have been given an opportunity of contact with a party of some hundred German workmen who had volunteered to work in Russia more than a year ago. These workmen, themselves of decided communistic leanings, have transmitted tales of strongest disappointment and misery. Their enthusiasm and hopefulness have suffered a complete reverse and they are unanimous in the opinion that the country is utterly and hopelessly ruined.

False Rumors of Large Orders

Manufacturers and dealers all over the world will do well to keep these facts in view, especially as rumors have recently been spread of enormous orders for manufactured articles which are said to have been placed in Germany and elsewhere. It is a fact that several emissaries from Russia have visited continental countries and negotiated with manufacturers for the purchase of machines of all descriptions and finished products, some orders having even been given and alluring pictures drawn of further orders to follow. None of these orders, however, has been executed, because they all suffered shipwreck when it came to the point of settling the mode of payment. Russian buyers, when entering into negotiations, always hold out for payment in gold, but when it comes to actual arrangements to be made they have to confess the absolute impossibility of doing so and they propose to pay with raw products, of which they say they have enormous quantities in store, ready to ship.

Manufacturers in continental Europe have, however, become very sceptical toward such tales. A number of German manufacturers, invited to Russia to inspect stores of raw products, came back entirely unconvinced. Such stores of merchandise as Russia could spare for furnishing against foreign purchases are widely scattered over the country, with no possibility to ship to the frontier.

Transportation Paralyzed

Transportation in Russia is even unable to cope with the most stringent requirements of the distribution of food and fuel within the country. Regular goods traffic there is none. The railroads are in a state of decay; fuel and rolling stock are lacking everywhere. Over 80 per cent of existing engines are out of repair and they have lately been put out of commission at the rate of 200 a month. Repairs are carried out in a slip-shod manner, as time is pressing. The same applies to cars. Visitors to Russia are struck with the number of cars out of repair or completely wrecked and clogging the side tracks of the stations. The decay of the road-beds is continually progressing and the railroad bridges are in an appalling condition. As no rails are produced repairs are made by taking rails from side tracks and even from main lines. The mileage of line in service is therefore steadily decreasing. Over 2,000 miles of track have thus been broken up in 1919 for repair purposes. On account of bad fuel and inferior repair of engines the latter cannot produce sufficient steam. Even passenger trains travel at a speed of from 4 to 9 miles per hour.

The Bolshevist Government is fully aware that before an improvement of the country's economic conditions can take place, transportation has to be improved. For this reason they have formed groups of engineering works, mostly engine and car factories, called "advance groups," which receive special attention in the matter of supplies of raw material, fuel and food for the workmen. One of these groups comprises the largest and best developed mills, locomotive and car works, i.e., the locomotive factories in Sormorow, Kolomna and Brjansk, steel mills in Wyksa, and the wagon works in Twer and Moscow. This group of works has been given a specific task to perform in the way of construction of rolling stock.

Reports on the result of this work for the first half year, recently made public, show that the task, although very modest, has not nearly been completed. The works in Sormorow, for instance, were commissioned to produce within 6 months 8 new engines, 30 extensive engine repairs and a specified number of duplicate parts. These works, which employ 8,500 workmen, carried out the following work: New engines, none; repairs, 14; duplicate parts, about 80 per cent of the specified quantity.

The works in Kolomna, employing 4,100 workmen had been given the task of producing in 6 months: 6 new engines, 10 narrow-gage engines and 18 repairs. The result was: One new main line engine, 5 narrow-gage engines and 5 repairs. This factory produced in pre-war times 30 engines a month.

The Moscow wagon works, employing in 1914 2,500 workmen, produced per half year in peace time 1,500 trucks, reserve parts for another 1,200 trucks, 150 new passenger cars, 120 street railway cars and 16 motor cars. The works management reports the output of the last half year as 120 trucks and no passenger cars. Of snow-ploughs, which in pre-war times have been a specialty made in large numbers, the management of these works say that preparations for their manufacture have been completed and "one snow plough is actually in the state of assembling." All manager's reports are unanimous in their opinion that fuel, lack of workmen and their inefficiency are responsible for the poor results. The works in Moscow are furnished only with a poor sort of lignite; pit coal is not obtainable even for these works which have the special attention of the country's rulers. It is significant that it has been impossible to procure for the works mentioned the requisite number of workmen, which was to be 50,000. The actual number of workmen has fallen short of this figure by 18,000. It is said that none of the laborers work full time, the actual working hours having been only 60 per cent of the regulation time. One works manager states that the output per man per working-day equals the output of 1½ hours on the pre-war standards.

The same deplorable conditions prevail in water transport. The complete fleet of barges for petroleum traffic on the Volga consists now of only 190 units, which is insignificant, considering that in pre-war times from 900 to 1,000 of such vessels were constantly moored in the harbor of Nishni-Novgorod.

Fewer Productive Workers

Reports from other manufacturing works show that the diminishing of the number of productive workers in Russia is general. From labor statistics recently published it is seen that in 35 government districts 6,090 factories employing 1,250,000 workmen were running in 1918. In 1920 only 5,800 of these works employing 860,000 workmen were in business. The decrease in the number of workmen was from 26 to 42 per cent in 2 years. The most strenuous efforts of the Bolshevist Government to increase the army of workmen—even the strong compulsion which is exercised—are ineffective. Most of the workmen have hired themselves to peasants, or have become administrative officials, of which there exist now one in six of the population.

It is an open secret that the Bolshevist leaders have long been conscious of the utter failure of their methods. This recognition does not find expression in public, but is proved by certain measures which have been taken lately. One of them is a bill, passed recently, regulating the conditions under which foreign private capital and enterprise is admitted in the country. The object of this bill is stated to be the improvement of the country's production and it creates facilities for foreign business men, individually or organized in companies, in the shape of concessions. Holders of such concessions shall have the right to export part of their production. They shall receive privileges if they introduce new methods which will raise the production.

Such concessions will be given for a long period and the Soviet Government gives a guarantee not to interfere with them in any way, either by nationalization or confiscation. The Soviet Government is trying to give this matter wide publicity in order to attract capital and enterprise from all sides, but continental business men look on the scheme with disfavor. Foreign capitalists and business men lured into embarking in the scheme are believed to take a heavy risk, as the Soviet Government is hardly able to carry out their guarantee, even if they were willing to do so.

Concrete Pile Bridge Fails From Slipping Foundations

Undercutting of New River in Imperial Valley Causes Banks to Move Toward the Middle of River

By E. E. East

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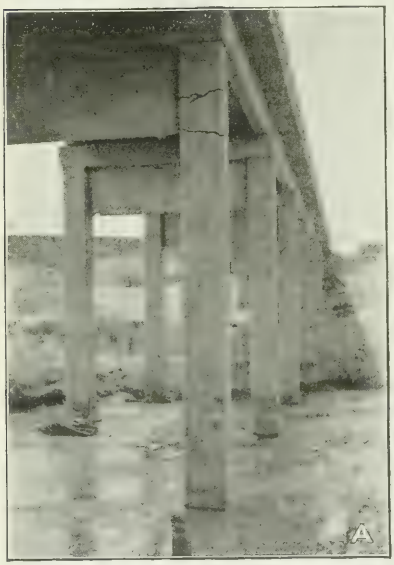
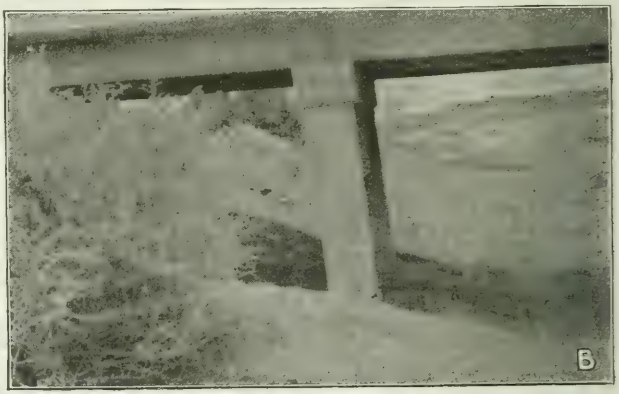
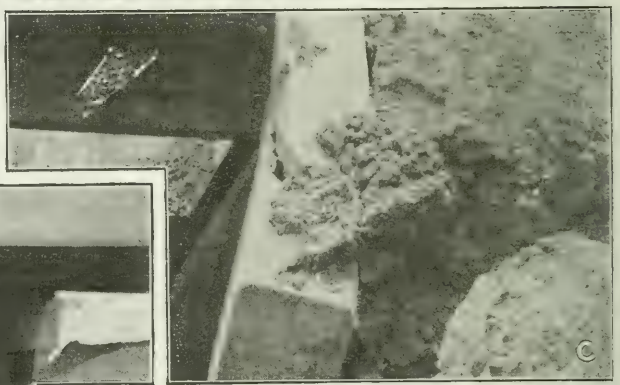
General slipping of the banks toward the middle of the stream, due to the deepening of the channel of an undercutting stream, has resulted in the failure of a reinforced-concrete trestle across New River in the Imperial Valley in southern California. The failure has been progressive and has now become so great as to make doubtful the possibility of saving the structure.

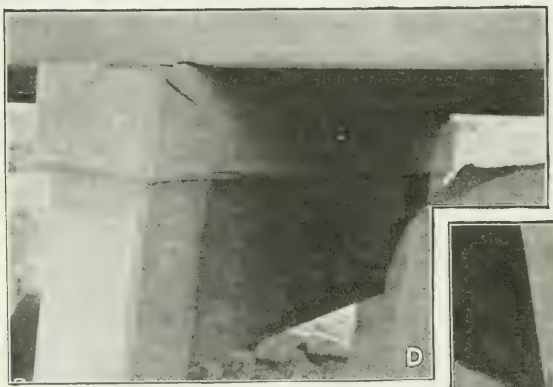
The channel of New River was cut during the overflow of the Colorado in 1905 and 1906. During the early stages of the flood the water spread out over a strip of ground approximately six miles wide and extending from the Mexican border to the Salton Sea. Through the efforts of various interests in the valley, in an attempt to save this territory from the erosive action of the flood, the river was finally confined to a channel of some 700 or 800 ft. in width, where it soon cut to a depth of 30 to 40 ft. below the natural ground level. With the closing of the break in the Colorado and the recession of the water the river gradually confined itself to the center of this gorge, where at the present writing it has cut its way through the loose loam soil to a total depth of approximately 60 ft. below the original ground line at the bridge location. A view herewith shows the present condition of the river.

The bridge was built in 1918 by Imperial County, on the line of the State highway from San Diego to



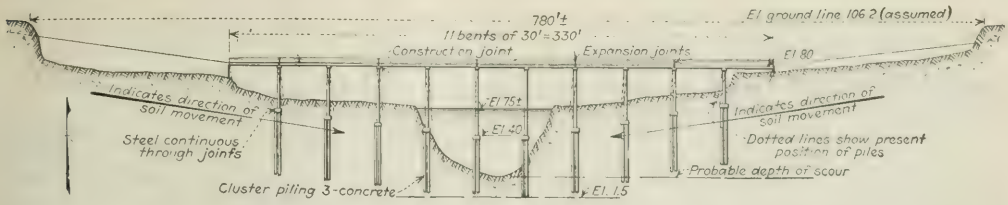






THE NEW RIVER JUST BELOW THE BRIDGE
CONDITION OF BRIDGE IN AUGUST, 1920

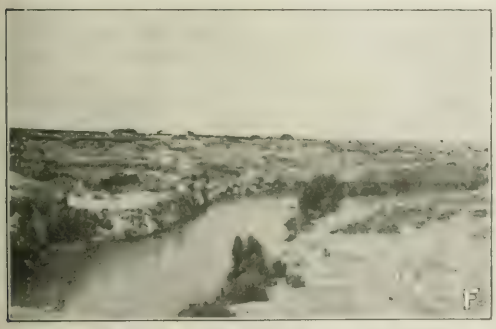
(A) Cracks developing in downstream pile in sixth bent. (B) Movement in girder line. (C) Movement toward stream at abutment. (D) Movement of first bent from east and cracks showing in cap. (E) Cracks at base of bent No. 1.



REINFORCED-CONCRETE TRESTLE OVER NEW RIVER IN IMPERIAL VALLEY, SHOWING MOVEMENT OF BENTS

Imperial Valley, and spans the second and present channel of the river. It is of the reinforced-concrete trestle type, containing 11 bents of 30 ft. span, or a total length of 330 ft. Three of the eleven bents are in the present stream channel.

Using an assumed datum of El. 100 the bridge floor is at El. 80. Reinforced-concrete piles were driven in two clusters at each bent to El. 1.5 for the central bents, the penetration being slightly decreased toward the abutments, and a concrete cap poured over them at El. 40 for central bents and stepped up, as shown in the sketch, to the abutments. On these caps the two posts for the superstructure were cast in place. Both footing and posts were tied by reinforcement into the caps.



THE NEW RIVER JUST BELOW THE BRIDGE

The piles for the bridge were driven with great difficulty, water jets being used in all of them. No change in the character of the ground was indicated for the depth to which the piles were driven. In fact, wells driven in the vicinity indicate a silt loam for a depth of several hundred feet.

About the beginning of last year (1920) employees of the State Highway Commission noted that the center of the bridge was apparently moving downstream. This movement was slight but sufficient to be noted by the eye, without the aid of instruments. Upon examination it was found that small cracks were developing in the abutments and posts at the end bents near the ground line and between the caps and the girders.

The writer had occasion to inspect the bridge in August, 1920, and found that the conditions had become more serious. A more recent inspection shows that the movement is continuing. The views herewith indicate the condition last August.

As shown in view *C*, the abutments have moved in toward the middle of the stream, the movement in each case being greater at the ground line than at the girder line. Bent No. 1 from the west end (view *E*) shows a horizontal movement of approximately 10 in. in a vertical height of 12 ft. The upstream post in this bent has broken about 1 ft. above the cap, while the downstream post has broken at the cap line. A vertical movement along the expansion joint in the girders and floor of about 1 in. was noted, as shown in view *B*. View *D* shows the movement of the first bent from the east end of the bridge and cracks developing in the cap there. View *A* shows cracks developing in the downstream post in the sixth bent. The fill approaches to the bridge and the concrete pavement at points on either side where the road leaves the cuts have settled in each case 12 in. or more. No settlement was noted at the abutments, although view *C* shows a movement of the fill as evidenced by cracks.

From the character of the failure noted, it would appear that there is a movement of the ground from the extreme banks of the channel on each side toward the middle of the stream, this movement being permitted through the release of pressure due to the cutting of the river. This movement may have been assisted by the numerous earthquakes which have occurred in the valley during the past year.

Properties of Various Hickories Compared

The chief difference between true and pecan hickory, as shown by tests at the Forest Products Laboratory, is in toughness or shock-resisting ability, the property which is so valuable in wood handles and vehicle parts. In this property true hickories are far superior to the pecans. The strength of pecan is somewhat higher than that of oak or maple, and for such articles as handles and buggy spokes carefully selected pecan is probably to be preferred to either of these two woods. In heavy wagon parts, such as axles, spokes and felloes, maple and oak are reputed to stay in place better than hickory. Except in case of extreme shortage of maple, true hickory and oak, it would probably be inexpedient to use pecan hickory for these heavy parts. The sapwood or white wood of hickory, which is usually preferred by the trade, is the better wood in young, thrifty trees, but in over-mature trees it is inferior to the heartwood. A red color does not necessarily make sound hickory suitable for vehicle stock. A more useful criterion than color is the proportion of summerwood, or non-porous wood, in the annual growth rings. In hickory stock intended for the more exacting uses, the non-porous wood should form at least one-half and preferably three-quarters of the annual ring. The remaining part should contain very few pores. A further precaution to be observed is that the non-porous part of the annual ring should be hard and flinty. The best criterion of the strength properties of either true or pecan hickory is the weight of the dry wood. This weight should not be more than 10 per cent below the average for true hickory, or not less than 45 lb. per cu.ft. of oven-dry wood.

Some Unsettled Points in Structural Design

Engineering Judgment Applied to a Dozen Open Questions on Columns, Beams, Grillages, Crane Girders and Rivets

By R. Fleming
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QUESTIONS often present themselves in the design of steel structures on which the designer does not find adequate help in textbooks. A few of these points are considered in the present article, which, however, does not attempt to *settle* anything but simply records the writer's views and practice.

Mill-building columns with brackets carrying crane girders or other loads and columns with knee braces usually present in their design two puzzling questions: Shall bending moments be determined with the ends considered fixed or hinged? and, how shall the direct or axial stress and the bending stress be combined in proportioning the column?

Bending Moments in Columns with Brackets

The first question is not one of pure mathematics but depends for its answer upon the physical condition of the ends and the anchor bolts. Ordinary set anchor bolts but partially fix the base. The point of contraflexure is probably at one-fourth to one-third the distance from the base to the bottom of the bracket or knee brace. Connections of roof trusses to columns are never strictly rigid, although with proper details the error in assuming them to be so is slight.

In consideration of these factors, the writer finds the bending moment by first assuming the ends of the column to be hinged, equating the vertical and horizontal couples and solving for the horizontal reaction at the base. This reaction multiplied by the distance to the bottom of the bracket or knee brace determines the bending moment at that point. Because the ends of the columns are partially fixed, eight-tenths (sometimes seven-tenths) of the bending moment thus found is used in the fundamental formula for flexure $S = Mc/I$ to determine the extreme fiber stress. (It may be noted that the Rankine method for eccentric loads as given in various editions of the Carnegie "Pocket Companion" does not apply to a load resting on a bracket between the ends of a column and applied several inches from the column face.)

Proportioning a Column for Eccentricity

As to the second question: Many bridge specifications, among them those of the American Railway Engineering Association, call for members subject to both axial and bending stresses to be proportioned so that the combined fiber stress will not exceed the permissible axial stress.

The Canadian Engineering Standards Association specifications for steel railway bridges (Sept., 1920) contain the significant paragraph:

> Members subject to both axial and bending stresses shall be proportioned so that the combined fiber-stress will not exceed the allowed axial unit-stress; except such members as may be subject to bending moments from their own weight or from eccentricity, when the total fiber-stress shall not exceed the allowed axial unit-stress more than 10 per cent; but in no case shall the section be less than that required for the axial stress alone.

Bishop, in his "Structural Drafting," 1920, writing of members which resist bending and direct stress says:

> In a compression member the allowed unit stress is usually a function of the least radius of gyration. Opinions differ as to whether the least radius of gyration about *either* axis of symmetry or the least radius of gyration about an axis *perpendicular* to the plane of bending should be used. The use of the former is often specified, particularly for bridges, but the resulting margin of safety is unnecessarily large where the direct stress is relatively small. It is better to consider two different allowed unit stresses in compression as explained below. This method of design has been used extensively in building work by engineers of repute with apparent satisfaction. (1) The unit stress which is determined by the least radius of gyration about an axis *perpendicular* to the direction of bending should not be exceeded by the sum of the unit stress in direct compression and the unit stress due to bending. (2) The unit stress which is determined by the least radius of gyration of the *whole* member should not be exceeded by the unit stress in direct compression *alone*. If the radius of gyration used in (1) is also the least radius of the whole member, step (2) is unnecessary.

The side columns of buildings are usually stayed in the direction having the least radius of gyration by the walls or siding. The greatest bending stress from a bracket or knee brace is at the point of maximum bend-moment and varies to zero at the points of contraflexure. The axial stress from the load that causes bending is carried by that portion of the column below its point of application. Since neither the maximum bending stress nor the entire axial stress extends the whole length of the column the writer in proportioning side columns (Case 1 of Bishop) usually increases the allowable working stress 20 per cent, provided the section thus obtained is not less than that required for bending or axial stress alone. For interior columns with brackets or knee braces, and unstayed in both directions, the writer follows Bishop, i.e., does not use the 20 per cent stress allowance just noted.

Beams and Girders Unsupported Laterally

In an article, "Beams Without Lateral Support" (*Engineering News*, April 6, 1916, p. 648) the writer pointed out the wide variation of published rules for the strength of beams unsupported laterally. This variation is still found. For instance, the Carnegie "Pocket Companion," edition of 1920, for an unbraced beam of a span 40 times the flange width allows 43.8 per cent of the stress that would be permitted if the compression flange were secured against lateral deflection, while "Cambria Steel," edition of 1919, allows 73 per cent for the same beam.

The American Railway Engineering Association's 1920 specifications for steel railway bridges limit the stress per square inch in the compression flanges of plate girders to $14000 - 200\,l/b$ in which l is the length of the unsupported flange and b is the flange width. Ketchum, in "The Design of Highway Bridges," 1920, specifies $16000 - 150\,l/b$ for beams and girders. The specifications of the South Carolina highway department, 1919, prescribe $20{,}200 - 350\,l/b$ when the unstayed length l exceeds $12b$, and limits l/b to 40. The Boston building law of 1919 gives $19200 - 160\,l/b$ for for l/b greater than 20. The 1920 Chicago law gives $20000 - 160\,l/b$ for ratios over 25.

Since the bending stress in a beam due to direct load varies from a maximum to zero, it seems needlessly severe to assume the compression flange to be a column loaded the whole length with the maximum bending

stress. The problem is to find an equivalent length of column with equivalent loading. Several attempts have been made to do this.

Box, in his "Strength of Materials" (first edition 1883) concludes that the maximum tendency to deflect laterally is represented by considering the compression flange as a column of a length equal to two-thirds of the length of the span and carrying a load equal to one-third the greatest compressive stress at any point.

Prof. H. F. Moore, in "The Strength of I-beams in Flexure" (*Bulletin 68*, University of Illinois Engineering Experiment Station, 1913) concludes that the computed *ultimate* flange stress for steel I-beams not restrained against sidewise buckling is given by the formula: $40000 - 60\ ml/r'$ in which l is the length of span in inches, r' is the radius of gyration of the I-section about a gravity axis *parallel* to the web, and m a constant ranging from 0.25 for a fixed-ended beam with load at the mid-point to 1.0 for a cantilever beam uniformly loaded. For a simple beam with load at mid-point m is given equal to 0.50 and for the same beam uniformly loaded m equals 0.67.

It is readily seen that both the Box and the Moore methods allow much greater extreme fiber stress than any of the specifications quoted.

The present writer uses the following unit bending stresses when the compression flange is unstayed laterally: For I-beams deeper than 10 in., and for plate girders without cover plates, $19000 - 250\,l/b$; for I-beams 10 in. deep and under, and for plate girders with cover plates, $19000 - 225\,l/b$. When the compression flanges of beams and girders are rigidly held at the ends, he takes the unsupported length l as three-fourths of distance center to center of end connections.

Crossed Diagonals As Struts

Some ten years ago the writer designed several hundred towers of a power transmission line. The towers were four-sided, each side being double-latticed with horizontal struts at the panel points. The web system was calculated as two Warren trusses, the angle diagonals of the two systems being bolted together at their mid-points. The tower legs were inclined, thus taking most of the shearing stress due to the wind and making the stresses in the diagonals quite small. The question at once came up as to what unsupported length, l, should be used in the negative, or reduction, term of the column formula. From some tests made with paper models it was deemed legitimate to assume for l the distance from center of end bolt hole to bolt hole at intersection. For the small stresses 1½ x 1½ x ⅛-in. angles (galvanized) were used. No buckling of any of these light angles has ever been reported. For heavier angles, say ¼ or ⅜-in. thick, and corresponding stresses, with a single bolt at their intersection, the unsupported length would have been taken as three-fourths of the distance between centers of end connections, as the writer would consider the restraining effect of the tension diagonal to be less in this case.

Similarly in double latticing of flat bars riveted at intersections, the writer assumes the unsupported length l in the negative term of the compression formula to be three-fourths the distance between centers of end rivets. This is approved, by implication, by the many bridge specifications that require the thickness of bars in single lattice to be not less than one-fortieth the distance between end rivets while one-sixtieth is allowed for bars in double lattice if riveted at intersections.

Shall grillage beams be proportioned on the assumption that the maximum bending moment is at the center or at the edge of the superimposed load? A few years ago textbooks and handbooks were about equally divided between the two methods but at present the first method is in the lead; half a dozen rolling mill handbooks use it.

There is room for doubt. As a beam becomes loaded the point about which it tends to turn shifts from the center toward the edge of the superimposed load; on the other hand the edge of any wall column base or beam is seldom strong enough to take the uplift from the projecting portion of the beams below, and its yielding shifts the fulcrum back toward the center. The truth therefore is apt to lie between the two methods, and the writer has accordingly adopted the following practice:

For foundations with but one tier of beams, bending moments are calculated about the center of the superimposed load and 16,000 lb. per sq.in. is used for extreme fiber stress in bending. For foundations with two or more layers of beams embedded in concrete, bending moments are taken about the center of the superimposed load and 20,000 lb. per sq.in. is used for both layers. Under specifications allowing but 16,000 lb. fiber stress, the point of maximum bending moment is assumed midway between the center and the edge of the superimposed load.

Crane Girders and Coal Bunkers

Crane impact has not been measured, but the prudent designer is bound to allow for it. In view of the infrequency and lack of harmony of specification requirements, the writer takes the impact due to electric traveling cranes at 25 per cent and that due to hand-power traveling cranes at 10 per cent. No impact is considered for two cranes in action on the same girder.

In addition to vertical loads the top flanges of crane girders are designed to resist a total transverse horizontal thrust of 20 per cent of the lifting capacity of the crane, or 10 per cent at each end of the crane, divided equally among the wheels of the end truck.

Coal bunkers are assumed to be surcharged when it is possible for them to be so loaded. The weight of loose coal is usually taken at 56 lb. per cu.ft. for anthracite and 50 lb. for bituminous; the angle of repose 30 deg. for anthracite and 35 deg. for bituminous. The writer has found that for bunkers up to 20 ft. in depth the hydrostatic pressure of 25 lb. per cu.ft. is ample for lateral pressure; this assumption usually allows for sufficient surcharge. Of course, the bottom of the bunker is designed for actual weight of coal contained.

Miscellaneous Points

In determining column loads no reduction of floor area is made for stair openings, unless the area of opening is one-third or more of the area of the floor panel.

Column formula commonly used: $S = 16{,}000 - 70\,l/r$ with a maximum value of $S = 13000$.

Tension in rivets is assumed at 7,000 lb. per sq.in. Tension in field bolts (not anchor bolts) is assumed at 9,000 lb. per sq.in. net section.

Shear and bearing values of countersunk rivets are assumed at three-fourths the values of rivets with full heads when the metal is not thinner than one-half the diameter of the rivet. As a rule countersunk rivets are not used in thinner metal, but when unavoidable they are rated at three-eighths the values of full-headed rivets. Flattened heads are assumed equal to full heads

when their height is not less than three-eighths inch, or one-half the diameter of the rivet for ⅝-in. rivets and less. Rivets flattened to less than these heights are regarded as countersunk rivets.

Bearing value on plate-girder stiffeners transmitting loads is assumed at 24,000 lb. per sq.in. of metal, excluding the area of the chamfered portions over fillets of flange angles. Stiffeners transmitting loads are designed as columns of length equal to one-half the depth of the girder.

Highway Traffic Committee Urges Advance Planning

Answers to Questionnaire Indicate Need for Standardization of Traffic Census Methods and Results

BASED on a questionnaire to which 52 replies were received from 23 state highway departments, 21 counties in seven states, 5 cities in four states and 3 commercial organizations, a final report on present and future traffic conditions was submitted to the annual meeting of the New Jersey State Association of County Engineers, at Trenton, Jan. 25, by a committee consisting of J. L. Bauer, chairman, J. J. Albertson, J. M. Abbot, F. A. Reimer and H. F. Harris. The committee, which was appointed in 1919, presented a summary of the replies to its questions and also made recommendations governing future traffic studies, emphasizing particularly the need for a standardization of traffic census work so that results on different roads in different parts of the country may be intelligently compared. A summary of the report follows:

Results of Questionnaire

The results of the questionnaire indicated that for purposes of road classification the terms "heavy" and "light" were preferred to "commercial" and "pleasure" for designating the character of traffic. Opinion was evenly divided as to whether such a classification should be based on maximum or on average traffic. It was indicated that a 2½-ton vehicle should be the dividing line between "heavy" and "light" traffic.

Thirty-three answers showed that no traffic records were available, while fourteen of those who had traffic records indicated that they were in most cases not dependable. Such records as have been taken, however, show that truck traffic has been increasing on country roads at a faster rate than other automobile traffic.

Replies to questions regarding roadway widths varied widely. Paved portions of existing roadways ranged from 9 to 60 ft.; forty-eight replies indicated general widths of 16 to 20 ft., thirty-six named 18-ft. widths and twenty-five named 16 ft. Widths between gutters were shown to range from 20 to 60 ft., 32 ft. being the average width of all mentioned. Total roadway widths were from 20 to 120 ft., with 60 ft. as the average and 50 ft. as the width most generally in use.

The probable increase in automobile traffic in the next 10 years will be somewhere between 30 and 500 per cent, according to the replies received. Fifteen replies stated that the future yearly increase will be greater than the yearly increase in the past; twelve believe that such yearly increase will be equal to that of the past; while eleven are of the opinion that the future will bring about a reduced rate of increase. There was, however, practically unanimous agreement that commercial traffic on country roads would increase faster than other traffic and that total loadings would show an increase.

Road traffic, the committee pointed out in one of its questions, has doubled in some sections in periods of from two to three years. Assuming road traffic 6 years hence to be four times as great as it is at present, a query was raised as to whether present roads could accommodate the increase. Thirty replies answered in the negative and fifteen in the affirmative.

Practically all replies showed a desire to eliminate railroad grade crossings and to increase paved widths of roadway and rights-of-way. Twenty-two replies approved the suggestion made by the committee of planning parallel roads on main routes so as to provide for one-way traffic roads or for a division between commercial and pleasure traffic. Many localities are studying this question.

Commenting on the growth of the automobile industry, the report states that in 1919 there were more than 7,500,000 motor vehicles in the United States; the gain in registration in 1919 over 1918 was about 25 per cent. Assuming the production of motor vehicles to increase in the future at the same rate as in the past the passenger car production in 1930, according to the report, will be 3,400,000 vehicles and motor-truck production 1,340,000 vehicles. At present in the United States there is one automobile for each 14.14 inhabitants. In France the proportion is one automobile to 198 persons, while in Great Britain it is one automobile to 180 persons. The State of Iowa claims one automobile for each six persons.

The report indicates that within a few years it is reasonable to expect that with the aid of the United States Government a sum approximating $1,000,000,000 per year will be spent on highways.

Traffic Data

Information received by the committee in reply to the questionnaire, covering traffic data in various parts of the United States, is summarized below:

On the Lincoln Highway in Pennsylvania between Philadelphia and Trenton it is estimated that in the year 1918 the total traffic of teams, automobiles and trucks was 225,000.

In the County of Los Angeles, Cal., in various months in 1919 and on eight different roads the traffic ran from 2,000 in 24 hr. up to 7,200 in 24 hr., the count being made on four classes of traffic, horse, motorcycle, automobile and motor truck. The estimated tonnage was from 3,064 tons in the first case to 8,832 tons in the second.

At the city line of the city of Seattle, Wash., at South Park in July, 1919, the total daily traffic ran from 700 to 2,070, counting about 8 hr. per day.

In Allegheny County, Pa., in various months during 1919, counts were made on twenty-three roads for a period of seven days each and for 12 hr. each day. The total counts for the seven days on each road ran from 1,579 vehicles to 15,442 vehicles.

In Union County, N. J., the traffic census made on four successive Saturdays and Sundays in the early summer of 1918 at four of the densest traffic roads in the county showed a total traffic census for 24 hr., taking the average of days of observance, at from 4,500 to 12,000 vehicles. Two of these points registered very close to the figure 12,000 vehicles in 24 hr.

Daily traffic for the new Hudson River vehicular tunnels between New York and Jersey City, as forecast by the Tunnel Commission, will be as follows:

1924—date of opening of tunnel, 16,500 vehicles daily.
1929—25,900 vehicles daily.
1934—37,800 vehicles daily.

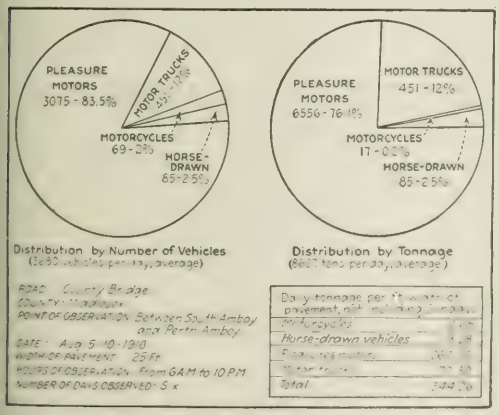
The amount and increase of traffic over four New York City bridges over the East River in a period of seven years is given below:

	1912 Daily	1919 Daily	Per Cent Increase
Brooklyn Bridge	4,000	6,700	67
Manhattan Bridge	4,800	21,400	345
Williamsburg Bridge	6,000	16,300	172
Queensborough Bridge	3,500	18,700	435

Uniformity Needed

The report points out there is apparently no basis of understanding throughout the country as to the terminology of traffic. Traffic information is obtained in different ways and for different periods of time, so that with the data available comparisons cannot well be made. The committee believes that traffic could be divided by units of 100 vehicles per day and roads then numbered from one up, traffic No. 1 covering 100 vehicles per 24 hr., traffic No. 8, 800 vehicles per 24 hr., etc.

The committee recommends greater extension of traffic census work, extension of research work, planning,



SPECIMEN CHART SHOWING TONNAGE DISTRIBUTION

now, for future state or county highway systems and extensions thereof, and the planning of present construction with a view to traffic in the immediate future. It is realized also that the methods of taking the traffic census must be standardized. Reproduced herewith from the report is a sample of a traffic census sheet following that used in one of the eastern states which the committee believes to be suitable for general use. With this sheet the totals of any class of traffic and the grand total of all traffic are obtainable; the loads passing over the roadway in proportion to the width thereof may also be determined. The specimen sheet herewith is somewhat condensed in space; actually more room would be provided for the census figures.

The report also submitted a sample method of charting traffic, as shown herewith.

Replies to the questionnaire indicate that the normal maximum or average maximum traffic should be taken as the basis of traffic for the roads. In northern climates the periods for taking traffic censuses could be selected as follows:

	Month	Days of Observation
First period	April, May, June	3 consecutive days, including Sunday
Second period	July	3 consecutive days, including Sunday
Third period	August	3 consecutive days, including Sunday
Fourth period	September, October	3 consecutive days, including Sunday

SUGGESTED FORM OF TRAFFIC CENSUS SHEET

Traffic Census Sheet County No.....Station No.....County.....
State Highway Department of New Jersey 192
Road at
Exact location
Count taken from to from To.

Time Count Was Taken	Motorcycles	Light Horse		Heavy Horse		Pleasure Motor Cars		Light Motor Trucks		Heavy Motor Trucks		Specials			Street Cars	Hourly Totals
		Empty	Loaded	Empty	Loaded	Light	Heavy	Empty	Loaded	Empty	Loaded	10-Tons	15-Tons	Over 15-Tons		
6 a.m. to 7 a.m.																
7 a.m. to 8 a.m.																
8 a.m. to 9 a.m.																
9 a.m. to 10 a.m.																
10 a.m. to 11 a.m.																
11 a.m. to 12 N...																
12 N. to 1 p.m.																
1 p.m. to 2 p.m.																
2 p.m. to 3 p.m.																
3 p.m. to 4 p.m.																
4 p.m. to 5 p.m.																
5 p.m. to 6 p.m.																
6 p.m. to 7 p.m.																
7 p.m. to 8 p.m.																
8 p.m. to 9 p.m.																
9 p.m. to 10 p.m.																
10 p.m. to 11 p.m.																
11 p.m. to 12 m.																
12 m. to 1 a.m.																
1 a.m. to 2 a.m.																
2 a.m. to 3 a.m.																
3 a.m. to 4 a.m.																
4 a.m. to 5 a.m.																
5 a.m. to 6 a.m.																

Total roadway—
Weather
Type of pavement Condition of pavement
Width of roadway Width of pavement
Notes

Kind of Vehicle				County
Motorcycles				
Light horse, empty				
Light horse, loaded				
Heavy horse, empty				
Heavy horse, loaded				
Light pleasure car				Tons
Heavy pleasure car				Tons
Light motor truck, empty				Tons
Light motor truck, loaded				Tons
Heavy motor truck, empty				Tons
Heavy motor truck, loaded				Tons
Specials				Tons
Specials				Tons
Specials				Tons
Light motor truck, loaded				Tons
Heavy motor truck, empty				Tons
Heavy motor truck, loaded				Tons
Totals				

The traffic census should cover the entire 24 hr. in each case. In many instances, however, the traffic during a part of the total day might easily be approximated and expense thus saved.

It is recommended that state highway departments and county highway departments prepare maps showing present and future highway systems and extensions thereof. The planning should extend to a period, say 20 years ahead, along broad lines in a manner somewhat similar to that now in use in many places in city planning.

New roads should be built of generous width, not less than 60 ft., with particular attention to the securing of curves of large radius and the avoidance of steep grades and railroad grade crossings. This plan of future roads could be altered from time to time as necessity arose, but should always be kept many years in advance of present-day needs.

Considerable work could be done at this time, the report states, which would be of great future benefit if, in planning construction, special attention were given to wide right-of-way widths, flat curves and easy grades. These points are among the most permanent of present considerations, as they would, no doubt, outlast the present actual road constructions. Likewise, in the design of bridges, if of a permanent character, such as steel, stone and concrete, the idea could be kept in mind of their use by a traffic, say 10 or 20 years in advance of the present date. This consideration might lead to the building of wider and stronger structures.

In conclusion, the committee believes that the requirements of the future along road-building lines cannot now be fully determined, but by the use of present knowledge, the securing of additional necessary data and the estimating of future traffic, much may now be done by road builders which will not only be of present value, but which will be of greater value in the immediate and more distant future.

Federal Aid for Drainage Proposed

Government assistance in the drainage of swamp lands, protection of overflowed lands and reforesting of cut-over lands is provided in a bill now before Congress, drafted by Edgar A. Rossiter, consulting engineer, Chicago. Such assistance would be rendered through the Department of the Interior, with a fund provided by annual appropriations by Congress. Under the proposed plan any state reclamation board could call for an investigation of a project to determine such charge per acre on the lands affected as would return to the fund the estimated cost of construction, the board to have charge of construction. For operation and maintenance an additional charge might be made, but this work might be transferred by the Department of the Interior to a local drainage association or district. When any project includes a navigable stream which might be utilized for barge transportation the cost would be divided between the Federal government and the landowners. Mr. Rossiter points out that Illinois alone has 10,000,000 acres of swamp and overflowed lands, but that State laws provide no relief, while the Federal reclamation act establishes a precedent for such improvement work as is covered in the proposed bill. He states that arid lands are worth $50 to $100 per acre when irrigated but that swamp lands are worth $200 to $350 per acre when drained.

Criticism of California Highways Policy Answered

State Commission Issues Reply to Joint Report of Auto Club's Engineering Advisers

IN REPLY to a joint report on California's highway system made recently in behalf of two local automobile associations (see *Engineering News-Record*, Feb. 3, p. 207) the state highway commission has issued a statement in defense of its policies from which the following extracts are taken:

Two major criticisms are made of the policies under which California has developed its highway system: One has to do with the type of roads constructed—particularly their width and thickness. The second deals with the plan under which it is proposed to expend moneys remaining in the $40,000,000 bond issue.

The first criticism involves the question whether state highways should be built upon the unit plan and widened, thickened, and surfaced as traffic increases, or whether the ultimate road, if such a thing exists, should be built as the first and original construction. If the latter plan is adopted, it marks a complete departure from the policy under which California has developed a highway system that touches and serves almost every part of the state. If the plan that the two auto clubs now advocate had been adopted, highway construction in California would today be practically confined to the construction of a boulevard between a few large cities.

Against this policy is that of the commission for the construction of a road of sufficient width and thickness to take care of existing traffic, with reasonable regard for traffic growth. It provides for widening and thickening as traffic demands a heavier duty road, without the loss of the original investment.

On this point the biennial report of the highway commission says: "This policy has resulted in giving to California a mileage in improved highways that could never have been built had roads been originally constructed to meet traffic demands of the far future. Not only has this added mileage justified the commission's construction policy, but it is further justified by the fact that the alternative policy of building completed roads would have cost the state millions of dollars without due return."

It would be interesting to know just how the fact will be determined as to just what future traffic is to be, and what thickness and width of road it will be necessary to build to take care of such traffic. To quote from the report of the auto clubs: "The number of automobiles in California has increased from 98,399 in 1913 to 535,000 in 1920. In the same interval trucks have increased from 5,299 to 35,000." Continuing the report says: "We may confidently expect a great increase in the number of trucks. Their size, weight and future speed is an uncertain question."

The fact that the state highway system is taking care of this enormous expansion of traffic indicates the substantial character of its construction, and that the roads were planned both with foresight and judgment.

So much for past construction policies. The highway commission agrees with the auto clubs that the time has come when traffic demands a heavier duty truck highway. Recognizing this, the commission, before any question of the sufficiency of the highways was raised, had already substanially increased its specifications. Much of its biennial report submitted in January is devoted to recommendations for widening, thickening and surfacing the older highways and for obtaining funds for this improvement through the medium of a gasoline tax.

The commission contends that this heavier duty highway can be secured without the loss of any appreciable part of that portion of the $36,000,000 that California has invested in its paved roads if a continuous program of widening and thickening is carried on well in advance of permanent injury to the highway through intensive traffic.

As to future construction, the auto clubs suggest a road from 6 to 8 in. in thickness, reinforced, of a minimum width of 20 ft. and 24 ft. wide near the large cities. The specifications of the commission call for a 5-in. reinforced road, of a minimum width of 15 ft., but built wider where present traffic or the outlook for early traffic development demands a wider highway; and with the road designed so that it can be widened and thickened to meet future traffic demands.

The commission is not averse to increasing its minimum specifications. But the people of the state must understand that the construction of wider and thicker highways will cut enormously into mileage, just as the increase in specifications from a 4-in. reinforced slab to a 5-in. reinforced slab has cut into mileage.

Relative to the second major criticism, the $40,000,000 bond issue was made up by budgeting amounts to certain roads. The commission stands by the budget. It proposes to spend on every road as much as is in the budget for it. It does not propose to rob one road to build another. The auto clubs practicaly propose to abandon the budget and to such an extent as may be necessary to throw the new roads overboard.

The commission has adopted as its standard of construction a cement concrete base or slab built to meet traffic necessities. As funds are made available, this slab should be widened, thickened and finished with a wearing surface. Such a road, the commission believes, is the most practicable highway, both as regards the ability of the state to construct and as regards the service to be obtained from the road. The commission is not convinced, as the auto clubs appear to be, that the concrete road without a wearing surface is the final word in pavement design.

Proposed Grouping of Railways in Great Britain

Government Plans Seven Groups—Companies Prefer Five—Controversy Over Basis of Rates and Financial Returns

COMBINING the railway systems of Great Britain into a few large groups is proposed by the British government and a bill for this purpose has been prepared by the Minister of War. Certain features of the bill do not meet the approval of the railways, which have presented their views to the minister through the Railway Companies Association, in the hope of effecting a settlement which will protect the interests of the companies and their shareholders, and will avoid excessively high rates or the continuation of subsidies at the expense of the taxpayers, but will place the railways on the sound financial basis necessary for their efficient operation.

Under the government plan, there would be six groups for England and Wales and one for Scotland, but the Minister of War has expressed some doubt as to whether the passenger and freight rates can be so revised as to secure even approximate financial equilibrium within each group. The Railway Companies Association agrees with the general principle of grouping, but suggests five groups covering England, Wales and Scotland as being more likely to obtain the desired financial results. In particular, it divides the Scotch lines between two of the groups, so that there would still be competition for Scotch business. Under the companies' plan all lines north of the Thames would be divided into two groups, northeastern and northwestern, with about 5,000 and 6,500 miles respectively. A third group of 4,000 miles includes a system from London to the west, with all the Welsh lines. A fourth, with 2,500 miles comprises all lines south of the Thames and the fifth is composed of all the London local lines.

The amalgamation or consolidation of capital of the several companies comprised in each group appears to be made compulsory in the new bill, but the companies consider that, although such amalgamation may become expedient, it should be optional. As to financial returns, the bill provides that some prescribed authority shall determine rates which, with efficient and economical management, will enable the companies to earn a net revenue substantially equivalent to the combined net revenue of all the companies absorbed in the group. A difficulty has arisen from the stipulation that this revenue is to be determined upon a pre-war basis.

It is agreed by the companies that if this term is taken to mean that the return to capital is not to exceed the pre-war rate, it would be impossible to raise on reasonable terms the additional capital which is required for further railway development. The companies probably would accept a provision to the effect that the future net revenue is to include a return on capital which will place railway investments in the same relation to other industrial investments as in pre-war days.

A statement issued by the Railway Companies Association points out that the principal purpose of the financial arrangements is to make the railways self-supporting in the hands of the present owners, to put an end to State subsidies, and to reduce or eliminate serious claims against the government arising out of its present possession of the railways. In view of the difficult problems of finance, administration, organization and operation the association considers that it will not be practicable to have the groups ready for operation before 1924. It is suggested, therefore, that when the existing government control ceases in August, 1921, the government shall continue the present agreement until January, 1924, and shall meanwhile guarantee the companies the same net receipts as in 1913.

Railway Labor Representation

A serious point at issue is the provision of the government railway bill that the railway managing boards shall be composed not only of directors elected by the proprietors, but shall include also the chief officers and workmen elected by the employees. Strong objection is made by the companies to having labor representatives on the boards, especially as the employees have no financial interest or responsibility in the companies, so that matters involving heavy expenditures and possible consequent reduction in dividends would not affect the employees to any extent. This participation in the management is advocated vigorously by labor interests, but the companies consider that it "is unjustifiable, wrong in principle and would be subversive of discipline."

Further, the companies urge that as the government accepts no financial responsibility for the railways, there is no ground for imposing upon them a plan which radically affects the charter of a company and its powers of management, and which interferes with the right of shareholders to choose their own directors. On the other hand, the companies recognize the possibility of advantage in giving the employees a part in dealing with operating problems. The Railway Companies Association therefore suggests the appointment of committees composed of officers nominated by the board of directors and employees elected by the employees from their own ranks, each committee having a director as chairman.

A National Problem for Engineers—

Taking Up The Slack in Industry

Possibilities in the Elimination of Wastes and the Intelligent Direction of Productive Power to Reduce Unemployment and Labor Friction

By Herbert Hoover,
President, American Engineering Council.

At the meeting held Feb. 14, in Syracuse, N. Y., of the American Engineering Council—the governing body of the Federated American Engineering Societies —Herbert Hoover, the council's president, outlined the possibilities of the survey of industrial wastes which the federation has organized. An abstract of his address follows:

THE federation of engineering societies has been brought about solely that we might secure for public service the collective thought and influence of 100,000 to 200,000 of our professional engineers. This great body of men in administrative and technical service penetrates every industrial avenue and thus possesses a unique understanding of many of our intricate economic problems and an influence in their solution not equalled by any other part of the community. Wanting nothing from the public, either individually or as a group, they are indeed in a position of disinterested service. This federation has initiated services to the public in many directions.

I propose to deal with only one measure of this service today. Your council has organized a preliminary survey of some of the weaknesses in our production system. This survey will attempt to visualize the nation as a single industrial organism and to examine its efficiency toward its only real objective—the maximum production. In a general way this inquiry will bear upon the whole question of deficiency in production—industrial waste in a broad sense.

Kinds of Waste

The waste in our production is measured by the unemployment, the lost time due to labor conflict, the losses in labor turnover, the failure to secure maximum production of the individual due either to misfit or lack of interest. Beyond this, again, is a wide area of waste in the poor co-ordination of great industries, the failures in transportation, coal and power supplies which re-echo daily to interrupt the steady operation of industry. There are other wastes due to lack of standardization, to speculation, to mismanagement, to inefficient national equipment and a hundred other causes. There is a certain proof of deficient production by comparisons of our intense results in 1918, when, with 20 per cent of our man-power withdrawn into the army, we yet produced 20 per cent more commodities than we are doing today. We are probably not producing more than 60 or 70 per cent of our capacity; that is, if we could synchronize all national effort to maximum production, we could produce 30 or 40 per cent more commodities and service. Our national machine is today doing worse than usual, as witness the 3,000,000 idle men walking our streets. One part of the human measure of this shortage in production is the lack of necessities or comforts to them and their families and their anxieties as to the future.

No one will ever suppose that it is possible to bring national productivity up to the full 100 per cent, but the whole basis of national progress, of an increased standard of living, of better human relations, indeed, of the advancement of civilization, depends upon the continuous improvement in productivity. While we currently assume that great advances in living standards are brought about by new and basic inventions, yet ever a greater field of increasing standards lies in the steady elimination of wastes. The primary duty of organized society is to enlarge the lives and increase the standards of living of all the people, not of any special class. We are, therefore, proposing to make a preliminary examination of the volume of waste in certain industries, the proportions that lie in each field of fault. And no engineering report is worth the paper it is written upon without constructive suggestions in remedy.

Productive Power Must Be Shifted

There is ofttimes a superficial dismissal of this subject of maximum production on the assumption that there are positive limits in production due to oversupply. Such assumption has no proper foundation in the broad view of industry as a whole. Too much economic thought on production has delimited its boundaries by the immediate volume of demand of a given commodity. There is no such thing as the nation overproducing, if it produces the right commodities. The commodities or services produced by the whole nation are capable of absorption by the whole nation, if they are of the right character. In other words, if we could attune the whole industrial world to the highest pitch, agriculture as well as manufacture, an increasing production would mean a directly increasing standard of living. When ten men or one hundred million men divide their united output, they can by doubling their output have twice the amount to divide. The problem in doubling output is to direct it to commodities or services that they can use. There is no limit to the increase of living standards except the limitations of human strain, scientific discovery, mechanical invention and natural resources.

It is true enough that any particular commodity or service can be overproduced, for each will reach a saturation point in demand when all the members of the community have been supplied. The absorption of increased productivity lies in the conversion of luxuries of today into necessities of tomorrow, and in spreading these through the whole population by stimulation of habit and education. Wheat bread, railways, good roads, electricity, telephones, telegraphs, automobiles and movies were once luxuries. They are still luxuries to some parts of the population.

It is but a corollary that certain commodities can better be produced for exchange for commodities from outside our boundaries more appropriate to our needs. Today we have capacity for production of some commodities not only in excess of our home need, but even beyond export demand under present financial conditions. As a matter of practical remedy, we must either reorganize these financial relations or abandon some part of this kind of production and turn our idle men to making things of which we are not yet fully supplied.

To put the matter in another way, there is no limit to consumption except the total capacity to produce, provided the surplus of productive power is constantly shifted to new articles from those that have reached the saturation point of demand. For instance, we have the productive capacity wasted today that would improve the housing conditions of our entire people to the level that perhaps only 50 per cent of them enjoy—and at the same time not encroach upon our established necessities. I am not suggesting that the forces of production can be shifted by imperial direction. The practical thing that can be done is to eliminate some of the wastes and misfits in our production and depend upon the normal processes of business and human desires to absorb them.

The largest area of waste lies in the large periods of slack production and unemployment due to the ebb and flow of economic tides between booms and slumps. The ideal would be steadily increasing production—an ideal of no likelihood of exact realization because of inability ever to gage the advance in growth of consumption or the approach

of saturation. On the other hand, there are certain possibilities of stabilization worth consideration. For instance, we can classify labor into that engaged in the production of and in the service from this equipment. Our studies of industries as a whole show that we usually expand our equipment just at the periods of maximum demand for their products, instead of doing our plant expansion during periods of slack consumption. We thus make double demands on labor and we doubly increase unemployment in periods of reduced consumption. That is, indeed, one of the factors in our great unemployment today.

Everyone knows that, for our normal productivity, our transportation facilities are today inadequate. We know that we are insufficiently housed, insufficiently equipped in our public roads and our public utilities; that we need an entire revision of our power supply, that we need expansion of our waterways, and yet armies of idle men are walking the streets. The reasons why this occurs are not far to seek, in that it is at times of high productivity that capital is most easily obtained. It is then that the necessity of increased equipment most impresses men's minds and it is the high hopes of these periods that lead them into the adventure of expansion. Nor is it possible to expect that all industry could be so stabilized as to do its capital construction in periods of depression in commodity demand. Nevertheless, there are some industries that could, by co-operation of the government and co-operation among themselves, be led in this direction. More particularly does this apply to railways, telephones, telegraphs, power supplies and other public utilities, and to the expenditure upon our state, municipal and national public works.

Another variety of intermittent employment, and thus great waste, lies in certain industries now operating upon an unnecessarily wide seasonal fluctuation, as for instance the bituminous coal industry. This is today one of our worst functioning industries. These mines operate seasonally and erratically. They proceed from gluts to famines, from profiteering to bankruptcy. As already determined by our engineering bodies, the men who mine our coal find work only 70 per cent of their time. In other words, there are 30 per cent more equipment and 30 per cent more men attached to this industry than are necessary if it were stabilized to continuous operation. The mining engineers have already pointed out the directions in which remedy lies—through storage, through railway rate differentials and other remedies. Through constructive action an army of men could be released from this industry of necessity to convert some luxury into a necessity of tomorrow. This is no plan to control prices or profits, although through it both the producer and consumer in coal could be placed upon a sounder basis than today. The interest of the consumer and producer is, however, even less important than relief from the intermittent employment and unemployment within this industry that today brings a train of indefinite human misery and some of our lowest standards of living.

Labor Friction

The second largest area of waste in productivity is the eternal amount of labor friction, strikes and lockouts. The varied social and economic forces involved in this problem need no repetition here. Fundamentally this is not alone a struggle for division of the results of production between capital and labor, but there is also a loss greater from strikes and lockouts in the element of purely human friction and loss outside the area of dispute on wages and hours. The growth of industry into large units has destroyed the old mutuality of interest between employee and employer. Our repetitive processes have tended to destroy the creative instinct and interest in employees; at times their efforts sink to low levels indeed. We will have to reorganize the whole employment relationship to find its solution. There is great promise in this field during the past two years, and the progress in this matter is one of the subjects of our inquiry.

Yet another variety of loss lies in the unnecessarily faulty distribution of our labor supply due to seasonal and to shifting demands. An adequate national employment service is the first need to reduction of these wastes.

Probably the next largest fraction of waste in productivity lies in a too high degree of individualism in certain basic products and tools. In other words, a standardization of certain national utensils makes for economy in distribution, in operation and in repairs. The necessity of maximum production during the war opened a great vista of possibilities in this section. Such standardization as car couplings, or wheels, and cars generally, represents real progress in this direction. These possibilities lie in a hundred directions. There are all sorts of cases from sizes of chains to the size of automobile wheels. Today dozens of different sizes are placed in the market by manufacturers and entail not only special equipment and skill to produce these many varieties, but also great stocks are required in distribution and losses are entailed due to lack of interchangeability. It is certain that there are a great many articles of every-day use in which the manufacturer would be glad to undertake some co-operation in standardization, from which the saving in national effort would be interpreted not into millions but into billions of dollars. This does not mean that we stamp the individuality out of manufacture or invention or decoration; it means basic sizes for common and every-day things.

Another type of waste lies in our failure to advance our industrial equipment. The Super-Power Board will demonstrate the saving of 25,000,000 to 50,000,000 tons of coal annually by the electrification of our Eastern power supply. The St. Lawrence Waterway Commission will demonstrate the saving of five to ten cents a bushel to the farmers of fifteen states by unlocking the lakes to ocean going vessels. Nor will this added efficiency to our national transport injure our present systems of canals and waterways, for we have ever found that the prosperity of an industry blesses them all.

Nor do we believe it is necessary to effect these things by the government. The spirit of co-operation that has been growing in our country during the last thirty years has already solved many things; it has standardized some things and is ripe for initiative toward co-operation of a widespread character. The leadership of our federal government in bringing together the forces is needed. No greater field of service exists than the stimulation of such co-operation. The first step is sane analysis of weakness and sober proposal of remedy. If the facts can be established to an intelligent people such as ours, action is certain, even if it be slow. Our engineers are in a unique position for this service, and it is your obligation to carry it forward.

Would Meter Water Used by Government

A joint resolution requiring the metering of all water used for federal and district purposes in the District of Columbia and the charging of its cost against the various public departments and institutions using it was introduced in Congress on Jan. 29. The bill provides:

That the Commissioners of the District of Columbia shall, within six months after the passage of this joint resolution, cause water meters to be installed in the buildings occupied by the executive and municipal departments and governmental institutions in the District of Columbia wherein such meters are not already installed, and to ascertain from the U. S. Bureau of Standards the cost of impounding and filtering the water used in such buildings, and upon such information shall base the rates of charges to be made therefor, taking into consideration the cost of the service, the consumption of water and the relative investment of the Government of the United States and the Government of the District of Columbia in the water-supply system of the District of Columbia. The cost for the use of such water service shall be paid to the water department of the District of Columbia by and out of appropriations for the respective executive and municipal departments and governmental institutions to which it is furnished, under existing regulations governing the rendition and payment of water bills or under such modification of such regulations as the Commissioners of the District of Columbia may deem necessary.

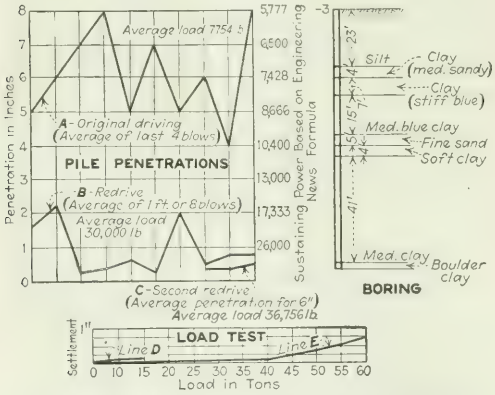
Pile Load Based on Penetration In Redriving

Loading of Foundation Piles in Clay Computed from Resistance to Hammer on Day After Initial Driving

By J. Frank Mullen
Boston Building Department

During the construction of the new home office building for the John Hancock Mutual Life Insurance Co. at Boston, Mass., being built by L. P. Soule & Son Co. as contractors, question arose between the engineer-in-charge and the Boston building department as to what loads the piles were capable of sustaining.

The site was excavated to El. —3, which was 1 ft. above pile cut-off. Borings indicated that a stratum of fairly stiff clay about 16 ft. thick with top about El. —25 extended throughout this site, overlying a medium blue clay, and that boulder clay or hardpan was found at —102. When the subcontractor for piling, Scully Foundation Co., drove foundation piles 30 to 35 ft. long into the clay a final penetration of 4 to 8 in.



PILE-DRIVING AND LOAD TEST DATA SHOWING GAIN IN BEARING POWER WITH TIME

per blow was noted. The city building law limits the bearing power of piles to the value given by the *Engineering News* formula, $\frac{2WH}{P+1}$. Applying this formula to the case would make it impossible to space enough piles under the proposed building. As it was suspected that the material consolidated around the piles after driving, the last pile driven each day was left one foot high and was driven to its proper grade on the following morning. These piles showed much smaller penetration after resting over night. They are referred to as "redrive tests."

Two static load tests were made, one on a single pile loaded to 15 tons at the rate of five tons per day, and another on three piles loaded at the rate of 15 tons a day until the total load was 60 tons. The ultimate load was allowed to remain 24 hours before the final reading was taken.

Herbert A. Wilson, city building commissioner, after a careful study of the records of the initial driving, the redrive tests and the load tests was convinced that the results warranted a much greater safe load than that given by the *Engineering News* formula. Nevertheless, holding that the law required the formula to be applied to the penetration obtained at the time of initial driving, the commissioner felt obliged to disallow the designed load on the piles. Frederick A. Waldron, engineer-in-charge for the company, appealed from this decision to the city Board of Appeals. He asked that, on the basis of the driving and load-test results, a maximum future load of 11 tons per pile be allowed in that portion of the building which is to be built to four stories now and ten stories 25 to 30 years hence, and a maximum load of 10 tons in the center building, which is to be erected at once.

The data of the driving and load test have been plotted in a diagram reproduced herewith. Link *A* represents the penetration obtained in the initial driving, for ten piles; the *Engineering News* formula gives an average working load of 7,754 lb. Line *B* shows the penetration of these ten piles when redriven 1 ft. twenty-four hours after the initial driving; the formula now gives an average load of 30,000 lb. per pile. Line *C* shows the penetration of three piles redriven a further 6 in. one month later; the average load by the formula has now increased to 36,756 lb.

All piles shown on the chart were spruce, 30 ft. long, 10 in. butt and 6 in. tip diameter, driven under a 10-ft. fall of a 2,600-lb. hammer. The plotted results are generally representative of the penetrations of over 10,000 piles that were driven.

At the hearing of the Board of Appeals, Charles R. Gow and J. R. Worcester, consulting engineers of Boston, spoke in favor of allowing the proposed pile loads of 10 and 11 tons. The decision of the board adopted the same view, allowing the proposed loads as warranted by the soil conditions.

Drying Periods of Various Woods

Douglas fir, yellow pine, incense cedar and spruce are the fastest drying species (by kiln) of wood, according to the table below, prepared by the Forest Products Laboratory. Any dry kiln in which the circulation is adequate and the temperature and humidity are properly controlled should produce in the time specified material of high quality, free from visible degrade, if not quite equal in strength properties to air seasoned stock. The table gives the approximate time required to kiln dry, under mild conditions, 1-in. plain sawed green and partially air-dry stock with 25 per cent moisture to a moisture contact of 6 per cent, based on weight of dry wood.

Species	Days Drying Time: Green from the Saw	Days Drying Time: Partially Air Dry
Hardwoods:		
Swamp Oak	45 to 50	20 to 25
Northern Oak	30 to 40	17 to 20
Walnut, Cherry	22 to 30	13 to 15
Mahogany, Beech	16 to 22	9 to 12
Tupelo, Gum	20 to 26	10 to 14
Birch, Ash, Sycamore	15 to 21	9 to 12
Poplar, Basswood, Chestnut, Butternut, Elm, Cherry	8 to 10	4 to 6
Maple, Hickory	17 to 23	9 to 13
Conifers:		
Western Larch	9 to 12	4 to 6
Cypress, Redwood	10 to 18	6 to 8
Douglas Fir, Yellow Pine, Incense Cedar, Spruce	4 to 6	3 to 4

For stock more than 1 in. thick and less than 3 in. the drying time is proportional to the thickness. Quarter-sawed stock requires from 25 to 35 per cent more time than plain-sawed. Drying to 10 or 14 per cent moisture takes from one-quarter to one-third less time than drying to 6 per cent.

Road Builders Discuss Highway Development

Abstracts of Papers Read at the Convention of the American Road Builders Association at Chicago.

THERE are published below, in abstract, some of the papers presented Feb. 9-12 at the annual convention in Chicago of the American Road Builders Association. A brief news report of the meeting appeared on p. 315 of last week's issue.

Traffic Development in Wayne County

By Edward N. Hines
Chairman, Board of Road Commissioners, Wayne County, Mich.

WITH 1,370 miles of highway in Wayne County, Mich., about 80 per cent of the traffic uses about 25 per cent of the mileage. Traffic counts made in 1912 and again in 1920 on six important radial roads show that the number of horse-drawn vehicles is from 3.6 to 20.8 times less in 1920 than in 1912, while automobile traffic, during the same period, has increased from 4 to 7 times and truck traffic has increased from 8 to 29 times. The total traffic is 2 to 4 times greater in 1920 than in 1912. On one road the daily average for a week was 10,500 vehicles, but on other roads the average was between 2,000 and 3,500.

The county system consists of trunk lines radiating from Detroit, three belt lines and secondary roads connecting local centers. The radial roads carry the heavy traffic noted. It is now planned to increase the number of radial routes by seven heavy-duty roads paved 36 ft. wide on a 100-ft. right of way. Concrete paving is contemplated. Besides structural maintenance, main roads are kept clear of snow in winter. About 45 miles of road are lighted and lighting is being extended as rapidly as possible. It is found that lighting encourages motor truck traffic at night and so reduces congestion during the day.

Highway Bonds for Investors

By H. C. Sylvester, Jr.
Vice-President, National City Co., New York

MONEY borrowed to finance highway construction should be repaid as soon as the principal and interest can be raised by taxation without unreasonably burdening or oppressing the taxpayer. Under present conditions it is impossible to forecast the time when reconstruction will be necessary, but before that time arrives the bonds issued to finance the original construction should have been retired. No highway bond should run longer than 30 years. If the locality cannot pay sufficient taxes to retire a highway debt within 30 years, there is grave question whether the highway should be undertaken.

Issue a security which will be attractive to the investor. If a highway can be financed by State bonds the money will be borrowed at a lower rate than if it is financed by county, townships or district bonds. County bonds, similarly, are a much better security and much more attractive to investors than are township or district bonds. Bonds should be paid from an ad valorem tax and no limit should be placed on the rate of tax which may be levied. While a security based upon a special assessment may be marketable, the price paid in the shape of interest and discount will be much greater than in the case of an obligation secured by an ad valorem tax.

Serial issues are preferable to flat time issues. The serial issue immediately absorbs the money raised by taxation to pay the principal; the creation of a sinking fund is rendered unnecessary. The accumulation of large sums in the city treasury in the name of a sinking fund, possibly bearing a small rate of interest, while full interest is payable on the city's debt, is avoided. The serial issue automatically conforms to the principles of economic financing, and even if compared to cases when the sinking fund is efficiently administered results in a saving to the municipality. The serial method of dispensing with a sinking fund avoids the danger of loss from improvident or negligible management of sinking fund money, or from dishonesty or incompetence. It removes the temptation so to employ large sums of money as to further personal rather than public aims, and if consistently carried out, it avoids incurring the expenses for the management of a sinking fund. But a further and much greater advantage rests in the fact that if a serial issue be made the danger of a refunding at maturity will be avoided.

Contractual Relations in Highway Construction

By W. A. Rogers
Bates & Rogers Construction Co., Chicago, Ill.

THE problem of contractual relations in highway construction has three phases—the duty of the engineer, the duty of the contractor and the duty of both contractor and engineer to the public.

Duties of Engineer.—The contractor is entitled to have described in the specifications just what is wanted and can be followed. Incorporating in specifications clauses which are practically impossible of fulfillment with the thought that better work will be secured by fixing almost impossible standards is less apt to secure this result than if the specifications provide for what is reasonably possible of fulfillment. It has been said that drastic specifications have sometimes been made for highway work with the laudable purpose of scaring away unsatisfactory and irresponsible contractors and putting into the hands of the engineer requirements which could be used to advantage in the case of irresponsible contractors, and on the other hand, could be eased up for those contractors who were doing satisfactory work. This is entirely wrong. It has just the opposite effect. When a specification is drawn which, in any respect, is not workable, it casts a cloud on the entire document and the responsible contractor feels as though he were being placed in a position where an irresponsible inspector or engineer might cause him serious trouble and expense.

Contracts and specifications should be definite and clear in the placing of responsibilities. The furnishing of materials by the State is both wrong in principle and not productive of the best results, either as to harmony between the parties or as to decreased cost. It injects

into the work a question of divided responsibility. It makes the State responsible for something which is part of the construction and on which the progress and economical operation of the work are vitally dependent. If the materials are not delivered in the order and at the rate which the work requires the cost increases and the engineer, who is not paying the bills, can hardly appreciate this effect as does the contractor.

If, however, the engineer does specify that the State shall furnish any of the materials, then the State should assume the full responsibility for delivery. If the State fails to deliver its materials as required by the work, thus adding to the cost of the work to the contractor, then in the interest of fairness and satisfacory relationship the state should assume the responsibility for such failure. Placing on the contractor a risk over which he has no control is just adding another gamble to a game which is hazardous enough without it. Contracts and specifications should be so drawn, in the interests of both parties, that they are as free as possible from risks of this kind.

Supervision of the work, another duty of the engineer, should be delegated in the field only to men of good judgment and experience. Inexperienced, incompetent field supervision causes delay to both State and contractor and increases expense. Bear in mind that the data on which a contractor of experience bases his bid price is the cost of previous work of similar character interpreted in the light of the conditions of the job on which he is figuring. In his previous costs are reflected the cost of not only every onerous clause in the specifications, but also the results of unfair and incompetent engineering supervision. It is, therefore, necessary and desirable that engineers in charge of highway work should be thoroughly competent.

Competent engineers are entitled to compensation proportionate to their skill and experience. It is a mistaken economy to save on highway engineers' salaries. Well paid experienced engineers make possible the best and most economical highway work.

Duties of Contractors.—Each job should be studied carefully and properly equipped with plant. Whether the delivery of materials shall be by truck or by industrial plant should be settled. The method adopted for unloading and storing materials is a very important item and the success or failure of the work is dependent to a large degree on the plant and equipment adopted. The contractor must provide an adequate and satisfactory supply of water. Then he must co-ordinate all of the different elements, consisting of materials, water supply and an efficient crew to build the finished highway on a subgrade, finished to an exact surface. He must then see that it is properly protected and properly cured. Above all, the contractors' organization should be made up of men who are willing to meet the engineers half way, who take pride in the quality of their work and who are anxious to give the State an honest job. Only in this way can the highway contractor be successful.

Duties to the Public.—We are building the most carefully constructed and most costly system of highways ever made and yet every year miles of these highways are damaged because the weight of some trucks which the automobile manufacturers are developing is heavier than the roads were designed to bear. The significant point is that such trucks represent a comparatively small percentage of all which use the highway. In the interest of the public which bears the cost of constructing these highways, some action looking to the limitation of the size of trucks must be taken. Who are better able or who more responsible for settling this problem than the highway engineers and highway contractors who know the science of constructing the roads in question and who are blamed when they fail to stand up under the traffic? In self-protection as well as out of regard for the public interest it is our joint responsibility to see that proper action is taken.

Highway Development in Alaska

By Major James A. Steese
Corps of Engineers, U. S. A., President Alaska Road Commission

SINCE road construction under the Alaska Road Commission was begun in 1905, there have been built 1,031 miles of wagon road, 636 miles of sled road and 3,223 miles of dog team trail at a total expenditure including maintenance of about $5,180,000. Construction and maintenance costs per mile have averaged about as follows:

Type	Construction	Maintenance
Wagon road	$2,500	$250
Sled road	300	25
Trail	100	10

Generally the policy of development has been to build trail which is converted into sled road and then into wagon road as traffic demands and finances permit. A ten-year program has been prepared which involves an expenditure, including $200,000 a year for maintenance, of $1,000,000 annually. This will provide an additional 834 miles of wagon road, 464 miles of sled road and 71 miles of trail, all combining with the existing roads to form a co-ordinated and consistent system.

Discussion

A. R. Hirst, State Highway Engineer of Wisconsin.—Four tasks in the improvement of relations between highway engineers and contractors overshadow all others. The first is to ensure competent state highway engineering organizations by divorcing highway departments from politics and by paying salaries which are large enough to secure and retain competent engineering direction of highway work. The second is to minimize risk in a hazardous business by confining operations to a mileage of highway which, with the money and equipment capital available under the conditions, can be completed in one season. The third is to keep and learn costs so completely and thoroughly that bids are made with a knowledge of all the items involved and their reasonable cost. The fourth is to study and develop means of reducing the cost of highway construction to the end that the building of roads is encouraged and the people loyally served by the business which is getting their money. If contractors will throw the force of their influence to secure appropriations and salaries which will enable state highway departments to build up and keep reasonably permanent engineering organizations of competent men most of the problems of contractual relations will solve themselves.

R. G. Collins, Keystone Construction Co.—Contractual relations will adjust themselves when contractors learn highway construction so thoroughly that they will not underestimate costs and name bidding prices which are too low. Dispute with the engineer or the specifications cannot remedy conditions arising from a bid so low that a contractor with reasonably good management cannot

make a profit. If he can make a reasonable profit there is seldom any dispute. Contractors, before they theorize about contractual relations, need to educate themselves in highway construction costs and then base their bids on this knowledge.

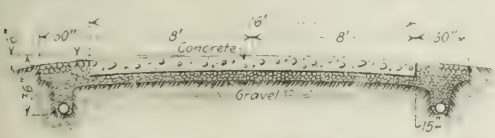
Problems in Road Drainage Which Require Study

By Frank H. Eno
Professor of Municipal Engineering, Ohio State University, Columbus, Ohio

UNDER present road construction practice there is seldom a paved road that does not provide perfect cross-drainage, at least from the center of the road to the edge of the paved way. Beyond that point perfection in drainage is difficult. A summary of experience and of outstanding problems in road drainage is as follows:

1. Unprotected earth shoulders are easily rutted during spring thaws and wet seasons. These ruts provide easy access for water to the subgrade. Building water-proofed hard shoulders along a pavement serves a double purpose, it protects the subgrade from water and it adds to the width of the road. It may prove to be cheaper than rebuilt pavements.

2. Dust-filled grass shoulders should be eliminated in order to prevent shoulder seepage into the subgrade.



DRAINAGE FOR PAVED ROAD IN IMPERVIOUS CLAY

3. Uncleaned ditches add largely to the expense of road maintenance, are unsightly, and in many cases are the direct causes of complete road destruction. The elimination of the ditch so far as is possible and the substitution of subdrainage, it is believed, will tend toward economy.

4. The practice of rolling clay subgrades should be carefully investigated to determine whether rolling increases capillarity, and if so whether serious harm is done.

5. The whole question of capillary action of water in subgrade soils needs investigation to determine what treatment is necessary with different soils in order best and most economically to prepare the subgrade for the road.

6. The slaking and saturation actions of soils, in fact the whole range of soil and water reactions, should be investigated in order to formulate specifications which the engineer may use for any soil situation encountered in the subgrade.

7. Advantage should be taken of natural soil drainage by building the road on top of the original soil, as far as possible. Minimize the cuts. Multiply the culverts. Conduct the water away from the road into natural channels as frequently as possible.

8. The question of how to prevent center longitudinal cracks in monolithic roads, and whether swelling soils have anything to do with these cracks, is propounded for investigation and observation. The presence of water in the soil is at the base of both of these actions.

9. The treatment of non-drainable soils to prevent them from being churned into plastic, unstable masses under the road is a final problem suggested to the road engineer for solution. The porous drainage course beneath the foundation is offered as one solution.

Tests of Water Action on Clay Soils

Different soils act differently in the presence of water. All of them, with the exception of sand, are made less stable when partially or totally saturated with water. The stability of some soils increases with the water content up to a certain degree of saturation and thereafter rapidly decreases as the degree of saturation continues to increase. Soils vary in their capacity for saturation. Tests now being carried on in the road laboratory of the Ohio State University Experiment Station show some remarkable differences in this respect. One yellow clay that absorbs water readily will hold 28 per cent of its weight of water, while another yellow clay, which absorbs slowly, holds 59 per cent. A grayish clay soil holds 57 per cent, while two black muck soils hold, respectively, 38 per cent and 70 per cent of water.

While making slaking tests it was noted that a variation in the water content of the clay cylinder at the time it was plunged into the water bath greatly affected the rate of slaking. Evidently the condition of the soil at the time of a long continued rainstorm, or of a substratum of clay at the time of the spring thaw, may variously affect the final results as to whether great harm or small harm is done to a paved road.

A few of the clay soils tested in the laboratory are so fine grained and dense that water will only pass through them by capillarity. The attraction between the clay and the water appears to be so close that the water will not be transmitted to a more porous medium. A bowl ½ in. thick shaped out of these clays will hold water for hours without showing additional moisture on its outer surface.

Based upon such evidence the question immediately arises, of what value is tile underdrainage laid in that kind of soil? Do not be deceived because this soil does not permit water to flow freely through it, do not think that it remains stable and that it retains a high bearing power. One of the worst failures on a road in Vinton County, Ohio, occurred where this kind of clay outcropped in the subgrade. The problem of how to treat road foundations through this kind of clay has yet to be solved.

The writer has suggested for trial in Ohio, where dense clay soils are encountered at subgrade elevation, that the road bed trench be deepened from 4 to 6 in. and that this depth of coarse, clean gravel or a uniform sized, clean, broken stone be spread beneath the regular foundation. This porous drainage course should be frequently connected with the side ditches or subdrains in order to free it from the collected water.

Oregon Drainage Association

At the sixth annual meeting of the Oregon State Drainage Association at Portland, Jan. 6, John W. Cunningham, consulting engineer, said that alkali which had laid on the ground an inch thick, as a result of several years irrigation without drainage, had disappeared within three years after the drainage system had been completed to such an extent that a good yield of alfalfa was raised. Mr. Cunningham asserted that special "laundering" of the soil, as sometimes advocated, is not necessary in eastern Oregon.

Percy A. Cupper, state engineer, pointed out that the Oregon drainage district law allows united action in drainage projects, permitting larger and more expensive schemes to be carried on than were possible previous to its passage. He said further that 150,000 acres are now organized under this act, and that bonds amounting to $530,000 have been certified by the state board.

That tile drains should have a capacity of about ⅜ in. in 24 hr. instead of either ¼ in. or ½ in., was the opinion of Ward Cretcher. While a ¼-in. capacity is often too small, he said that it is often needless to go to more than double the expense to provide for twice the run-off.

Tule lands in the Klamath Lake region, which are practically worthless, have been made to yield 45 bushels of rye per acre by drainage, said E. A. Geary, 26 bushels being the average yield. Mr. Geary added that in his part of the state a great need was felt for a cheap power ditching machine for small ditches.

Samuel R. Brown, of Gervais, was elected president and Prof. W. L. Powers, of Corvallis, secretary.

New Facts and Studies on Concrete

Extracts and Abstracts of Papers and Reports Presented at the Annual Meeting of the American Concrete Institute, Feb. 14-16, 1921.

Designing Concreting Plant

THE special committee on contractors' plant during the past year has made an exhaustive study of the different types of plants used to handle concrete on building construction. In the future other kinds of construction will be studied, but the present specifications include only reinforced concrete buildings. In the report there is first a specimen layout of seven typical plants with tabular and diagrammatic comparisons between the different types. A method is advocated whereby the proper kind of plant may be determined by a diagrammatic analysis which considers cost of plant and installation and cost of operation of the separate parts of each plant with a final reduction which gives the comparative costs of producing a yard of concrete with each of the types of plant. The report further has descriptions of some separate concrete plants analyzed in their elements.

Studies on Cracking of Stucco

Continuing his long series of tests into the nature of stucco, J. C. Pearson, of the United States Bureau of Standards, reported on a new set of tests in a paper entitled, "Shrinkage of Portland Cement Mortar and Its Importance in Stucco Construction." By means of a very accurate microscopic instrument, called the "comparator," by which could be measured the minute variations in an established base line on a small piece of concrete from the beginning of its setting until final set, the expansion and contraction of a concrete mortar during the setting period was measured for a number of different mixtures. It was found with water-tight forms that while occasionally there was an initial expansion, there was as a rule a continuous contraction from the begining almost as soon as the concrete was placed and continuing in a minor degree for some months. Such a contraction would in a stucco wall, of course, result in map crazing. The investigators, therefore, decided that the tightness of the forms had something to do with this pronounced contraction and made a number of tests with plaster of paris forms which permit a certain amount of absorption of the water in the concrete. When these bases are dry their absorption is high, but this can be controlled by wetting with measured quantities of water prior to filling the forms. It was established that this absorption or "suction," as the plasterer would call it, had a very great effect upon the time of set or stiffening of the mortar. If mortar was placed in a form with a dry base set occurred almost before the plugs could be placed in position and initial readings taken. Slight wetting of the plaster bases deferred this set until earlier readings were taken, say from 15 to 20 min., and heavier wetting deferred the set still longer. Correspondingly, the amount of contraction was reduced so that a measure, not yet complete or accurate on account of the limitations of the tests, was reached which tended to establish the proper amount of moisture at the base of the form for proper stuccoing.

Status of Government Concrete Ships

THE committee on concrete ships and barges gives a paragraph to each of the twelve concrete ships built by the government during the war. These data may be abstracted as shown in the accompanying table. In addition the committee notes that the canal barges have been none too successful—on account of weight and ease of puncture—that there are no difficulties in design or construction in concrete ships, but that costs are high and operation complicated.

STATUS OF GOVERNMENT CONCRETE SHIPS, JANUARY, 1921

Ship	Type	D. W. Tonnage	Built at	Launched	Delivered	Remarks
Polias..	Cargo	3,500	Flushing, L. I.	May, '19	Oct., '19	Abandoned on rocks, Penobscot Bay, Feb., 1920.
Atlantus....	Cargo	5,000	Brunswick, Ga.	Dec. '18	Oct., '19	Operated by Shipping Board (tied up)
Cape Fear.	Cargo	3,500	Wilmington, N. C.	July, '19	Nov., '19	Sunk in Narranganset Bay, Oct., 1920
Sapona.....	Cargo	3,500	Wilmington, N. C.	Oct., '19	Jan., '20	Operated by Shipping Board (tied up).
Dinsmore	Tanker	7,500	Jacksonville, Fla.	June, '20		.....
Moffit ..	Tanker	7,500	Jacksonville, Fla.	July, '20		.....
Latham..	Tanker	7,500	Mobile, Ala.	July, '19	May, '19	Salvaged from Tampico Breakwater, 1920 (for sale).
Selma...	Tanker	7,500	Mobile, Ala.	July, '19	May, '20	Salvaged from Tampico Breakwater, 1920 (for sale).
Peralta.....	Tanker	7,500	Oakland, Calif	Oct., '20		.....
Palo Alto.....	Tanker	7,500	Oakland, Calif.	May, '19	Sept., '20	Operated by Amer. Fuel Oil & Trans. Co.
Cuyamaca.....	Tanker	7,500	San Diego, Calif	June, '20	Sept. '20	Operated by France & Canada Oil Transp. Co.
San Pasqual	Tanker	7,500	San Diego, Calif	June, '20	Sept. '20	Operated by France & Canada Oil Transp. Co.

A New Hooped Column Formula

STUDY of the more extensive tests of hooped concrete columns and of tests showing shrinkage and time-yield of concrete structures has led F. R. MacMillan to propose a new formula for spirally reinforced columns with vertical steel. It was presented in a paper entitled "A Study of Column Test Data." The column tests show that different tests disagree as to ultimate strength capacities of columns but agree rather closely as to yield point and that the column load at the yield point is a function of the ultimate strength of the concrete and the yield point strength of the longitudinal steel, regardless of the hooping steel. The conclusion is that column formulas should not be based on ultimate strengths as determined in available tests. Looking further into the plasticity of concrete as revealed by continuous flow under a constant load, Mr. MacMillan devises a formula which considers the value of n much higher than the customary 8 to 15 and takes into account the total unit shrinkage in the concrete were it unrestrained. This shrinkage puts additional strain in the longitudinal steel which causes higher stresses than are usually assumed to be present. He proposes to take advantage of these high stresses, which do not

result in failure in the actual columns, thereby saving in steel and in concrete. The formula resulting is

$$P/A = 333\ (1 + 29p) + 15{,}000p$$

where P = total load;
A = total core area;
p = longitudinal steel ratio.

It will be noted that the spiral steel does not enter into this, but the recommendation is that the longitudinal steel be limited between 1 and 8 per cent and spirals be required not less in amount than ¼ of the longitudinal steel and in no case less than ½ per cent.

Test of a Concrete Mixer

PROF. W. K. HATT, of Purdue University, reported the results of a well-considered test on a standard concrete mixer which was designed to study the action of the mixer and the effect of different standards of operation on its output. The paper reports power consumption in relation to discharge and details of operation of interest to concrete users. It was found that strength and consistency increase rapidly as time of mixing is increased from 30 sec. to 1 min. but after that any gain is hardly worth the increased cost, that the manufacturer's stated speed gave best results (in other words, that time factor rather than number of turns of the mixer is the determining factor), and that an early introduction of water to the drum brought correspondingly early strength. The paper further gives some suggestions for future conduct of such tests, which, the author states, are much needed as a step toward better concrete.

Test of Concrete Oil Tanks

PERMEABILITY tests on small concrete tanks containing mineral and vegetable oil have been under way at the Bureau of Standards for over two years and were noted in the "Proceedings" of the Institute for 1919. Since then some additional information has been gained which is summarized in a paper by George A. Smith, of the Bureau, as follows:

Mineral oils covering practically the entire range of fuel oil, have been stored in concrete tanks for nearly three years and have shown no injurious effects upon the concrete.

Cocoanut oil, lard oil, neatsfoot oil and boiled and raw linseed oil have been found to be more or less injurious to concrete.

On the basis of this last series of tests, 1:1½:3 concrete, mixed to a consistency suitable for reinforced-concrete construction and properly placed should be satisfactory for containers of fuel oils whose viscosities are above 0.06 in absolute units, or about 50 Saybolt seconds, at 20 deg. C.

While many of the tests have shown penetration for the lighter oils which are not in excess of permissible losses, the use of concrete tanks for kerosene and gasolene storage would hardly seem warranted under ordinary conditions.

A limited number of tests indicates that the use of hydrated lime or the application of sodium silicate solution is not effective in reducing the permeability of concrete to the lighter oils.

Dam Named in Honor of Jerry O'Shaughnessy

By unanimous action of the City Council of Columbus, Ohio, the new storage dam for the water-works of that city will be named in honor of Jerry O'Shaughnessy, who died recently after some fifty years in the service of the city.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Antioch Plan and First Engineering Course

Sir—In *Engineering News-Record*, Feb. 3, 1921, p. 233, there appears a communication entitled "The Antioch Plan." A statement is made in this communication to the effect that the department of engineering established at Union College in 1845 "was the first engineering course in connection with an American college."

In view of the facts I would be remiss in my duty were I to permit this statement to stand unchallenged.

Norwich University [located at Northfield, Vt.], chartered by the State of Vermont in 1834, was, by the terms of its charter, bound to furnish a course in civil engineering. In the language of the charter the board of trustees was required "to furnish at said institution constantly a course of military instruction, both theoretical and practical, and also of civil engineering, and the practical sciences generally."

The University was opened for the reception of students in May, 1835. Its first academic year (1835-1836) it maintained (pursuant to the provisions of its charter) a Department of Civil Engineering, "embracing those branches of literature and science which are particularly requisite for the practical and scientific engineer." This course was pursued by eighteen members of the Corps of Cadets during that academic year.

The establishing of this department of engineering at Norwich University antedates the establishing of the department of engineering at Union by ten years.

Norwich University was the first scientific and classical as well as the first military collegiate institution in the United States.

The engineering course established at Norwich University in its first academic year has been maintained throughout the years that have followed. Norwich men are justly proud of the record which its sons have made, and properly jealous of its reputation as the pioneer among collegiate institutions in the engineering field.

CHARLES A. PLUMLEY, President,
Northfield, Vt., Feb. 9. Norwich University.

The Antioch Plan; What to Teach

Sir—Mr. Morgan, in the "Antioch Plan" (*Engineering News-Record*, Jan. 20, p. 108), has, I believe, hit on one of the worst sore spots of our present system of engineering education, that is, our tendency to train men for subordinate positions only. The average engineering student never has a thought of anything but a good technical job, and neither has the average engineer, for that matter. Under the Antioch Plan the whole mental attitude of the student will change, and from the very first day his goal will be, not the top of an engineering department, but the top of a technical business or a large engineering development.

Of course such a training requires the study of subjects not found in our present curricula, and the man who suggests such lines of study usually runs up against a wall labeled, "Our courses are already too crowded!" After about six years as a college student, and another six years as a teacher, I have become enough of a heretic to answer that they are largely crowded with rubbish, so far as the main object is concerned, and considering the limited time available.

But what is the main object of an engineering course? The general opinion is that it is to shoot the student full of facts and knowledge of methods, and that the more

information we cram into him in college the less he will have to acquire after he graduates. Also we fondly dream that every little bunch of information packed in is put there to stay, and hence pure gain, while every one left out is dead loss. Let's be honest with ourselves for once; how many of us really believe that, even on the day he gets his diploma, our graduate remembers as much as one-fourth of what we have taught him, or that one-fourth of *that* information is always on top for instant use at any time? Although we try to "kid" ourselves to the contrary, we really know that our student will forget at least three-fourths of what he has studied, and will have a pretty hazy idea of the rest. And if so much of this information is so readily lost, then why the frantic efforts to cram it in as if we were really able to fortify our man against all possible contingencies?

If we can not turn out graduates chuck full of information, then what *can* we turn out? To my mind the main object of an engineering education is to give a man such a broad outlook that he will know with what subjects he will have to deal as a successful engineer and manager, to acquaint him with the best sources of information on these subjects, and to teach him enough of the elements of each subject so that he can use the sources of information after he has them. We cannot do any more than that anyway, so why not turn our efforts to doing that well?

It seems to me that our problem resolves itself into two questions: What does the student now get that he doesn't need, and what does he need that he doesn't get? We must solve the first before we will have room for the second, but suggestions as to the solution are dangerous, for every suggestion brings a yell out of some one who sees his pet slighted. As a starter let some of our most prominent engineers blow the dust off their books on college algebra, descriptive geometry, analytical geometry, and calculus, take them chapter by chapter and list all the subjects over which they sweat blood for endless hours in college. Then let them cross out all subjects for which they have never had any use, to say nothing of those which they could not use when they *did* need them. How much will be left, and why should the rest absorb valuable time in college any more than Greek or Sanscrit? By the time we similarly shake down chemistry, physics, and even mechanics and the higher courses in technical design, we will have a lot of room to inject a few things that *are* needed by every engineer who makes a real success.

The trouble with the actual elimination of dead wood from a college course is that a present-day college resembles an automobile factory, for instance, in which one department makes tires, another wheels, another bodies, etc., each according to its own sweet will, and in which each department head is a specialist in his own work only, with no clear idea of what is needed for a complete car, but jealous of any dictation from those who do know. The idea of making anything on earth under that system, except college graduates, would be admittedly absurd, and why the single exception?

Now what does the student need that he does not get? The greatest need perhaps is for elementary business training. It probably is not an exaggeration to say that the majority of young engineers are like little children so far as real business affairs are concerned, and most new graduates, although they may think they know how to design a suspension bridge, cannot even balance a simple expense account. They do not know the cost of the most common engineering materials or how to estimate the cost of the simplest structures. Let's transfer about eighty per cent of our mathematics from such things as hyperboloids (whatever they are) to dollars and cents. A study of efficiency methods and the management of labor will be worth more than a study of water, steel, or gas analysis to a civil engineer, and as a rule will interest him a whole lot more. I tried to introduce such things in a small way with my students, and the response was certainly gratifying. The students voluntarily got up plans for increasing the efficiency of small construction jobs around the campus, etc., and an "engineering assembly" at which a number of seniors tried to sell various types of paving to a mock Commissioners Court, was packed to the doors.

Anyone who would have the temerity to suggest a course in etiquette as a part of an engineering education would become the target of endless ridicule, but are there not many engineers who have been hanicapped in their professional careers by a lack of ease in social affairs? Instruction along this line is, I believe, a part of the training given at West Point, and any English course might at least include a few lessons on formal social correspondence.

No commencement address is considered complete without an allusion to the fact that the world looks to the college graduates to be leaders in their communities, and some engineering graduates become leaders largely because they are college graduates, but I do not think that is often because of the training in the details of technical design which was given them by their professors. It is more apt to be the so-called "outside" college activities which develop leadership. So far as anything that his studies have taught him is concerned, the engineering graduate knows about as much as a new-born babe regarding his obligations as a citizen. I have found few seniors who knew much even about their city and county government, or who cared anything at all about it. That men should be turned out as college graduates who are practically ignorant and utterly indifferent concerning matters of government is almost a crime, and no man should be handed a diploma until he has been taught enough civics to vote intelligently.

Take a hypothetical case of two young graduates: One has spent from three to five hours a week for two years studying mathematics and the rest of his time on other purely scientific and technical subjects. The other man knows only enough mathematics and mechanics, say, to design a reinforced-concrete beam quickly and correctly, and knows about half as much as the first man does about other engineering subjects. Instead of that, he knows the elements of corporation finance, something about management of production, about marketing, and about accounting. He can read a financial paper intelligently and knows some of the reasons for success or failure of commercial projects. Also he knows how the government is operated and his own part in the operation, and he knows how to express his ideas clearly in speech and writing. Although his technical knowledge is less than that of the first man, he knows just where to look for needed information. Which one is more likely to be a success at the end of ten or fifteen years? Very likely the first man will be working for the second.

Birmingham, Ala., Feb. 7. R. L. MORRISON,
Engineer of Tests,
Pittsburgh Testing Laboratory.

For Construction Only at Reasonable Costs

Sir—As there is likely to be more or less active propaganda carried on to induce a large program of concrete road construction the coming season, particularly in connection with the prevailing unemployment problem, the attention of the engineering profession and of citizens generally should be brought to bear on the fundamental principles which should govern public improvements of this kind. Active steps should be taken to see that large expeditures are prevented unless conditions are in harmony with such principles.

Inasmuch as road construction of a permanent nature is almost entirely financed by bond issues, the cost of such work is thereby spread over future years and will have a direct influence on the future cost of living, in proportion not only to the present cost of the work built but to the rate of interest paid on such bond issues. Permanent improvements of this kind should only be built during periods of low cost, both for construction and interest on the bonds.

Consider, for example, the effect of the price of cement, as this is one of the principal items entering into road construction: During 1920 we have seen the price of cement f.o.b. mills go to approximately tripple its price in normal time. In Milwaukee during the past season we have had to pay quite generally $4.20 per barrel plus sacks, as compared with contract prices for season delivery in 1909, 1910, etc.

of $1.05 per barrel plus sacks. It may be safely assumed that 1920 road construction averaged at least double the normal cost.

Costs of coal and labor are important factors in the price of cement. Coal has recently collapsed in price and labor is rapidly coming down in cost and going up in efficiency. Therefore, cement costs should be materially reduced. It has, however, been commonly talked by cement agents and dealers that cement prices would not be reduced much for 1921, owing to the enormous demand for it on road construction.

As the country progresses with the process of deflation it is necessary for all lines of business to participate. If cement prices are encouraged to remain unreasonably high, not only will the country be burdened with an unreasonable cost for permanent road construction and other public work, but the retarding effect on much other necessary construction, such as housing, water powers, business buildings, etc., will be disastrous. We should therefore not be rushed into high-priced permanent public improvements under the false policy of merely relieving unemployment.

The country generally is facing an enormous burden of taxation. At this time we should go back to first principles in considering public expenditures, and authorize only such improvements as can be built in harmony therewith. To state the case of road construction briefly: Let us build permanent roads only where urgently needed, and then only at reasonable costs. RALPH E. NEWTON,

Newton Co., Industrial Engineers and General Contractors.

Milwaukee, Wis., Jan. 11.

Electrification Cost Data

Sir—In your issue of Dec. 2, 1920, p. 1067, appears editorial comment on an article in the same issue in which there is a description of the electrification of the C. M. & St. P. Ry. in Montana, Idaho and Washington. You claim that there is undue reticence in withholding the figures of the cost of operation, and that no actual figures have been made public.

I wish to call your attention to information on the subject as presented by the committee on electricity, American Railway Engineering Association, in the report of March 20, 1920, and printed in the *Proceedings* of the association in Volume 21, pages 197 and 251.

The report gives, for the road in question, the capital cost of the electrification of 440 miles of main line, with some comparative operating costs and other data. There are also given some specially prepared tables of electrical operating costs and expenses. From these figures as given I should think that an estimate of the total operating costs of the line could be made, by simply adding such of the other items of costs of operating as would be required.

Please allow me to quote two of the conclusions of the committee's report:

> Second: That such a system of electric operation will increase the capacity of a railroad from 25 to 35 per cent
>
> Third: That such a system of electrification will probably prove economical as compared with steam operation, when the cost of reliable electric power and coal bear the relations one to the other that they do in the preceding table, as shown above the diagonal line, provided the railroad traffic is favorable to electric operation.

With reference to your complaint that the actual operating costs are withheld, it would be fair also to quote further from the A. R. E. A. committee report (page 268) as follows:

> As a result of these conditions any comparison of present electrical costs with steam prior to Jan. 1, 1917, is subject to very considerable corrections to bring the steam expense to the same basis of costs as the electric. The corrections are so numerous and subject to so many interpretations that the real facts cannot be made sure of at the present time. It is possible, however, to obtain from the annual operating statements certain operating costs which in many cases may serve as a guide in forecasting what economies may be obtained by the substitution of electric operation for steam.

Reviewing the subject of your editorial, however, with an open mind, it may be admitted that there are still lacking many figures on the cost of operation on the electrified portion of the C. M. & St. P. Ry. which it would be necessary to know in order to become convinced that the electrification of this line has been justified. For example: a reduction of 22½ per cent in the number of trains might mean a reduction of only about 5 per cent of the total cost of conducting transportation. The charges for engine and round-house men (I. C. C. acct. No. 21) and fuel, water service and locomotive supplies (I. C. C. accts. Nos. 22 to 25) are perhaps the only other principal items that would show a reduction due to electrification. Large as these five items are, in dollars, their sum is only about 22 per cent of the total cost of steam operation of the railroads of the United States.

Under the item of "maintenance of way and structures" there may be some reduction due to electrification, due to lessened rail and bridge renewals, all of which are yet to be determined. The main account would probably show some increase due to large cost of power distribution systems and power apparatus.

The capital cost of the line under discussion has been increased by $10,250,000. The gross revenue could not have been increased by the electrification, and with a line which would still have been operated below its capacity as a single track steam line, the fact that the electrification shows an increase in single track capacity may not be a significant accomplishment. F. T. HOWES,

Garrison, Mont., Jan. 9. Inspector, Engineering Department, Northern Pacific Ry Co.

Belle Isle Bridge Design Again

Sir—Your issue of Jan. 27 contains two articles which considered together are of very great interest. The first, on page 187, is entitled, "Pier Failure Wrecks Two Spans of Concrete Arch Bridge"; the second, on page 190, is entitled, "New Design for Belle Isle Bridge to Be Prepared." The first article describes the collapse of portions of two spans of the concrete arch bridge at Dayton, O., due to failure of the pier between them. The second article describes the great advantages which will result from the adoption of a reinforced-concrete arch design for the proposed Belle Isle bridge in Detroit.

The most interesting feature about the collapse of the Dayton bridge is the reason why all the spans did not fall in succession, on account of the thrust of the arches. The design, described in *The Engineering Record* of Mar. 24, 1906, does not make any provision against that kind of failure, since the piers are strong enough to take only the difference in thrusts due to different lengths of adjacent spans. The question is, is it safe to build a multiple-span arch bridge of any kind over a deep river or one where there is a large flow of ice, or where there is extensive navigation, unless the piers are founded on bed rock? This is the most important question to be answered in regard to the proposition for the concrete arch for the Belle Isle bridge at Detroit.

Next to this in importance is of course the relative cost and time required for completion as compared with another type of structure. In this respect the second article referred to, although not absolutely positive in its statements, appears to be in error on some important points. The original design is not a steel cantilever bridge faced with concrete, but in each span a number of concrete ribs reinforced with structural steel ribs. In this respect it would be a concrete arch, but steel cantilever arms were introduced. The use of these greatly facilitates erection, since the steelwork can be entirely erected and the concrete poured without the necessity of falsework from the bed of the river. Also a successive failure of all the spans if one span or one pier failed would not be possible.

It has been stated in newspapers that the total cost of the bridge as designed, including approaches, piers, roadways, etc., complete, would be about $5,000,000. In order to reduce this to $3,000,000, as stated in the second article above referred to, the cantilever arms would have to be omitted, thus saving $2,000,000. Figures of the structural

steel tonnage in the bridge are not at hand, but it is safe to say that all of the steel in the bridge would cost only a fraction of that sum.

The article is also in error in regard to the time of completion. With either type of bridge, the process would undoubtedly be to build all of the piers first. This is because there are pile foundations which must be completed in one operation. The next logical operation would be to construct cofferdams and build all the piers. While this is being done, all of the structural steel involved in the original design could easily be frabricated and delivered. With a much greater facility of erection of the original design, the time of completion, after the piers were built, would undoubtedly be greatly less than for the arch type.

The article is also in error in regard to the immediate and ultimate employment of about 50 per cent more local labor on the arch type. There would not be any more immediate employment, because the operation would be just the same until the erection of the spans was started. The spans themselves would probably involve more concrete in the arch type, but less forming on account of the ribs of the original design. It is safe to say that the labor would be just about equal on the erection of the spans.

The writer has no personal interest in the design of either the Dayton bridge or the Belle Isle bridge other than a general interest in any kind of bridge design, but is very much interested when he sees articles published in *Engineering News-Record* that are of greatly conflicting nature, and not in accordance with the facts.

J. T. N. HOYT,
Chief Structural Engineer for Albert Kahn, Architect.
Detroit, Feb. 4.

[Regarding Mr. Hoyt's comments on the news report of the Detroit council's decision to procure a new design for the Belle Isle bridge, it seems to be necessary to point out what should be obvious, that the report included no editorial opinion or coloring but gave only the news as to the action taken. In large part it quoted the ordinance adopted by the council. Through oversight, proper quotation marks were omitted. The term "steel cantilever bridge faced with concrete" is also quoted directly from the ordinance. However, whether this term is incorrect, or whether the commission design may fairly be called a reinforced-concrete cantilever, is perhaps more debatable than Mr. Hoyt's unqualified statement on the point implies.

As to the Dayton bridge accident, the importance of the case is patent. Yet if Mr. Hoyt's second paragraph is meant to suggest that it is not safe to build a multiple-arch bridge over the Miami River in the Dayton subsoil, it surely must be questioned. Its application to the Detroit River is of course quite another matter.—Editor.]

Design of Heavy Traffic Pavements

Sir—The very timely paper on "Considerations in Design of Heavy Traffic Pavements," by Prevost Hubbard, appearing in your issue of Dec. 30, p. 1264, was read with much interest. My attitude regarding the subject is in substantial accord with the conclusions drawn by Mr. Hubbard from his interesting series of experiments. My following suggestions are not controversial in nature, but are an amplification along lines suggested by Mr. Hubbard.

The text for my remarks is supplied by the last half of the opening paragraph which reads as follows: "With very few exceptions any well compacted soil will of itself support the heaviest conceivable traffic if its moisture content is properly controlled and if it is protected by a structure which prevents the displacement of particles at its surface . . . ."

Such a supporting surface is, par excellence, a well consolidated macadam pavement. While unsuitable for the direct effect of motor traffic, its composition is such that it has the necessary rigidity to support and also the necessary flexibility to adjust itself to inevitable minor settlements of subsoil, without impairing its supporting value.

A well-constructed foundation of this sort has all the flexible qualities of an asphaltic concrete base course as advocated by Mr. Hubbard as an alternative for the prevailing concrete foundation. While admittedly macadam would not develop any slab or beam strength as investigated by Mr. Hubbard, I believe that a modified impact test on a sample of macadam, topped with an asphaltic surface mixture could be devised and furnished data that would admit of an intelligent interpretation.

Such tests should confirm the opinion held by many engineers that macadam under many conditions, particularly where ideal drainage conditions are unobtainable, offers a more adequate and suitable support than concrete under like conditions.

I believe that the increase in depth of concrete foundation or concrete surface pavements, beyond that which is found necessary in the heaviest traffic city streets, is both unscientific and unnecessarily costly, particularly if it is made the excuse for insufficient drainage provisions.

E. J. WULFF,
Senior Highway Engineer,
U. S. Bureau of Public Roads.
Washington, D. C., Jan. 24.

Credit Where Due

Sir—I note in your issue of Feb. 10, 1921, you have given a brief but very good description of one of the interesting improvement projects that the National Park Service has under way—the construction of a suspension mule bridge across the Colorado River in the Grand Canyon of the Colorado in Grand Canyon National Park, Ariz. At the close of this article you state that the bridge was designed by George "C." Goodwin of the National Park Service, and that the construction would be supervised by D. L. Reaburn, Superintendent of the Grand Canyon National Park. This statement is true; but in fairness to others whose efforts have contributed toward the solution of this rather unique problem I feel that their names should also have been mentioned in your article. I desire to say that although the bridge was designed under my direction and in accordance with my ideas, much credit is due Capt. V. A. Endersly, assistant engineer, National Park Service, who made most of the computations of the stresses and did much of the detail work of drawing and design. Credit is also due W. H. Peters, assistant engineer, National Park Service, then acting superintendent, Grand Canyon National Park, who assisted in securing the field data and helped Mr. Endersly in the office.

GEORGE E. GOODWIN,
Civil Engineer, National Park Service.
Washington, D. C., Feb. 15, 1921.

Wind Pressure on Inclined Surfaces

Sir—in *Engineering News-Record* of Jan. 20, p. 125, R. Fleming states that Spofford's "Theory of Structures" teaches "the law of the square of the angle of incidence" for the resistance of air upon planes inclined to the direction of the wind. A reference to the book in question will show that this statement is incorrect. Prof. Spofford gives the Duchemin and Hutton formulas as well as the theoretical one above referred to. He distinctly states it is probably wise to use one or the other of the two empirical formulas, and gives a table comparing the results of the three, pointing out the low values given by the theoretical as compared with the experimental. While the language used could easily be more emphatic in its favor of the empirical formulas (this part of the text was written in 1910), it certainly does not advocate the law of the square of the sine of the angle of incidence.

HALE SUTHERLAND,
Asst. Professor of Structural Engineering,
Massachusetts Institute of Technology.
Cambridge, Mass., Jan. 25.

Sir—The reading of the sentence Prof. Sutherland criticises is, "Some textbooks, Spofford's 'Theory of Structures' among others, still follow the teaching thus condemned." If the thought in mind when the article was written were restated it would read:

> Some textbooks still follow the teaching thus condemned. Prof. Spofford in his "Theory of Structures," second edition, 1915, devotes a page to a formula making the normal pressure on an inclined plane surface,

from wind blowing horizontally, dependent upon the square of the sine of its angle of inclination. Prof. Spofford makes the formula derived the basis of his deductions for wind pressure upon curved surfaces. He states that "it probably gives too low results" for flat surfaces but is "probably more nearly correct" for curved surfaces.

The results for flat surfaces are not probably too low, they are at times absolutely wrong. If the formula were true aviation would be impossible. For a slope of 25 degrees the normal wind pressure would be one-fourth of that obtained by the well-established Duchemin formula; for a slope of 10 degrees it would be one-tenth as much. For a slope of 5 degrees and a horizontal wind pressure of 20 lb. per sq.ft.—a 70-mile gale!—the normal pressure on the inclined surface would be but 0.15 lb. per sq.ft. The formula has no place in a textbook unless it be emphatically condemned.

Furthermore, the "more nearly correct" results that Prof. Spofford obtained by the use of this formula for pressure on a cylinder are due to a compensating error, the use of the common but erroneous assumption that the effect of wind pressure on a cylinder is the summed effect of the pressures on an infinite series of tangential planes. If this assumption were true the Duchemin formula integrated between the same limits used by Prof. Spofford would give a pressure of 0.91, that on a plane diametrical section, or but little less than that on a vetrical plane; the best experimental data give a value of about ⅔. That Prof. Spofford's value (two-thirds) agrees closely with this figure is due, as said, to a compensation of errors.

A practicing engineer with but limited experience could easily conclude from the prominence given to the discredited formula in "The Theory of Structures" that he would not be far astray in following it. However, the present writer stands corrected in that he did not state clearly just what Prof. Spofford's lapse was. R. FLEMING.

New York City, Jan. 31.

Cost of State Road Surveys in Missouri

Sir—An article relative to surveys and plans for a state system of highways by the Missouri State Highway Department in *Engineering News-Record* of Jan. 13, 1921, p. 68, rather emphasized the statement that this work was being done for $100 per mile or less. I have made about 100 miles of these surveys and plans and cannot feel that the above statement reflects credit either on the State Highway Department or the State of Missouri. In addition I have conferred with a number of practicing engineers who have done work of this character by contract, and have been advised invariably that they have either failed to make a profit or have even suffered a loss.

My experience with the State Highway Department leads me to believe that their organization is neither more efficient nor better equipped than that of the practicing engineers doing highway work and I wonder if the following items of expense to the department are included in the actual cost: (1) Subsistence of field parties; (2) expense of field parties for field office; (3) cost of operation, maintenance and depreciation of motor cars; (4) a proportion of the division engineer's time and office expense; (5) a proportion of the general highway department office and overhead expense; (6) cost of completing the plans after they have been sent into the office of the department.

I should like to ask whether it is more economical for a state and a state highway department to endeavor to do at the lowest possible figure the preliminary work in connection with a system of highways, the aggregate cost of which would perhaps be $150,000,000, or whether it might be more economical to spend more time and money in the preparation of plans and doing preliminary work that might be reflected in a lower cost of construction and operation? At the beginning of the highway program engineers took considerable work at $100 per mile with the idea of getting the program initiated and because the law limited the department to that amount so far as paying engineers for the work by contract was concerned. Recently county authorities have been adding as high as $40 to $50 per mile to this amount in order to induce engineers to take the work. C. A. SHOCKLEY,
Shockley Engineering Co.

Kansas City, Mo., Jan. 26.

[It should be understood that the law limited the cost to the state to $100 per mile for the road surveys. This was explained in the article as well as the fact that county authorities were paying additional sums where the work could not be done within the prescribed limit of cost. The cost is stated to include both surveys and plans. Whether some other system might have been more economical did not enter into consideration, apparently, the Highway Department being governed by the law as passed by the legislature. A copy of Mr. Shockley's letter was submitted to the State Highway Department and the reply is to the effect that the article states the facts and that no special claims are made for what has been done, but that no good will be served by entering into a discussion.—EDITOR.]

Effect of Excessive Heat on Mild Steel and Concrete

Sir—In a letter reported in *Engineering News-Record*, Dec. 2, 1920, p. 1102, I referred to certain tests made in England showing the great reduction in the yield point and tensile strength of mild steel at high temperatures. I have now obtained precise information on the tests referred to, and in view of the fact that they throw much light on the behavior of reinforced concrete under fire gives the information herewith.

The tests were made by Prof. F. C. Lea, of Birmingham University, England, and communicated to the British Association at its meetings last August. The tests had for their object the determination of

1. The effect of rise in temperature on the yield point and tensile strength of mild steel.
2. The effect of rise in temperature on the compressive strength of concrete.
3. The protective insulation afforded steel by the concrete covering usually employed in buildings.

While due justice cannot be done to these tests in a brief space the following general information as to the results may be of interest:

1. The value of the yield point begins to fall at 250 deg C., and then falls rapidly until at 600 deg. C. it is but 20 per cent of the corresponding figure when cold. The tensile strength falls rapidly after 400 deg. C. is passed and at 600 deg. C the breaking strength is about 7½ tons per square inch. This is below the usual design for working stress.

2. Compression tests made on 1:2:4 gravel-concrete cylinders immediately after heating to temperatures up to 700 deg. C. indicated that the compressive strength fell off rapidly after 450 deg. C., and, after heating to 700 deg. C. the crushing strength is but 20 per cent of its value when cold.

3. Tests made on the temperature gradient in concrete cylinders from outside to inside indicated that it is roughly a matter of two hours before a temperature of 600 deg. C. would be communicated to steel at a depth of 1½ in.

In a fire of several hours' duration the protection afforded the steel by one or two inches of concrete would be very slight. From the descriptions given as to the duration and intensity of the Galveston fire it seems reasonable to imagine that both the concrete and the interior steel reached temperatures approaching 700 deg. C. Although the author has not had the opportunity of examining the destroyed structure yet, it seems possible to him that in view of the above tests failure would result under such conditions, whether the columns were reinforced with spirals or not. In the first fire it seems reasonable to believe that failure resulted from the inability of the steel and concrete to carry the stresses at such temperatures.

While the avoidance of sharp angles and corners in concrete is helpful in preventing spalling of the concrete under certain conditions, yet it seems that the main point is to use lower working stresses and a thicker protective coating on the steel. EDGAR A. CROSS.

High Point, N. C., Jan. 24.

HINTS FOR THE CONTRACTOR

Kitchen Boiler Makes Roller for Finishing Concrete Pavement

A 30-gal. kitchen boiler of the sort that has a longitudinal, electric weld instead of the riveted joints sometimes used, has been found useful on California road work as a roller for smoothing out concrete pavement before finishing the surface with the usual floating tool. A convenient handle for the roller is made with a ¾-in. galvanized pipe, using a piece long enough to reach across the pavement. To attach the handle, a piece of pipe about 4 ft. longer than the boiler is fitted with a tee at its mid point into which the handle can be screwed. Two right-angle bends are then made near each end of the branches from the tee and the two pipe ends are thrust through holes in the center of each end of the boiler.

Dragline Excavator Also Drives Piles in Reclamation Work

BY A. W. WALKER
Engineer, U. S. Reclamation Service

DURING the construction of drains in the Grand Valley Drainage District, Colorado, it has been necessary to install a great many highway bridges and canal flumes. Practically all of these structures, on account of soil conditions, have been built on pile foundations.

In order to save labor and equipment a dragline machine was used for a temporary pile driver. A set of

DRAGLINE EXCAVATOR DRIVING PILES IN COLORADO RECLAMATION WORK

leads was built with two 6-in. x 8-in. x 25-ft. timbers faced on the inside with 6-in. steel channels securely bolted with countersunk bolts. The outside corners of the 6-in. x 8-in. timbers were faced with ¾-in. x 2-in. angle irons securely bolted. The timbers were braced the correct distance apart (size of a standard 2,000-lb. hammer) by heavy iron yokes made of 1-in. x 4-in. iron, some of the bolts which fastened the channel face irons to the lead timbers also fastening the yokes to the timbers.

At the top of the leads a 12-in. steel sheave was mounted, with housings made of ¾-in. sheet steel. Considerable care was exercised in mounting this sheave securely to make it and the leads rigid, this being accomplished by fitting 1-in. x 4-in. strap irons over the upper corners of the leads. The upper end of these strap irons had 1½-in. holes in them for the hoist-line clevis pin to fit in.

When in operation, one side of the leads is left open. A pile driver follower which fits in the leads and down over the top of the pile, holds the top of the pile in position. The leads are raised and held in a vertical position by the hoist line on the machine. The hammer is raised and dropped by the dragline which is a ½-in. cable substituted for the regular 1-in. line.

In driving piles for an ordinary bridge the procedure is as follows. In most cases the piles are driven before the drain is excavated.

1. The bucket is removed from the hoist line and the 1-in. dragline removed from the drag drum.
2. The ½-in. hammer line is placed on the drag drum and over the sheave at the upper end of the leads. In order to speed up operations the drag drum is lagged with 3-in. oak lagging which can be put on and taken off in a few minutes, as it is in two sections.
3. The clevis of the hoist line is fastened to the upper end of the leads which are then pulled up into position.
4. The hammer is fastened to the ½-in. line and then threaded into the leads. The follower is then threaded into the leads and attached temporarily to the hammer with a sling made of ½-in. cable.
5. The leads are then spotted over the pile point by moving the machine for approximate adjustment and raising or lowering the boom for final adjustment.
6. The leads are then swung around to the piles and with the hammer and follower lowered to the ground. The pile is fastened to the hammer with a rope sling. The hammer is raised to the top of the leads. The leads are raised to the point of the boom and all swung around into exact position. The pile is swung into the leads. The hammer and follower are lowered onto the top of the pile and the sling which attached the follower to the hammer is unfastened and the driving begins.
7. The material between the piles is excavated by the dragline as well as the material back of the piles. The bulkhead planking is placed, the piles are cut off, and the bridge deck put on. The necessary backfilling is completed by the machine.

Painting Signal Lanterns Decreases the Number Stolen

LANTERNS left all night as danger signals on road barricades or where pavement repairs have been made were so frequently stolen from work carried on by the California Highway Commission that special endeavor was made to find some means of protecting them. After some experiment the best plan was found to be painting the lantern bases a bright red and stenciling over this the letters "C. H. C." Since this has been done loss from theft has greatly decreased.

NEWS OF THE WEEK

New York, February 24, 1921

Federation Organizes Waste Survey of Industry

Hoover Names Committee of Engineers To Carry On Nation-Wide Investigation of Conditions

At the meeting in Syracuse, N. Y., Feb. 14, of the executive board of the American Engineering Council, the governing body of the Federated American Engineering Societies, Herbert Hoover, the council's president, announced the appointment of the committee which will make a country-wide survey of industrial wastes. The personnel of the committee is as follows:

J. Parke Channing, (chairman) mining engineer, New York City; Dr. Ira N. Hollis, president, Worcester (Mass.) Polytechnic Institute; L. W. Wallace, newly appointed secretary of the American Engineering Council, Baltimore; H. R. V. Scheel, assistant treasurer, Brighton Mills, Passaic, N. J.; L. P. Alford, editor, *Management Engineering*, New York; George D. Babcock, manufacturing executive, Peoria, Ill.; F. G. Coburn, Bethlehem Shipbuilding Co.; Morris L. Cooke, consulting engineer, Philadelphia; Harrington Emerson, consulting engineer, New York; E. E. Hunt, formerly labor investigator for the Clothing Manufacturers Association, New York; C. E. Knoeppel, industrial engineer, New York; Robert Linton, mining engineer, Montana; Fred J. Miller, past-president, American Society of Mechanical Engineers; J. H. Williams, engineer, New York; Robert D. Wolf, vice-president, American Society of Mechanical Engineers, New York.

Territorial Organization Planned

Mr. Hoover is also a member of the committee and will take a leading part in the conduct of the waste survey. The scope of the undertaking was outlined by Mr. Hoover in an address at the council meeting, published in abstract on p. 342 of this issue. It is proposed to organize the engineers of the country on a territorial basis, each state having an engineering organization, with the American Engineering Council the executive organ of all.

The American Engineering Council, at its Syracuse meeting, gave formal approval to the action of the committee on procedure in requesting President Harding to appoint an engineer to the Interstate Commerce Commission; the committee was authorized to name six qualified engineers when requested so to do. Activity in behalf of the National Department of Public Works will be continued by the council through its public affairs committee. Endorsement was given to the policy of registration for professional engineers. The council's Russian affairs committee was made a new committee on international relations, the old personnel being retained.

An invitation from Philadelphia engineers to have the council hold its next meeting in April in that city was accepted. The June meeting will be held in St. Louis.

The council recommended to President Harding that an engineer be appointed Assistant Secretary of War.

L. W. Wallace, New Secretary of Federated Societies

Lawrence W. Wallace, whose election to the secretaryship of the American Engineering Council, the governing body of the Federated American Engineering Societies, was announced in this journal last week, was born in Austin, Tex., Aug. 5, 1881. After graduation from the Agricultural and Mechanical College of Texas in 1903 with the degree of B. S. in mechanical engineering, he served a special apprenticeship with the Santa Fe Railway and then joined the faculty of Purdue University, becoming head of the department of railway and industrial management. Mr. Wallace is author of technical works, among them "Car

New Secretary of the American Engineering Council

L. W. WALLACE

(Continued on p. 356)

Concrete Institute Holds Active Meeting

No New Standards, But Special Attention Paid to Matters of Construction and Design

For the first time in a number of years the American Concrete Institute met last week in Chicago without such aid to registration as is given by coordinate bodies in session at the same time. Hitherto the annual conventions have generally, if not always, been held at the same place and about the same time as the Cement Show, the American Society for Testing Materials, or with road or housing conferences, all of which brought a number of men who helped boost the registration but who did not contribute proportionately to the attendance or discussion at the meetings. This year, however, the Institute was on its own, and every one of the 250 odd registered was there to attend the sessions or discuss papers and reports. As a result the meetings were longer and more lively than in any since the early days.

Committee Recommendations

No new standards were adopted by the meeting to go to letter ballot. One specification and one recommended practice had been prepared by the Committee on Concrete Products for block, brick and trimstone, but they were withdrawn by the committee in consideration of a proposed revision of form of all the standards of the Institute which is to be initiated this year. The Committee on Concrete Storage Tanks submitted some simple changes to its recommended practice of last year and the Committee on Concrete Houses presented a tentative draft of a specification. A proposed standard specification for reinforced-concrete chimneys by the committee of that name was referred back to the committee because of some evidence on the floor of lack of harmony among its members.

This absence of standards does not mean that the committees have been idle during the past year. On the contrary they have been exceedingly busy. Eighteen out of the twenty-two in the Institute reported at the meetings and most of the reports were more than merely of progress. Rather the indication is that concrete is not so simple or stabilized a material that it is possible to come before any body with a set of paragraphs which state that this and that are facts and things shall be done this and so, only to have to appear the following year with some new assertions which require revision of the

standard. The committees seem to be showing a commendable desire to study the fundamentals of their respective subjects, to undertake research and apportion out detail investigation in the effort to establish the data on which a fair permanence of standards may rest. In this category may be noted particularly the committees on roads, bridges, metal forms, aggregate and concrete surfaces. The Committee on the Rockaway Fire cleaned up its work by presenting a final report on the fire in the concrete warehouse in Far Rockaway, N. Y., in 1916, a report which not only describes that fire but the tests on the building after repair and which discusses in some detail the effect of fire on concrete.

The Committee on Research for the first time presented a comprehensive report, which outlined a program for future work of the Institute in the field of investigation. It is proposed that the various subjects indicated, on which a number of different agencies are working more or less independently—and on some of which no work is being done—be portioned out to the committees of the Institute either for original study or for collation of material and co-ordination of effort. The move is a definite step forward in a systematic study of concrete.

Discussion on Design and Construction

Two major and one minor subdivision of the discussions before the convention may be made. The major subjects were design and construction; the minor, concrete products. In the old days of the Institute's predecessor the latter subject was of prime importance but of late years it has been allowed to lapse and the concrete product men have not felt altogether at home. This year they had one entire session at which their problems were discussed, particularly the question of fire protection and insurance risk of the concrete block structure. Progress was made toward a program of fire tests of this type of construction, to the end that the fire underwriters may have what they have not now, some definite information as to the fire resisting qualities in specific kinds of concrete block structures with blocks of a specific make and material. It is being recognized in the Institute that the factory-made concrete product is having a wider use and that it is necessary to provide some authoritative agency which can be a forum and a judge. The prospects are that in its future activities the Institute will devote more time to the concrete product.

Of the major subjects, design, as in the past, held a large part of the program. Foremost among the papers was a joint presentation by Dr. H. M. Westergaard of the University of Illinois, and W. A. Slater, of the Bureau of Standards, of a discussion of "Moments and Stresses in Slabs." This is really a monumental piece of work, which will run into a hundred or more printed pages in the "Proceedings" of the Institute. Dr. Westergaard has made an analytical examination of the slab of unprecendental thoroughness and has applied the developed theory to the design of the reinforced-concrete girderless floor. Mr. Slater has studied a number of beam tests with the idea of discovering the laws of variation between observed and computed stresses and has applied the knowledge so gained to an analysis of most of the available full-size tests of concrete flat-slab floors. The complete paper when available should be an invaluable compendium of knowledge of the girderless floor.

Two papers on the design of columns were given, one by S. C. Hollister on bending moments in interior columns and the other by F. R. MacMillan on a new hooped concrete column formula. The former analyzes the moments of columns in a building due to various disposition of load on the floors and panels; the latter utilizes the steel compression due to concrete shrinkage and time yield and deduces a formula which gives a more economical column than do those in general use. Both papers present studies which doubtless are being used by the joint committee in its present preparation of a concrete specification.

Problems of the Concrete Builder

The other major field is one to which the Institute is devoting more and more attention, that is the problems of the concrete builder, who generally, of course, is a contractor. The Committee on Contractor's Plant continued its last year's study of building construction plants with a thorough analysis of the comparative merits of seven different kinds of layout and critical descriptions of three specific layouts. The Committee on Floor Finish outlined the proper methods of laying a concrete floor. Both of those reports had enthusiastic discussion by men of practical experience. Papers of direct interest to this field were the reports of a performance test of a concrete mixer by Prof. W. K. Hatt, two papers on concrete road construction equipment by F. M. Balsley and C. R. Ege, methods and formulas for coloring concrete by John W. Lowell, an investigation of the possibilities of using greater tolerances in sand and gravel grading for road concrete by Professor Hatt and R. B. Crepps and a study of shrinkage of stucco as it affects its placing by J. C. Pearson.

One report, that of the Committee on Standard Units of Design, is an attempt at harmonizing the two major subjects. It is a tentative recommendation of standard sizes and dimensions to be adhered to in building design in order to reduce the expense of unnecessary variations which the designer may put in with the idea of saving in material, but which on account of lack of uniformity may really add to the cost.

The Wason Medal was awarded to W. A. Hull for his paper "Fire Tests of Concrete Columns," presented to the 1920 convention.

Reports showed that the Institute is in a satisfactory condition with well up toward 700 members and a small balance in bank. Steps were taken at the convention to develop the scope of the society by the prosecution of a more definite plan of operations and better co-ordination of committee work. H. C. Turner of the Turner Construction Co., New York, was continued as president and W. P. Anderson of the Ferro Concrete Construction Co. of Cincinnati, Ohio, elected as junior vice-president, C. W. Gow of Boston holding over as the senior vice-president. Robert W. Lesley, after a number of years of service, has retired as treasurer and Harvey Whipple, the secretary of the Institute, was elected to take his place. His address is New Telegraph Building, Detroit, Mich. Abstracts of some of the more important papers and reports appear in this and later issues of *Engineering News-Record.*

Boston Garbage Disposal Contract Still in Force

Acting on the advice of experts, says Mayor Peters of Boston, Mass., in his annual message delivered Feb. 7, the city has rejected the proposal of the Boston Sanitary & Development Co. to cancel its contract with the city for garbage disposal and forfeit the amount of its $100,000 bond, and the subsequent proposal that the city increase its payment to the company by $25,000 a month. The Mayor states that he is prepared to take over and operate the garbage reduction works and proceed against the assets and bondsmen of the company for any losses the city may sustain in case the company defaults.

L. W. Wallace

(*Continued from p. 355*)

Design," in addition to special instruction books for railway educational departments.

He brings to the secretaryship of the council experience as a manufacturing executive, having served as assistant general manager in charge of production of the Diamond Chain & Manufacturing Co., of Indianapolis. More recently he has been director of the Red Cross Institute for the Blind in Baltimore, which provided vocational training for ex-service men. Mr. Wallace is a member of the American Society of Mechanical Engineers and vice-chairman of that organization's management section. He is now serving his third term as president of the Society of Industrial Engineers and is a past-president of the Indiana Engineering Society. He has served as vice-chairman of the Federation's committee on elimination of waste in industry and as the council's treasurer.

While located temporarily in the Engineering Societies Building, New York City, Mr. Wallace will soon transfer his office to Washington, where the American Engineering Council will eastablish permanent national headquarters in the McLachlen Building.

The New Administration of the Am. Soc. C. E.

In this and succeeding issues of "Engineering News-Record" will appear brief biographical sketches of the newly elected officers and directors of the American Society of Civil Engineers, as announced in the issue of Jan. 20, p. 140, following the annual meeting.

Otis Ellis Hovey, Treasurer

Otis Ellis Hovey, treasurer, was born at East Hardwick, Vt., in 1864. His English-Scotch-Irish ancestors settled in New England early in the seventeenth century.

He was graduated from Dartmouth College in 1885 with the degree of B. S. He served as engineer of the Hoo-

OTIS E. HOVEY

sac Tunnel and Wilmington R.R. in 1885 and 1886 and as draftsman with the Edge Moor Iron Co. until the autumn of 1887, when he entered the Thayer School of Civil Engineering, at Dartmouth, from which he graduated with the degree of C. E. in 1889. During 1888 he had charge of a dam and several paper mill improvements in Massachusetts, on the staff of D. H. and A. B. Tower.

From early in 1889 until June, 1890, he was instructor in civil engineering at Washington University, St. Louis, Mo. He then became associated with the late George S. Morison, past-president, American Society of Civil Engineers, and took charge of Mr. Morison's Chicago designing office, where he served until 1896. During this period Mr. Hovey had charge of the designs and estimates of many bridges, including the Bellefontaine, Alton and Leavenworth bridges; also miscellaneous engineering work, including the railroad yard and structures for the St. Louis entrance of the C. B. & Q. R.R. He also designed and was resident engineer of a four-track bascule bridge in Chicago.

From January, 1896, until May, 1900, he was engineer of the Union Bridge Co., and had entire charge of a large variety of bridge and structural work. On the formation of the American Bridge Co. he became engineer of design, first at Pencoyd and later at New York; and in 1907 was appointed assistant chief engineer resident in New York, which position he now holds. His work has covered a wide field in steel structures, and he has devoted much time to the development and improvement of movable bridges and turntables during recent years. He had charge of the execution of the contract for the six emergency dams of the Panama Canal in 1911 to 1913. His duties have twice required trips to Europe and twice to Panama.

He served on the nominating committee of the American Society of Civil Engineers during the years 1911 and 1912.

Ira W. McConnell, Director

Ira W. McConnell, director, District 1, was born in Schell City, Mo., in 1871, and was graduated from Cornell University with the degre of C. E. in 1897. For two years he served as instructor in the College of Civil Engineering at Cornell, and for one year as professor of civil engineering at the Missouri School of Mines. As contractor's superintendent for the Nash-Dowdle Co. he was employed for two years on railway terminal work in Chicago and municipal drainage work in New Orleans.

For six years following he was in the U. S. Reclamation Service; four years as construction and project-engineer on the Gunnison tunnel and on the Uncompaghre project, and two years as supervising engineer of the Central District in charge of Reclamation Service work in Oklahoma, Kansas, Colorado, Nebraska, Central and Southern Wyoming and South Dakota. This assignment included such notable projects as the Pathfinder dam, the North Platte project, the Grand Valley project in Colorado, the Belle Fourche project in South Dakota, and the Garden City project in Kansas.

In 1909 Mr. McConnell became chief irrigation engineer for J. G. White & Co., New York, and later vice-president and general manager of the Idaho Irrigation Co. at Richfield, Idaho. In February, 1912, he was employed by the Stone & Webster Engineering Corporation as consultant in connection with the design, construction and operation of public utilities, water powers, railways, steam power stations, industrial buildings, etc., and in 1917 he became chief engineer for Stone & Webster.

In 1916 he made a five months' study of general business conditions in South

IRA W. McCONNELL

America, the trip covering the developed portions of Brazil, Uruguay, Paraguay, Argentine, Chile and Peru. Mr. McConnell was works manager and assistant general manager for the American International Shipbuilding Corp. at the Hog Island Shipyard.

In 1918 he became vice-president of Dwight P. Robinson & Co., Inc., New York City.

John P. Hogan, Director

John P. Hogan, director from District 1 (New York), was born in Chicago in 1881 and was graduated from Harvard University in 1903 with the degree of A. B. and the following year from the Lawrence Scientific School with the degree of S. B.

From 1904 until 1906 he was engaged

JOHN P. HOGAN

in subway construction in New York as assistant engineer on the Rapid Transit Commission and resident engineer on the Brooklyn Rapid Transit Commission. He joined the engineering staff of the Board of Water Supply of the City of New York on the location and construction of the Catskill Aqueduct as assistant engineer in 1906 and served with that organization until 1917, reaching the grades of division engineer and acting deputy chief engineer. While division engineer he was in charge at various times of the construction of 28 miles of aqueduct and one reservoir, including the Rondout pressure tunnel at High Falls, N. Y., the Narrows flexible-joint steel pipe siphon leading from Brooklyn to Staten Island and the Silver Lake Reservoir on Staten Island.

Mr. Hogan entered the military service in May, 1917, as captain with the First (later named the Eleventh) Engineers, and served two years in France, with the A. E. F., ultimately reaching the rank of lieutenant-colonel, General Staff. He served as chief of the topographical service, Second Army, and as depty chief, topographical service, A. E. F. For this work he was decorated as chevalier of the Legion of Honor.

After terminating his military service Col. Hogan entered consulting practice with Col. William Barclay Parsons, of New York, his principal work involving the conduct of water power investigations in New York State.

Idaho Organization, in Year, Increases Seven-Fold

Growth of the Idaho Society of Engineers after it became the Idaho Chapter of the American Association of Engineers a year ago has increased the membership from 50 to 350. More than 100 delegates attended the first annual convention Jan. 10 and 11 at Nampa.

Action was taken requesting Congress to enact legislation providing for a continuation of Federal-aid for highway work and for a National Department of Public Works.

The chapter now has bills before the legislature covering amendments to the civil engineers' license bill; providing that the University of Idaho may be enabled to give extension courses in technical and liberal arts subjects; providing that at least one member of the Public Utilities Commission shall be an engineer; and giving the right to the State Board of Health to prevent the dumping of untreated sewage into streams. A better salary scale for engineers in state service is on the program.

The following officers were elected: President, Lee R. Cooke; vice-presidents, E. E. Moberly and J. H. Wilson; secretary-treasurer, Capt. E. F. Ayres, Boise; executive-committee, E. B. Darlington, Dr. C. N. Little and Barry Dibble.

Illinois Society Awards Prizes at Annual Meeting

Prize papers constituted a new development at the annual meeting of the Illinois Society of Engineers, held in Chicago, Jan. 26-28. Awards, limited to writers of not more than five years' membership for the express purpose of interesting the younger men, were made for the following papers: 'Keeping our Streets Smooth," by Harlan H. Edwards, city engineer, Danville, Ill.; and "Asphalt Pavements of the Future," by Allen Dimmick, of the Texas Co., Chicago.

Affiliation and co-operation with other engineering associations was the subject of prolonged discussion.

In an address on special assessment methods, Edgar B. Tolman, a Chicago lawyer, pointed out that if local improvement bonds are to be made attractive to bankers and investors it is necessary so to arrange the financing that interest will be paid on the prescribed dates. Failure to provide for such regularity, largely owing to the inexperience of local authorities, has resulted in greatly depreciating the market for such securities.

Resolutions

Resolutions as to public affairs included the following: (1) Suggesting that the state highway department should construct experimental sections of paving of different types; (2) that drainage of farm lands should be encouraged and extended; (3) that legislation should be passed more favorable to municipalities in financing waterworks projects; (4) that the state should accept the program of the U. S. Geological Survey for more rapid progress with the topographic mapping of the country and should appropriate $35,000 annually for this work; (5) that the new state administration should retain the present head of the State Department of Health; (6) that the Society endorses the principle of regulating public utilities by a state commission; and (7) that under present financial conditions the state should render liberal support to the University of Illinois.

A registered attendance of nearly 150 included about 90 members and set a high-water record for the meetings of this society, which has now a membership of about 270. Chairmen elected by the several sections include W. P. Bushnell, Quincy, Ill., drainage section; A. L. Webster, Wheaton, Ill., surveying section; W. S. Shields, Chicago, sewerage section, and C. C. Wiley, Urbana, Ill., road and pavement section.

Officers of the society for 1921 were elected as follows: President, Samuel A. Greeley, Chicago; vice-president, Robert I. Randolph, Chicago; secretary E. E. R. Tratman, Wheaton, Ill. It was voted to hold the next meeting of the society at Decatur, Ill., in January, 1922.

Amendments to New York Licensing Law Proposed

Several amendments to New York State's licensing law for engineers, which was signed by the Governor last May, are proposed in a bill (No. 147) introduced in the Senate by Mr. Ferris Jan. 24. Among the principal changes are the requirement for a yearly renewal of the license, at a fee of $1, and a clause defining "professional engineering" as follows:

"Professional engineering, as covered by this act, means the practice of the professional engineer who through technical knowledge gained by education and experience in one or more branches of that profession initiates, investigates, plans and directs the application of the resources of nature to the use and convenience of man; and who represents himself or herself to be such an engineer either through the use of the term engineer with or without qualifying adjectives or through the use of some other title implying that he or she is such an engineer."

To Co-operate with A. R. E. A. in Heavy Traction Studies

An arrangement to co-operate with the American Railway Engineering Association regarding progress in heavy electric traction has been made by the committee on heavy electric traction of the American Electric Railway Engineering Association. It is contemplated that the work will cover foreign as well as local practice.

Alaska Railroad Susitana Bridge Open for Traffic

Traffic has been opened over the Susitana River bridge of the Alaska R.R., according to press dispatches received from Anchorage, Alaska, Feb. 9. It is 1,200 ft. long, including a single span of 503 ft., the largest in Alaska. The bridge is located at mile 264. Its cost is estimated as $850,000. The opening of the bridge leaves less than 100 miles between the ends of rail this year.

Ask Bidders on Hydroelectric Equipment To Take Bonds

Mayor H. M. Caldwell, of Seattle, Wash., in a statement before the finance committee of the City Council, suggested that because of the dearth of construction throughout the country the successful bidders for the hydroelectric machinery to be used on the Skagit project might be willing to accept payment in city bonds. He also urged that the successful bidder be permitted to purchase an additional $1,000,000 of bonds at par, but that this be optional with the bidders. It is reported that certain prospective bidders have signified their willingness to accept bonds in payment for the equipment. The equipment which the city will buy includes two 35,000-hp. electric generators and exciters, etc. Bids will be opened Feb. 18.

Federal Aid for Roads Has Small Chance of Passing

(Washington Correspondence)

No additional appropriation for the Federal-aid road program is likely to be approved at the present session of Congress. A determined effort was made last week to attach as a rider to the Post Office Appropriation Bill the $100,000,000 appropriation for this purpose. The effort was unsuccessful. A bill providing this $100,000,000 appropriation was passed by the House by a large majority, as noted in last week's issue. The Senate action is attributed to the advocates of the Townsend bill, which provides for a national highway system.

Under the parliamentary conditions governing the vote taken in the Senate, a two-thirds vote was required in order to attach the Federal-aid proposition to the Post Office Appropriation Bill. Judging from that vote the House bill could be passed with a considerable margin were it possible to get that bill before the Senate. In the congestion which now exists and in view of the attitude of the committee, it is not thought probable that a vote can be secured in the Senate on the bill which passed the House.

New York Governor Indorses Joint Port Plan

In a message to the New York State Legislature on Feb. 16 Governor Nathan L. Miller urged the early passage by the legislature of an act authorizing the state to enter into a treaty with New Jersey forming a joint port district and port authority for New York harbor. He states that early adjournment probably will prevent full consideration now of the comprehensive plan formulated by the New York, New Jersey Port and Harbor Development Commission, but that the formation of the joint district should and can be effected at once. One paragraph in the message is especially interesting. It reads as follows:

"The Interstate Commerce Commission has decided that historically, geographically and commercially, the Port of New York is one port and on that theory denied the claim of New Jersey to a freight differential in its favor. Unless the State of New York now consents to treat the port as one port and to take the necessary steps to reduce excessive terminal costs, it must be prepared for a contrary holding by the Interstate Commerce Commission."

Use of Machines for Trenching Shown Water-Works Men

Moving pictures and lantern slides showing trenching machines, steam shovels and drag-line excavators at work digging trenches for water-works and sewers and available for other conduit trenching brought out a record attendance at the lunch and meeting of the New York section of the American Water Works Association in New York City on Feb. 16. Those showing views were the Bucyrus Co., the Parsons Co., the Marion Steam Shovel Co., and the Austin Machinery Corporation. W. R. Conard sent a paper reviewing the use of trenching machines at Camp Merritt and elsewhere during the war.

New Plans for Belle Isle Bridge

Proposed new plans for the Belle Isle bridge, prepared in accordance with a recent action of the city council calling for the presentation of the plans within 30 days and without cost to the city, were presented by Daniel B. Luten at a hearing Feb. 16, and the matter was taken under advisement by the council. The plans included two primary designs, of 16 spans and 18 spans, respectively. The total length of the bridge in each case is 2,195 ft., the same as provided by the original plans of the bridge commission. The first design is for an open-spandrel reinforced-concrete arch bridge with 95 to 160-ft. spans and 88-ft. wide, with cantilever sidewalks. The second design is for a solid-barrel arch bridge of 92 to 124-ft. spans, with spandrel walls and earth fill and without the cantilever sidewalks.

Bridge Commission Suggested

The appointment of a bridge commission to consider the matter and pass upon plans submitted was suggested by Esselstyn, Murphy & Hanford, the engineers who are employed by the city to make the detail drawings and supervise the construction, following out the general design of the bridge commission, which has been disbanded. The Detroit Section, Am. Soc. C. E., in a letter from its secretary urged the reappointment of the bridge commission to pass on all plans and advocated the commission's retention until the bridge was completed. Mr. Esselstyn favors reappointment of the original commission in view of its long and careful investigations.

Features of New Plans

In preparing his plans, Mr. Luten stated, the plans recommended by the bridge commission as well as the present specifications were followed closely. According to the proponents of the new plans they will reduce the cost of the bridge because of greater ease of construction, elimination of a large amount of steel and reduction of concrete. Four estimates were submitted, varying from $2,171,725 to $2,486,360, stated to be based on prevailing prices in Detroit with an allowance of 25 per cent. The designer's fee of 10 per cent of the successful bid would be paid by the contractor. Mr. Luten stated that the bridge could be built within two years.

Proponents of the commission or present design advocate competitive designs if the original plan is not to be adhered to. The contract which Esselstyn, Murphy & Hanford have with the city does not allow any latitude in changing the general design of the proposed bridge.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Convention, March 15-17.

The Engineers' Club of Trenton, N. J., at its meeting March 10, will be addressed by Clifford M. Holland, chief engineer of the New York-New Jersey Tunnel Commissions, on "The Special Problems of the Hudson River Vehicular Tunnel."

The Society of Terminal Engineers held its monthly meeting in New York City, Feb. 15, devoted to a discusion of standard unit containers in freight service. The principal paper was delivered by Calvin Tomkins, chairman of the society's committee on containers, as a progress report. As a standard unit Mr. Tomkins favored the demountable motortruck body container. Discussion followed by F. L. DuBosque, superintendent of floating equipment, Pennsylvania System, New York, and J. H. Butler, loss and damage department, American Railway Express Co.

The New York Post, Society of American Military Engineers, is planning to hold its next meeting at 7:30 p.m., March 1, in the Engineering Societies Building, New York City. At the recent annual meeting Major-Gen. W. C. Langfitt, formerly chief engineer of the American Expeditionary Forces in France, where he served for more than two years, was elected president and Major Percy L. Barbour secretary of the post.

The Utah Irrigation and Drainage Congress, at its fourth annual convention in Salt Lake City, Jan. 17-18, elected the following officers: President, Dr. F. S. Harris; first vice-president, R. E. Caldwell; second vice-president, E. A. Porter; third vice-president, Ephraim Bergeson; secretary-treasurer, U. A. C. Logan.

The Seattle (Wash.) Section, Am. Soc. C. E., at its annual meeting Jan. 31, elected the following officers: President, T. E. Phipps; vice-president, Bertram D. Dean; secretary-treasurer, Frank H. Fowler.

The Wyoming Engineering Society at a recent meeting elected the following officers: President, Ambrose Hemingway; vice-president, James Wisda; secretary-treasurer, Henry Watson.

Personal Notes

Roger M. Freeman, for the past three years supervising engineer Bureau of Yards and Docks, U. S. Navy, has opened a consulting office in New York City as construction engineer, specializing in the design and construction of industrial buildings, steel plants and power plants. He is a graduate of the Massachusetts Institute of Technology and after service as assistant engineer with his father, John R. Freeman, Providence, R. I., on the design of large hydro-electric developments in this country and Canada, joined the staff of the Turner Construction Company. He left that organization to become associated with the Chase Co., Inc., of Waterbury, Conn., to build up an organization and to direct the design and construction by force account of about $2,000,000 worth of industrial buildings, mostly reinforced-concrete factories. Two years later he joined the Bureau of Yards and Docks of the Navy where he was in charge of the construction of a number of important forging and heat-treatment plants, the largest being that of the Erie Forge & Steel Co., of Erie, Pa., costing about $9,000,000. Lately he has been in charge of the design and construction of the armor plate and gun-forging plant for the Navy Department at South Charleston, W. Va., costing about $20,000,000. At its peak the organization for this work inclu led about 50 draftsmen and engineering assistants and 1,500 men in the field.

Hiram D. Phillips, assistant division engineer, Massachusetts State Department of Public Works, Bureau of Highways, has been appointed engineer of District 2, Franklin and Hampshire Counties, Conn.

Charles F. Scheible, manager of the Hunter Construction Co., has been appointed Director of Public Service, Youngstown, Ohio.

Major Edwin H. Marks, Corps of Engineers, U. S. A., has been relieved from duty in the office of the Chief of Engineers and ordered to Duluth to take charge of the engineering division in that area.

Clarence M. Brooks, formerly engineer, Division 4, New Hampshire State Highway Department, has been appointed highway commissioner of Vermont.

Ernest M. Levy, formerly resident engineer on the Conway-Vilonia Road, has been transferred to the position of office engineer of the Parkes Engineering Co., Pine Bluff, Ark.

R. N. Kinnaird, with the Des Moines Water Co., previous to the sale of that company to the city, announces the opening of a consulting office in the Iowa Building, Des Moines, specializing in water supply and purification, municipal sanitation, sewerage, power plant engineering, coal mining, coal, sand and gravel preparation and handling.

Sid Smyth, for the past two years engineer of Cochise County, Ariz., has been reappointed for a two-year term.

William C. Hahn, vice-president and assistant manager Kirchner Constructoin Co., Cincinnati, Ohio, died Feb. 5 at Cincinnati. He was 56 years old and entered the contracting business 35 years ago as foreman under Mr. Kirchner. A number of streets in Cincinnati and vicinity were built under his supervision, also the coagulating basins and the settling reservoirs of the new Cincinnati waterworks at California, Ohio.

Major W. B. Harrison, Corps of Engineers, U. S. A., has been ordered to the Canal Zone to serve with the 11th Engineers.

E. H. Groot, assistant engineer under the U. S. District Engineer on the completion of the construction work and installation of machinery at Dam No. 43, Ohio River, West Point, Ky., has been placed in charge as assistant engineer of the Louisville & Portland Canal, including shops, dry dock and lock and Dam No. 41, the maintenance and operation of Dam No. 43 and the central engineer's depot for the Louisville district at Pilchers, Ky.

Major Allen P. Cowgill, Corps of Engineers, U. S. A., has been placed upon the retired list by reason of physical disability incident to the military service.

R. O. Comer, formerly designing engineer in the engineering department,, Board of Port Commissioners, New Orleans, La., has been placed in charge of canal and lock work on the Navigation Canal.

J. H. Chubb, northwest manager, service bureau, Universal Portland Cement Co., has been made manager of the service bureau, Chicago, succeeding to the position vacated by J. H. Libber-

Paul Sterling, formerly maintenance engineer, New York, New Haven & Hartford R.R., Lines West, is now assistant to the engineer maintenance of way, with headquarters at New Haven, Conn.

W. G. Pearce, formerly with Chipman & Power, consulting engineers, Toronto, Ont., has been appointed assistant designing engineer of the sewer section, Department of Works, Toronto.

J. R. Hunt has been appointed road engineer of Wyoming County, W. Va.

Ronald McKinnon has been appointed city engineer of Sydney, N. S., succeeding N. K. Hay, resigned.

Norman J. Goebel has been appointed engineer for the board of water commissioners, Oshawa, Canada.

ton, who has gone with the General Chemical Co., New York City.

Major Leon E. Lyon, Corps of Engineers, U. S. A., has been assigned to the Lighthouse Service to superintend construction and repair of aids to navigation in the Philadelphia lighthouse district.

E. S. Smith, formerly Director of Public Service, Youngstown, Ohio, has been appointed chief engineer of the Ohio State Highway Commission.

J. R. Anderson and E. M. Anderson have organized the firm of Anderson & Anderson, architects and engineers, with offices at Wheeling, W. Va.

C. F. Graeser, formerly resident engineer on design and construction of municipal improvements with W. B. Saunders, consulting engineer, Helena, Mont., is now assistant engineer, Minnesota Highway Commission.

W. A. Hendry of Halifax, N. S., has been appointed chief engineer, Nova Scotia Highway Board.

H. F. McFarland, Jr., formerly chief engineer in charge of the location and construction of the Wichita Falls, Ranger & Fort Worth R.R. from Dublin, Tex., to Breckinridge, has been appointed chief engineer of the Wichita Falls & Southern, with headquarters at Graham, Tex.

Obituary

E. S. Draper, principal assistant engineer Boston & Albany R.R., died Feb. 6 at Boston, Mass. He was born in Wayland, Mass., in 1883 and was graduated from Tufts College, 1904. In 1905 he entered the employ of the Boston & Albany R.R., leaving that company in 1912 to become draftsman with the Stone & Webster Engineering Corp. at Boston. In 1913 he re-entered the employ of the Boston & Albany R.R. and served as assistant engineer, later engineer of structures and in May, 1920, was appointed principal assistant engineer.

Eliot N. Smith, for nine years on the engineering staff of the Catskill aqueduct, Board of Water Supply of New York City, died last week. He was graduated from Oberlin College in 1900 and received his engineering degree from Harvard University in 1904. After service with the New York Rapid Transit Commission from 1904 to 1906 he was appointed assistant engineer Board of Water Supply, New York, engaging in design, estimates and preparation of contracts for the Catskill work. Leaving the water board in 1915 he became associated with the firm of Smith, Hauser & McIsaac, contractors of New York City, and later was appointed supervisor of the bureau of engineering of Nutley, N. J.

Building Trades Employer and Employee in Joint Conference See Need For Co-operation

Philadelphia Meeting Results in Conviction That Each Element Must Yield, to Revive Construction

In the hope of coming to some common agreement whereby the cost of building construction can be so lowered as to stimulate a revival of construction, the industrial relations committee of the Philadelphia Chamber of Commerce called into conference for four days last week all elements in the construction industry. Each element had adverse criticism to offer regarding the others, and the sum total of this criticism is embodied in a statement of conclusions to which the conference came. Knowing exactly what things were wrong, the conference ended with the adoption of a resolution—whose motion to adopt was made by an employer and seconded by the president of the building trades council—recommending the holding of immediate additional conferences between labor, employers, material men, financiers, architects and engineers with a view to reaching an understanding that will cause the immediate release of contracts for building construction. Local conferences throughout the United States were also recommended and it was urged that a national conference be effected immediately for the stabilization of views and purposes in the building industry, based on the facts and conditions presented at the Philadelphia conference.

Conclusions

The conference arose out of the fact that building construction in Philadelphia, as well as elsewhere, is practically at a standstill. It was also observed that with a revival in construction other basic industries would be greatly improved. The conclusions which the conference reached were: (1) That current costs of construction materials still remain much higher as compared with pre-war costs and as compared with the average of all other commodities; (2) that current construction labor costs have not had proper adjustment to accord with present conditions; (3) that practices and conditions surrounding the financing of building construction require modification; (4) that relations between employers and employees call for improvement and stabilization in order to secure continuity of operations in all building construction; and (5) that employers and contractors have not progressed to the needed extent in effecting reasonably prompt deflation of values throughout the construction industry (and all stages thereof from raw materials to finished product) including their own overhead and profits. One of the chief accomplishments of the conference was the harmonizing of employer and employee, and the impression of each of the necessity for co-operative, constructive thinking and acting.

In order to reach the above conclusions, bankers, material men, representatives of statistical bureaus who shed light on living costs, etc., employers of building construction, labor and those skilled in the building trades participated in the conference. Practically two days were devoted to an analysis of the situation by employers of building labor and the skilled mechanics themselves. Contractors based their analysis on an examination of their own companies' conditions, and in almost every case it was charged that there was a decided decrease in efficiency which had had almost as much to do with the increased cost of building construction as the rise in wages. The other factor which they agreed had kept up building costs was the high price of materials which had not suffered its proportionate deflation.

Labor's Point of View

To meet this argument the representatives of labor asserted that their short working year—200 days on the average—would not, in justice, allow them to consent to a reduction in wages. However, they agreed that there had been a marked decrease in the general efficiency of their numbers, but laid it in every case to a war condition which forced them to dilute their skilled forces by the inclusion of barbers, shoemakers, clerks, and, in fact, every other class of worker except the skilled mechanic.

Prominent among the suggestions made at the conference as to what could be done to improve conditions in the building industry was a report made by the subcommittee on wages and building costs of the general committee of employers and building trades of the Philadelphia Chamber. It embodied an exhaustive study of the decline in business, cost of living, business failures, unemployment, a decline in wholesale prices, the rent situation, and other considerations, and it proposed a rate of wages in the building industry which it deemed a just wage based upon an expected further decline in commodity prices, and a wage which in general is 23.9 per cent lower than the existing rate. Inasmuch as the committee indicated that labor's share in the cost of building is approximately 40 per cent, such a decrease would mean a 10 per cent reduction in the cost of building. The present rate, weighted in proportion to the numbers employed in each trade, is at present, based on the 1920 wage agreements, $1.16 per hour, whereas the new rate, weighted in proportion to the numbers employed in each trade, is 88c. Though this shows a reduction of 23.9 per cent over the 1920 rate, it is an advance over the 1914 rate of 73 per cent. Further recommendations of the committee in connection with the suggested rate for 1921 were that double time be paid for work on holidays, Saturday afternoons and Sundays and for time after four hours of overtime. It also suggested that one and one-half time for overtime not exceeding four hours be paid, that the working week be 44 hr. and that 10c. an hour additional be given for night shifts.

Indicative of the desire of labor, despite its attitude on the wage-reduction question, to assist in the stabilization of construction, was its ready assent to sit with employers and other elements in the building industry in further conference. It agreed that its efficiency could be materially increased, and quickly, through the process of elimination and of education. It also showed itself in a disposition to accept a wage reduction in the event that material prices could be lowered much further and that contractors would be willing to forget their profits for the moment. That such a situation will be arrived at in the further conferences was indicated in the promise of one brick manufacturer to forget, in selling his brick, even the interest upon his $500,000 plant, and the promise of one investing builder that he would put his construction organization at the disposition of labor and would build 100 six-room two-story houses entirely without profit.

The conference was presided over by Ernest T. Trigg, chairman, industrial relations committee of the Philadelphia Chamber of Commerce.

Illinois Receives Highway Bids

The Illinois State Highway Department opened bids Feb. 18 for approximately 150 miles of concrete roads. The interest displayed was widespread, more than sixty contractors from Kansas City, Mo., to Muskegon, Mich., submitting tenders. The total attendance of contractors and material men at the opening of bids was about 800. The bids for construction of 18-ft. roadway of 7-in. concrete, under the Illinois specifications ranged from $26,000 to $45,000 per mile, on the basis of the cement being furnished by the state. Details of the prices and firms submitting bids appear in the construction news section.

Pennsylvania Opens Road Bids

Bids submitted to the Pennsylvania Highway Department Feb. 18 for the construction of approximately 104 miles of highway, mostly reinforced-concrete, were lower than those for some of the projects last year. The detailed figures are not yet available. The opening required more than 4 hours and contractors from all parts of the state were present, in addition to outside firms. More than 50 sets of plans for the contracts had been issued by the State Highway Department and about 130 bids were received.

Senate Immigration Committee Reports on Proposed Bill

On Feb. 15, the Senate Committee on Immigration reported the modified Dillingham bill as a temporary measure, expressing an opinion that no emergency existed which warranted a general prohibition of European immigration. The committee at the same time reported adversely upon the Johnson bill, designed to prohibit European immigration, which passed the House of Representatives several weeks ago.

The Dillingham bill provides for limitation of immigration upon a percentage plan, the limit fixed being 5 per cent of the number of natives of any country resident in the United States in 1910. Not more than 5 per cent of such a number is to be admitted in the course of a fiscal year. The bill is supposed to go into effect April 1, and remain in effect for 15 months. Through the percentage plan, the committee believes that not only will immigration be materially reduced, but that a greater proportion of immigrants who have demonstrated their assimilability will be secured.

The report dwells on the shortage of common labor and farm labor which is estimated at 4,000,000 July 1, 1920. It says it can see no injury done to a nation of 105,000,000 people by the receipt during the last six months of 1920 of 412,000 immigrants. The report also holds that immigration is affected by economic conditions and in the present depression there need be no fear of a flood.

In the hearings which the committee has been conducting upon the various proposed immigration bills, representatives of many industrial, civic, manufacturing and other concerns have been invited to present arguments. Among these was the National Federation of Construction Industries, which recently appeared before the committee in opposition to the Johnson bill presenting figures to show that there was no fear of an emergency inasmuch as all the steamers now plying the trans-Atlantic trade could, in the course of a year, bring but 1,052,000 steerage and third-class passengers to the United States, assuming that each vessel made ten round trips per year.

Production Decreases As Working Week Is Shortened

According to an investigation recently made by the National Industrial Conference Board into 436 manufacturing establishments in which 373,536 workers were employed, 87.2 per cent of the industries inquired into showed a reduction in per-capita production when the working week was shortened to 48 hr. or less. Eight and seven-tenths per cent of this number were able to maintain per capita output and 4.1 per cent actually increased. In the metal manufacturing industry, of 117 plants investigated 9 plants increased per capita output and 16 maintained it.

Bank Investigation by Lockwood Committee Denied by Senate

The Lockwood joint legislative committee which made an investigation of the housing situation in New York City recently has been denied increased power to investigate banks and insurance companies. The amendment to a resolution to such effect was defeated Feb. 15, by the New York State Senate.

The amendment sought by the Lockwood Committee, which was defeated, would permit the committee to investigate the form of organization and the business, practices, management, affairs and investment of all corporations and associations that have among other things the power to invest their funds in real property, or in bonds secured by a mortgage on the property in so far as the same may, in the judgment of the committee, bear upon the past, present, or future conditions of housing, building or loaning conditions in any of the cities of the state, insofar as such an investigation may, in the judgment of the committee, be pertinent to any recommendation for legislation affecting housing. The committee believed that, through such investigation, it might open channels for the financing of building operations.

Tax Exemption Bill Passed by New York Aldermen

An ordinance exempting from taxation for a period of ten years dwelling houses erected in New York City from April, 1920, to April, 1922, was adopted Feb. 15, by the New York Board of Aldermen. The ordinance provides an exemption up to $5,000 for a single house and $10,000 for a two-family house. Apartments are exempted at $1,000 a room up to five rooms. The ordinance must have the approval of the Board of Estimate and Apportionment before it becomes a law.

Ford Plant in Highland Park Increases Working Staff

Approximately 4,000 additional men have been added to the working force of the Highland Park, Mich., plant of the Ford Motor Co. This increases the force to 14,000 men. It is understood that a steady increase in the number of orders for new cars caused the additional men to be employed. All of the 4,000, it is reported, are married men who have not worked since the plant shut down Dec. 23.

Metal Trades Open Shops Idle Two Months

More than 100 factories of the Allied Business Metal Industries, New York City, resumed operations last week after almost two months of idleness, brought on by a lockout following a demand from the laborers of a decrease from 48 to 44 hr. per week. The shops re-opened upon a basis of no reduction in wages, 48 working hr. per week, and no discrimination against union or non-union men.

Wage Reductions Promised in Building Industry

One hundred building contractors of Denver, Col., members of the master builders association, voted recently to propose to the state industrial commission that a general reduction of 20 per cent in wages of those employed in the building crafts be made. Under the plan the reduction would become operative at the expiration of the 30-day period fixed by the state industrial law for giving such notice. Approximately 3,500 building craftsmen would be affected, union officials estimate. Of this total less than 25 per cent are now steadily employed, say the union officials.

General contractors and subcontractors of Chattanooga have served notice that, on April 1, the wages of all skilled labor in the building industry will be reduced 20 per cent and that "a day's work for a day's pay" will be demanded from their employees. The statement was signed by thirty-three contractors and was transmitted to the manager of the industrial board of the chamber of commerce.

Four Bethlehem Shipyards Cut Wages 10 Per Cent

Four yards of the Bethlehem Shipbuilding Corporation have undergone a 10 per cent wage reduction on all hour and piece work according to an announcement recently made by the secretary of the Atlantic Coast Ship Builders Association. The yards affected are the Fore River plant, Quincy, Mass.; the Moore plant, Elizabeth, N. J.; the Harlan plant, Wilmington, Del.; and the plant at Sparrows Point, Md.

Further Retrenchment Seen in Railroad Circles

News dispatches indicate that four shops of the New York Central R.R., employing about 3,600 men, have been closed temporarily. The shops are those situated at West Albany, N. Y., Elkhart, Ind., Collinwood, Ohio, and Depew, N. Y.

Approximately 900 workers of the Pennsylvania Railroad Co. were furloughed during last week according to an announcement made from Altoona, Pa., the Altoona car equipment department being the hardest hit. In this shop 511 men were furloughed. It is said there are thousands of cars on the sidings awaiting repair, but business conditions are such that there is no demand for them and nothing will be done, officials say, until the demand is apparent.

According to press reports the East End shops of the Norfolk & Western Ry., situated at Roanoke, Va., have closed down until March 1 because of lack of work. Approximately 1,500 men are affected.

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

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An Engineer in the Cabinet

FOR ENGINEERS no public event of recent years can compare in importance with Mr. Hoover's entrance into President Harding's cabinet. He has been selected, it is true, not because he is an engineer, but because he is Hoover—that exceptional combination of remarkable qualifications that has given him a deserved international reputation. Nevertheless, he is an engineer; he has the engineer's method of thought. His selection will help much in fixing a higher place for the engineer in the public mind.

Mr. Hoover's selection is to the engineers of trifling significance compared with its importance to the nation. He adds to the cabinet a very great strength. He comes to heavy national responsibility with a record of previous great national service—as Food Administrator during the war—and with those other remarkable records in the feeding of Belgium, the saving of Central Europe after the Armistice and his latest work, of raising $33,000,000 for European relief. This is an administrative record probably without parallel in the life of a single individual. Of this, the nation is fully aware, and Hoover will therefore carry into the cabinet a great measure of public confidence.

It may be thought that for such a man the secretaryship of commerce is too minor a post. In the sense that Mr. Hoover is eminently qualified for the biggest and most difficult place in the cabinet that is entirely true. Yet we believe that Commerce offers a most extraordinary opportunity, and one that Mr. Hoover, with his vision, will make the most of.

Despite the obvious fact that the nation can live only through agriculture, industry and commerce we have done only an infinitesimal amount to aid the two latter activities. Toward agriculture there has been a somewhat more intelligent policy. The Department of Commerce has been of only recent erection (1903). Before that time its work was done by weak bureaus, and since its elevation to department rank its activities have been far from commensurate with the place that industry and commerce hold in the nation's life.

It would seem to be the duty of such a department to sense the philosophy of American business practice, to learn its advantages, to find its defects, and to spread these so dramatically before the public that there would be a general maturing of our practice, a wider adoption of that which is good, a concerted effort to eliminate what is wasteful or wrong.

Just this sort of thing Mr. Hoover has initiated in the "Wastes in Industry" survey which he initiated and which, under his direction, is being made by the Federated American Engineering Societies. Surely here is a grasp of the significance of industry to the nation that not only gives assurance, but constitutes proof of what Secretary Hoover will do with the Department of Commerce.

To illustrate further it is worth while to point to the liaison which has existed between government and business in England. To that liaison is due in goodly measure her trade supremacy. Her diplomacy is but a forerunner of business. Her international policies are framed with trade considerations always in mind. The connection of business with the prosperity of the individual is a subject of constant governmental consideration. Therefore, support for business at home is no less strong than for export trade.

Germany's governmental attitude was similar, both toward domestic and export business. There, for example, the trust was not discouraged, but the people were protected from its abuses. Again, statistics were gathered in enormous volume that there might be available the figures needed for intelligent business direction.

We cite these examples not because Mr. Hoover will follow either an English or a German model, but to indicate by contrast how little, relatively, has been our governmental consideration of business. Nevertheless, business is the central material fact of the lives of over half of our people. Agriculture dominates the lives of the remainder.

While, therefore, we realize that the commerce portfolio is well down the list, as the importance of cabinet places is usually ranked, we look on it as a great opportunity. So, without doubt, does Mr. Hoover, or he would not have accepted it. With his vision, his business acumen, his appreciation of the psychology of the American people, his extraordinary administrative ability, we are justified in expecting results of very material advantage to the nation.

Teamwork in Government

SINCE we have empasized administrative ability so strongly in the preceding remarks, we cannot refrain from commenting on one striking feature in the change in our national administration this week. It marks the end of the lone-hand and apparently the return to teamwork in federal administration. The incoming President's selection for cabinet places of two men, at least, who are distinctly greater than himself in intellectual stature and all-round ability—Hughes and Hoover—is a sign of administrative sense that is distinctly encouraging. And we need encouragement today in thinking about our government—our inefficient, war-disrupted government. Business has largely recovered its poise. The government has not. It needs teamwork, strong teamwork to bring back order, efficiency and economy.

Another Call for Research

WHEN PRACTICAL MEN become dissatisfied with methods supplied them by the existing science of their subject, something is likely to happen. So, when a foundation builder like Daniel E. Moran points out the serious shortcomings of the theory of foundation resistance as we have it today, we may conclude, first,

that theory is indeed backward, and second, that the demand for a better science has reached the point for action. The former conclusion has been pointed out in these columns more than once within the past few years. The second conclusion means that a new epoch of foundation and soil study is just ahead. At present we produce many unsafe foundations and very many wasteful ones—wasteful because they do not make use of the resisting power of the soil, for lack of a satisfactory measure of this resisting power and for lack of theory to correlate test and structure. Progress must base on research of two kinds, experimental study of soil properties and analysis of foundation stresses. Such research faces great difficulties, but the problems at issue are of such wide importance that it may well engage our ablest investigating minds. What Mr. Moran has to say in criticism of present knowledge constitutes an urgent call for this research.

Bonding Operating Expenses!

REGARDLESS of the efforts of the Western Society of Engineers, various civic organizations, and the principal newspapers, Chicago, on Feb. 22, voted favorably on an $8,000,000, 20-year bond issue to pay current expenses incurred mostly during 1920. The limit of revenues for corporate purposes (running expenses) is set by the state legislature but the present deficit of about $7,700,000 was deliberately created by over-expenditures in the various departments. Short-time notes might have been issued but the voting citizens of Chicago prefer to saddle the debt onto their successors for 20 years. The 5-per cent interest rate will probably be augmented ½ per cent by the discount at which the bonds will have to be sold. Another deplorable fact is that the city's bonding limit, if all bonds authorized previous to this issue were sold, is only $4,400,000. In consequence other issues for permanent improvements must be postponed and the city is left with no reserve borrowing power. All talk about the iniquity of long-time bonds for short-lived roads pales into insignificance in comparison with the issuance of these long-time issues for deficits incurred for departmental salaries and current expenses.

Sustained Engineering Publicity

THERE are many means by which the engineer's place in our industrial and social scheme can be impressed upon the public. Quite a few are comprehended under the term "publicity," and these were the subject of a conference held under the auspices of the American Association of Engineers in Chicago last week. "Publicity" includes not merely the publication of articles in newspapers and in the general magazines, but such activities as public addresses, school lectures, moving picture films, and other media through which the story of the engineer and engineering can be carried to the popular mind. At Chicago chief discussion was directed toward the use of the newspaper for this purpose. It was agreed that the most effective method was by establishing contacts by local engineers with the local newspapers. However, unless the local publicity agent gets assistance from a national bureau, his activities are apt to cease with the getting into the papers of a few desultory notices of meetings. As the start of a national plan it was suggested that there be appointed by local societies publicity agents in forty of the larger cities to whom a central publicity bureau would send newspaper material each week. In a preliminary way the American Association of Engineers is doing this. The plan is worth expanding. Eventually there should grow out of the effort a manual of engineering publicity from which the local publicity committee and its individual representatives could learn how its work could best be done, what constitutes news, how to interest the editor of the local newspaper, how to prepare matter for newspaper use, etc. The good to be accomplished is so great and so obvious that it is hoped that something tangible will result from the Chicago discussion.

Relief for the Railroads

PAYMENT to the railroads by the Treasury Department of minimum amounts due them by the Government has been assured by the President's signature to the Winslow bill. There has been noted in these columns the serious condition of railroad credit due to the ruling of the Treasury Department against partial payments of amounts due the carriers covering the guarantee period from March to September, 1920, based on minimum acknowledgment of indebtedness by the Interstate Commerce Commission. With at least $300,000,000 due to the railroad companies and with the falling off in traffic, there was little wonder that the prospect has not been bright for new construction on a large scale, since a great many of the companies were unable even to pay current bills for maintenance materials. Although the railroad labor unions attempted to influence the President to veto the bill, it has become law, so that this "frozen credit" that has impaired many lines of business may be released. As pointed out by Senator Pomerene, it was merely a question of immediate payment of acknowledged debts pending the settlement of claims for larger amounts. With this legislation a potent argument against going ahead with needed railroad work has been removed. It is probable that a goodly part of the money will go into improvement work.

Cost of Reproduction

A DECISION at least temporarily barring evidence of physical value and cost of reproduction has been rendered by the Grand Trunk Arbitration Commission in determining the settlement between the stockholders and the Canadian Government, as noted week before last. When it was decided that the government must take over the Grand Trunk properties, an unusual situation was apparent in the problem of reparation to the owners, namely, that the value of the property as a going concern, based on earning power, was very much less than either cost of reproduction or investment value.

If deductions may be drawn from actions of the United States Supreme Court, the decision is in a fair way to be reversed, compelling the admission of evidence of physical value as well as other elements of value. Regardless of the fact that many portions of the Grand Trunk cannot be expected to pay for some time, they represent potential earning power, through actual investment in territories that may develop profitable traffic. Therefore, we believe it reasonable that the commission should at least admit evidence of physical value as developed by the engineers. A ruling which entirely bars such evidence certainly is arbitrary.

Labor Federation's Latest Declaration

WHEN 4,000,000 Amercan citizens speak through a single organization, or, since that is closer to the case, when their officers speak presumably for them, the views warrant the attention of the entire country. Last week the American Federation of Labor issued a statement of its position, and appended a "bill of rights." Like the similar statement made in December, 1919, the document is a disappointment.

Its central idea is that the federation is standing today for the protection of fundamental American rights. It is fighting, so the statement runs, two enemies—reactionary employers, on the one hand, and Bolshevistic influences and propaganda on the other. It protests against profiteering, against a method of industrial organization that has produced the present widespread unemployment, against industrial courts as arbiters of labor difficulties, against misuse of the power of injunction, and declares that trade unions have justified their existence by (1) making collective bargaining possible, (2) rescuing labor from autocratic domination, and (3) developing for the workers a standard of living and working conditions "fitting to American citizenship." It says, "Labor is anxious to serve. It has made this declaration repeatedly. It has lived and practised that determination. It has done this in the face of most wanton and brutal opposition."

So, in brief, runs the document. Its reading, however, leaves one with the impression that while working against forces sinister to labor and to the republic, the federation is placing the public in a decidedly secondary position, and has written an argument that, by emphasizing glittering generalities, will win support for its demand for "rights," but without committing the federation to the discharge of any responsibility. In fact, in the summary which closes the document, and which we have a right to assume includes all important features of the program, nothing is said about the interests of the public; on the other hand there is a demand (a) for "rights" and (b) for *freedom from responsibility*. Had the obligations to the public occupied a prominent place in the program, the leaders would not have emphasized their selfish aims to the exclusion of their public obligations.

The document, strangely, indicates also that the leaders realize the value of public support. However, in order to have a permanent hold on the sympathy of the American people the labor leaders must have a program in which responsibilities are as prominent as rights and must demonstrate, through the actions of their locals, that while striving for selfish ends the public also is to be benefited.

The day after the declaration was made public the federation formulated plans to lay its case before the American people. If newspaper accounts are to be believed, as much as $1,000,000 may be spent on this publicity. Before that campaign is mapped out, we hope that a "bill of responsibilities" will be drafted to go with the "bill of rights," and that the leaders will address themselves to a hard-headed presentation of the benefits of the labor movement to the country at large. Such an earnest study of the problem would reveal to the thoughtful among the leaders the serious weaknesses of the federation's present program and propaganda, and might lead to the formulation of plans that would so evidently redound to the benefit of the public as to win for the federation the coveted widespread public support.

Shall the Engineer Arm Be Recognized in Army Promotions?

ENGINEERING service in the World War will, in all probability, receive no recognition in the form of promotion to general rank unless engineers and engineering societies throughout the country bring their influence to bear on an immediate Army situation. Under the Army Reorganization Act twenty-six vacancies were created in the rank of brigadier-general. Through the President the Secretary of War sent to the Senate nominations which failed to include the name of a single engineer-officer who had been engaged in the performance of engineer duties with the A. E. F. in France. It is true that the list included former members of the Corps of Engineers who had been engaged on General Staff work, but no recognition was given to the personnel which was responsible for building our docks, railroad yards, storage depots, highways, bridges, and a wide variety of other works which were distinctly engineering in character. The Senate refused to confirm the nominations and action now falls to the incoming administration. The subject then will be reopened.

It is, of course, impossible to predict whether or not the same nominations will be offered after March 4. To be sure, however, that engineer officers will receive recognition for engineering work well done, it is necessary that the members of the profession exert themselves. Failure to recognize the engineer arm in these promotions is plain notice to the country of failure to appreciate the place that that arm holds in the conduct of modern warfare.

There exists no dearth of qualified engineer material for this increase in rank. In our opinion it would be a grave injustice to pass by such men as Col. Edgar Jadwin, formerly director of construction and forestry of the A. E. F., and in charge of the huge building program in the Services of Supply in France, and Col. Mason M. Patrick, originally chief engineer of the lines of communication in France and later promoted to become chief of the air service of the A. E. F., which he reorganized from a confused, inefficient organization into an effective, smooth-running machine. The former was a brigadier-general, the latter a major-general.

Promotion to general rank should be based on proved ability in actual service. In the A. E. F. the engineer branch was the largest of any of the so-called technical services, having a personnel of 175,000 officers and men. Both on the grounds of demonstrated qualifications for promotion, to say nothing of representation on a numerical basis, officers with such records as engineering administrators should receive promotion if justice is to be done. As a matter of fact, up to the present time neither of these officers has been promoted or recognized beyond the routine procedure of the War Department. Many others whose commands were smaller in number, whose responsibilities were less, have been advanced to the grade of brigadier general.

Largely through the apathy of the engineering profession the outgoing administration at Washington has been able to take action in many instances detrimental not only to the Corps of Engineers but to the profession at large. If the lesson of the past is to be learned, engineers as individuals and in their society organizations should communicate at once with their senators and with the new Secretary of War to the end that in making the promotions to brigadier-general engineers may receive what is their due.

Distribution of Soil Pressure as Related to Foundations

A Study of Foundation Resistance and Soil Stresses with Discussion of Pressure-Gage Measurements—Amount of Minimum Surcharge—The Direction of Future Progress

By Daniel E. Moran
Of Moran, Proctor & Proctor, Consulting Engineers, New York City
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SCIENTIFIC study of foundation problems, after remaining virtually stationary since the time of Rankine, has in recent years made a promising start with experimental study of soil pressures under loads. Rational thought on the subject has not developed to any extent, however, and the writer desires to present some considerations to stimulate such thought.

That the problems most actively discussed are really secondary is exemplified by the many opinions expressed on the question of how to calculate the bending moment in a projecting wall footing. The two competing formulas for such calculations differ in that one requires part of the wall load to be concentrated at the face of the wall, while the other assumes the wall to rest on its footing with uniformly distributed pressure. As the writer had occasion to show some years ago (in a chapter on foundations contributed to Kidder's "Architects' Pocket Book," 16th ed.), both are necessarily in error, and the truth is to be sought about halfway between their results. However, the greatest possible errors of this kind are negligibly small in comparison with the error (or uncertainty) involved in the universal assumption that the reaction of the soil is uniformly distributed across the width of the footing.

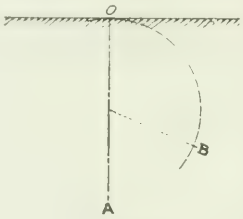


FIG. 1. STRESS CIRCLE IN SOIL

This assumption would be true for a footing supported on a fluid, or on a material acting as a fluid, but it is *not* true, and indeed is very far from the truth, in the case of a granular material, or rock. Experimental results and theory show that the pressure is greatest at the center of the footing and least at the edges. The bending moments, therefore, are much lower than those calculated by any of the formulas referred to.

The great importance of a knowledge of stress distribution in soils does not lie in the detail question of bending moment, but in the general problems of constructing safe and yet economical foundations. Before any precise planning of foundations is possible for a particular case, the laws of stress distribution in the material forming the foundation bed must be known at least qualitatively.

This requirement can not be avoided by selecting the foundation material. The location of a structure is generally determined by considerations other than the character of the material forming the foundation bed on which the structure must depend for support and consequently the material may be any one of the natural deposits forming the earth's crust.

It may be said in general that when rock is found it will act as an elastic solid; that when water, or soft clay, or granular material containing more water than can be held in the voids of the material, is found, they will act as a liquid; that when granular material such as sand is found it will follow certain laws governing elastic material and also other laws peculiar to granular material.

Pressure Concentration on Rock

When a footing rests on rock, the case may be properly considered as a load on a restricted area on the top surface of an elastic body of large dimensions as compared with the area loaded. Theoretical analysis has shown that the unit stresses in the rock under the center of the load are greater than at the edges. (Love, "The Mathematical Theory of Elasticity".) While the allowable unit loading on rock is high, spread footings are often necessary under the limitations of loading fixed by building departments; if proper account were taken of the concentration of loading under the central part of the footing, grillages and the like could be dispensed with in most cases, and simple pedestals of small size substituted.

Experiments show that the unit crushing load for a limited area of loading, central to the top surface of a cube, exceeds the unit crushing load for the entire top surface. From this we are justified in concluding that an area covered by a footing is reinforced by the surrounding rock to the extent that it would be if the rock mass were a cube with a top face equal in area to the area disclosed by the excavation. Exceptions should be made if the rock is seamed, faulted or in thin beds.

As an example (taken from the author's recent experience) take the case of a column load of 5,000,000 lb. resting on a billet base approximately 44 in. square, or 2,000 sq.in. in area, under which there was provided a two-layer grillage weighing approximately 10 tons, designed to distribute the load over a rock area of 8 x 8 ft. at 40 tons per sq.ft. The rock was of good quality and if a cube 8 ft. in each dimension were tested on an area of 2,000 sq.in. at the center (corresponding to the use of the billet alone) it undoubtedly would develop a unit crushing strength on that relatively small area of over 15,000 lb. per sq.in., or 30,000,000 lb., or six times the load. The writer is therefore forced to the conclusion that in this, and in many other cases where grillages are used to distribute column loads on rock, the only value of the grillage is to meet the requirements of municipal building codes; and that in general a pedestal, rather than a grillage, should be used on rock, or material which can be counted on as an elastic solid.

A still more remarkable instance, the use of a distributing girder on rock, came under the author's observation this year. In the reconstruction of a building two new columns were to be placed close to existing walls, the walls being about 40 ft. apart. A shallow trench was dug to rock and a reinforced-concrete girder

about 4 ft. wide, 6 ft. high, and 40 ft. long was constructed. The column bases were placed on the extreme ends of the concrete girder. The girder was designed to distribute the load of the two columns over a bed of solid rock not less than 4 ft. wide and 40 ft. long. The figured unit load on the rock could not have been over 200 lb. per sq.in., but on the concrete close to the vertical sides and ends of the girder it was undoubtedly 500 lb., the limit allowed by the building code. The construction would have been much safer if the column bases had been placed 6 ft. deeper, directly on the rock, at any unit load which would have been allowed by the building department. At 40 tons per sq.ft. (building department allowance on rock) the footing for each column would have required possibly 32 sq.ft. area; at 4,000 lb. per sq.in. a pedestal 27 in. square would have sufficed.

Non-Uniformity of Pressure in Sand

Similar anomalies in practice sometimes arise in connection with foundations on soil or granular material, but our lack of knowledge concerning stress distribution has here much more serious results. The vital relation of minimum surcharge to bearing capacity is involved both in loading tests and in actual foundations, and we appear to be largely in the dark as to the relation between settlement, load and footing design.

There has been much discussion lately as to the distribution of stresses in granular material, and various experiments have been made with the object of determining experimentally what these stresses are. However, when a mass of sand is subjected in a laboratory to loading tests, the results may differ from actual field results, due to the fact that the sand is confined in a bin of relatively small dimensions; that the proximity of the bottom and sides of the bin to the apparatus measuring the loads may, and generally does, influence the distribution and measurement of the stress; and finally, that the sand is not as compact as it is generally found in nature. Proper interpretation of the test results is therefore difficult.

In what are probably the most reliable tests, Goldbeck pressure cells were used. Various tests have been reported, notably by A. T. Goldbeck himself (Proc. Am. Soc. for Testing Materials, vol. 17, 1917, pp. 650, 651). Goldbeck's tests, and others contained in the report of the committee on Bearing Value of Soils of the American Society of Civil Engineers (Proc. Am. Soc. C. E., Aug., 1920), and still others in the second progress report of the committee on Stresses in Railroad Track (Proc. Am. Soc. C. E., Feb., 1920) establish the general character of the curves showing the vertical components of the stresses for horizontal planes below a loaded area. In the following illustration of experimental determinations of the stresses in granular material (Fig. 3) the writer has reproduced, with slight modifications as to scale, curves given by Goldbeck, with, however, the addition of a curve necessary to complete the series, which was deduced by the writer from the original curves. Curves *G* are taken directly from Mr. Goldbeck's article, the one marked *G int* is the interpolated curve.

Present Theory Faulty

In this connection reference should be made to an interesting study of stress distribution in granular material by Prof. M. L. Enger in the Track Stress report cited. Prof. Enger gives curves for the observed distribution of stresses in granular material due to loaded railroad ties, and also theoretical curves based on Rankine's theory of the relation of pressure in a granular mass devoid of cohesion ("Applied Mechanics," 16th ed., p. 220), combined with the assumption that "friction between tie and ballast develops pressures which are not vertical." It is interesting to note that Rankine himself, in discussing the application of this theory to a footing resting on granular material, says that

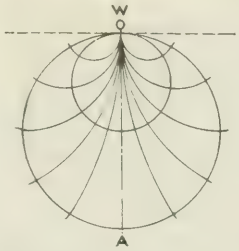


FIG. 3. STRESS TRANSMISSION FROM SURFACE LOAD

$$\frac{p}{wx} = \left(\frac{1 + \sin\phi}{1 - \sin\phi}\right)^2$$

is "the limit of the ratio in which the weight of a building exceeds the weight of the earth displaced by it *when the pressure is uniformly distributed over the base.*" Using the same theory Prof. Enger finds that the pressure cannot be uniform, but must increase from the outer edge of the tie toward a maximum at the center. It seems as if Prof. Rankine had made the assumption of uniform pressure, when he had in his own reasoning the theoretical means to disprove the assumption.

From the most casual inspection of Goldbeck's tests it may be seen that the assumption of uniform stress distribution in the material underlying the footing is untenable. It must be replaced by one based on the fact that when a footing is loaded the stresses in the natural granular material underlying the footing are greatest at the center and reduce to a minimum at the edge of the footing and one which also recognizes the well known fact that there is, in general, a tendency for a lateral movement of material away from the axis of the stress, which tendency may result in an upheaval of material at the side of the footing. There has been much discussion and misapprehension in this connection. The writer believes that the stresses in granular material under a loaded footing follow certain simple laws, and that the apparently conflicting or indeterminate results obtained by different experimenters will be readily reconciled and understood if we first have a conception of the theoretical distribution of the stresses.

Behavior of Sand Under Load

In considering a granular material such as sand we must recognize that under stress various things may happen:

1. Each grain being a particle of elastic material, the entire mass may be consolidated as a result of the elastic deformation of the grains composing the mass.

2. The mass may be consolidated and given a permanent set by crushing (to a greater or less extent) individual grains, permitting a readjustment in the position of the grains.

3. There may be a movement of portions of the mass in lateral and upward flow of sand near the edge of the footing.

4. There may be a consolidation of the sand resulting

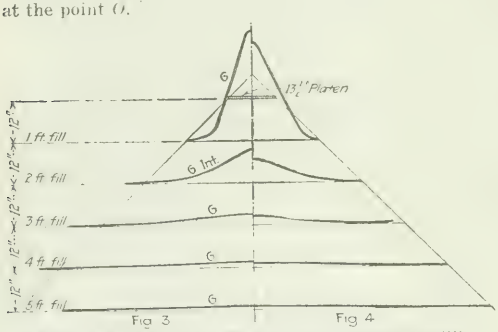
from any readjustment in the position of grains caused by vibration or by movements in the mass.

5. There may be shearing effects due to cohesion between particles of the granular mass.

Before considering the effects of cohesion, elasticity, consolidation by crushing, or other energy-consuming phenomena, it will be well to establish approximately the way in which the static stresses will be distributed in a theoretically perfect granular mass.

Spherical Surfaces of Uniform Stress

Let us assume, for simplicity, that the granular mass is composed of particles irregular in size and shape, devoid of cohesion, elasticity or weight. Let us consider first the distribution of a stress acting in any direction on any point in the interior of such a mass. In Fig. 1, let the stress W, acting in the direction $W\ A$, be applied at the point O.



FIGS. 3 AND 4. SOIL PRESSURES UNDER PLATEN WITH [illegible] LB. LOAD

Goldbeck's measurements at left. Author's theoretical curves at right.

The writer believes he has succeeded in demonstrating that the resultant stress at any point of the mass in the region between O and A, say at B, will be normal to the surface of a sphere passing through B and O and having its center on line $O\ A$; and, further, that the intensity of stress will be uniform and equal to Wc/D^3, in which c is a constant having a value about 40. The demonstration may for the present be expressed merely as the necessary resultant of the following principles: (1) That the paths of stress transmission diverge by the effect of the conjugate or lateral pressure which, resulting from hit-or-miss irregularities in grain arrangement, accompanies every directed pressure in a granular material; (2) that this lateral pressure is proportionate to the direct stress; and (3) that the lateral stresses traced around a closed curve must everywhere equilibrate each other. The lateral-stress surface may therefore be regarded as a shell of uniform tangential stress (like a balloon, but with compression in place of tension); and since the normal stress, being proportionate to the lateral stress, must also be uniform, the surface is a sphere.

However, without dependence on the two deductions above stated or their demonstration, it will be obvious that the outward spread of stress from the point of application of the load must occur along curved radiating lines somewhat similar to those drawn in Fig. 2, and the surfaces of equal stress are represented by closed curves which, whatever their precise form, may for the purposes of the present discussion be taken as circular in their lower portions.

The foregoing statement as to stresses is framed to suit the distribution of a stress applied to a point in the center of a mass of granular material. To apply it to the case of a load acting vertically downward on the horizontally-disposed top surface of a granular mass, we may pass to Fig. 2, in which W represents a stress along A, perpendicular to the top horizontal plane surface $C\ D$ of a mass of granular material. Draw through the point of application, O, circles of various diameters each tangent to the line $C\ D$ at O and all having their centers along the line $O\ A$; then these circles may be taken as representing the traces or intersections of spherical surfaces with the plane of the paper. It will then be true of any point on any circle that the direction of the stress through that point will be normal to the surface of the sphere, i.e., that the stress will act along the direction of a radius of the sphere drawn to the point; and also that the intensity of the stress will equal Wc/D^3 where c is 40 and D is the diameter of the stress sphere through the point. We may therefore consider the spheres as being contour lines drawn through points of equal stress.

Again, if from any point on the line $C\ D$ we draw a circle passing through O, this circle will evidently cut all the contour circles at right angles, i.e., tangents to both circles at the point of intersection will be at right angles; and circles so drawn may be taken as indicating stress gradients, i.e., lines of which it may be said that they start from the maximum stress at O and follow a path along which the intensity of stress constantly decreases. The rate of decrease in stress intensity will be less along gradient circles drawn with a large radius than along gradient circles having a small radius, and, moreover, the rate at which the stress intensity decreases will not be uniform along the gradient lines but will be inversely proportional to the number of contour lines cut in a given distance.

In the diagram we may, without modifying the stress conditions, substitute for the theoretical point application an application of stress through a surface, such as the under surface of a circular footing or of a circular platen in a testing machine, *provided* we place in the diagram the pressure-producing surface at a distance below the line $C\ D$ equal to its half-diameter. In other words, there will be no difference in the stresses produced in the granular material whether the load is applied at the point O or whether it is applied on a circular plate replacing the entire horizontal cross-section taken through the center of any one of the spheres which define surfaces of equal pressure.

Knowing the direction and intensity of stress at any point in the mass we can draw curves indicating the vertical or horizontal components of the stress along any desired line. In order to make a comparison with the experimental results the writer has constructed curves based on the foregoing theoretical considerations, to show the vertical intensity of stress on the planes corresponding to the location of the test planes and the size of the platen used by Goldbeck. The comparison is made in Figs. 3 and 4. It will be seen that the curves are of the same general character.

The Natural Foundation in Sand

What now is the practical conclusion to be drawn from the above theoretical considerations? How will the conditions differ when a natural foundation bed is loaded?

Let us suppose that the theoretical granular material, which we have been considering as being devoid of weight, cohesion and elasticity, suddenly becomes endowed again with its natural qualities. It is evident that under the center of the footing and along a line drawn vertically downward the stresses are greatest, and the effects resulting from the stress, namely crushing and compression of the grains, will be at a maximum; and that these effects will extend to a maximum depth, as compared with the other portions of the mass supporting the base of the footing. The intensity of the stress under the edge of the footing is much less than the intensity at the center and acts on a shorter and more inclined column of granular material opposing the descent of the platen. If there is no general movement of sand such as occurs when there is insufficient surcharge, the energy of settlement (i.e. the work in footpounds developed by the load of the structure moving downward, which is the energy which acts to crush and compress the sand) will result in a slight increase of the stress under the edges of the footing and a slight decrease in the stress under the center.

But if, as in most laboratory experiments, the surcharge is insufficient, the sand near the edges of the footing, being subject to stresses directed outward and upward, will overcome the weight of the insufficient surcharge and move outward and upward. The effect of this movement will be to destroy the supporting value of the sand subject to the movement, and the intensity of the stresses at the center will be increased by whatever amount of support is lost as the result of the sand movement.

The problem in general is, therefore, not only one involving the statical stresses produced in a theoretical granular material, but also one involving the dynamics of crushing, compression and movement of sand.

Effect of Surcharge

Consideration of the theory, however, demonstrates that if the surcharge equals one-half the diameter of a circular footing there can be no stress producing uplift of sand, because all of the contour lines indicating stress are below line *C D*, drawn through a point above the platen at a height equal to the half-diameter of the platen or footing. It is only when the surcharge is less than the half-diameter that we need fear lateral or vertical movements of sand.

When the surcharge, or some substitute for the surcharge such as a concrete floor, prevents lateral or vertical movement the problem reduces itself to one of determining the amount of settlement which will result from elastic compression, crushing and consolidation due to the stresses, possibly complicated by the slight shifting of stresses which must be expected as the result of the greater consolidation along lines of maximum stress. These effects, under any reasonable loading, will be very small—generally negligible—corresponding to the general experience that a footing on sand having a sufficient surcharge settles little.

Stress-strain determinations on sand, made for the writer by A. H. Beyer, Director of Testing, and W. J. Krefeld, Engineer of Tests, of the civil engineering laboratories at Columbia University, indicate that under an applied load of 100 lb. per sq.in. the total compression of Cow Bay sand per inch of length is 0.0049 to 0.0074 in. for sand compacted by vibration to a percentage of voids less than 30 per cent of the total volume. A sand not so carefully compacted, having voids 34.1 per cent of the total volume, compressed 0.0177 in. per inch of length. In the first two cases about 50 per cent of the total compression was recovered on the removal of the test load, so that, roughly speaking, we can say that for loads on compact sand one-half of the settlement is due to elastic compression, the remaining half being due to crushing or other consolidating effects which consume energy but do not produce a continuously effective resistance. In the case of the loose sand a much smaller proportion of the total energy goes to elastic compression.

To make an approximation of the facts in a practical case: While the unit stress under a footing designed on the basis of a uniform load of 4 tons per sq.ft. or 55½ lb. per sq.in. may amount to several hundred pounds per square inch directly under the center of the footing, this stress rapidly reduces in intensity with depth, so that the column of support which terminates under the center of the footing in a small area at high unit-pressure will, at a short distance below the surface, become a column of large area with a low intensity of pressure. The rate of compression due to the high unit pressure can only be figured for a short length of column before it must be reduced to the amount of compression due to a very much lower unit pressure. As the unit pressures vary inversely with the areas, and as the areas increase with the square of the distances, if the amount of compression is (within limits) proportional to the stress then the amount of compression per foot of length will decrease as the square of the distance.

A rational extension of Goldbeck's curves would indicate a center pressure under the platen of not less than 150 lb. per sq.in. The theoretical maximum would be much more. Experimental determinations of the actual stress are greatly to be desired.

The pressure under the platen is at the center more than 150 lb. per sq.in., but at 12-in. depth only 30 lb., at 24-in. depth probably 7 lb., at 36-in. depth 3 lb., at 48-in. depth 1½ lb., and at 60-in. depth less than 1 lb. per sq.in. Thus there is only a short distance in which high intensity exists, and the total compression must be small, probably not more than the amount due to a load of 100 lb. per sq.in. for a length of 2 ft. This applies to a load of 5,000 lb. on a 13½-in. platen.

It would seem from the foregoing that it would be safe to use much higher unit-pressures on sand, i.e., to reduce the areas of support, and also safe to design for much smaller bending moments at the center. The writer has for many years believed that this was the fact and that most failures of footings on sand were due to a movement of the soil because of lack of surcharge or to a general movement due to causes not connected with the design of the footing. Changes in the basis of loadings on sand and of footing design should go slowly and as a result of full confirmation of theoretic and experimental results, however.

Effect on General Foundation Problems

The author has, in this article, attempted to indicate the application of the experimental data, and of the proposed theoretical explanation, to the single example of footing and foundation design. There are many other problems involving earth pressures to which the principles involved may be applied.

The engineering world has been discussing earth pressures on retaining walls and bracing excavations

and earth pressures in general and the belief seems to be gaining ground that the theories of Rankine, Coulomb and others based on the sliding of earth along planes determined by the angle of friction do not correspond with practical experience. Many engineers believe that the maximum earth pressure against a vertical wall is not at the base. This opinion is supported by the present theory.

The movements of soils under pressure and the failures of banks along spherical or cylindrical surfaces have seemed to the author not to be explicable by the older theories but do seem in accordance with the present theory.

A number of interesting conclusions will undoubtedly come to the mind of anyone who has closely followed the foregoing.

IMPORTANCE OF DETERMINING CONDITIONS OF SURCHARGE

It is evidently absurd to speak of any granular material as having a bearing value of a fixed amount, unless the conditions as to surcharge are known.

It is evidently useless to make or compare test loads on sand or other granular material unless we formulate the conditions as to surcharge. If we wish to determine the resistance to crushing and elastic deformation, the surcharge must be of a depth not less than half the diameter of the area tested, and must be well-compacted. If we want to determine whether cohesion or other qualities in the sand will prevent or reduce the movement of sand, we should specify what amount of surcharge should be used.

As ordinary sand under a test load of 1,000 lb. per sq.in. compresses less than 0.05 in. per inch of length, it is evident that sand can be loaded by a properly-designed footing greatly in excess of the conventional 4 tons per square foot, provided a reasonable amount of surcharge necessary to prevent motion can be maintained. It is evident that under the same condition the bending stress in the footing will actually be much less than as calculated by any of the current formulas.

Preferential Power Contracts Subject to Regulation

A decision recently handed down by the Supreme Court of California rules against Hartland Law who contended that the California Railroad Commission exceeded its powers in forcing him to pay the Great Western Power Co. rates fixed by the commission for electrical energy and steam heat, despite the fact that he held a twenty-year contract at a lower rate. The decision settles a dispute of long standing arising from the fact that municipalities and others enjoying special rates held that the commission had no right to disturb a situation in which the holders of long term contracts for utility service enjoyed advantages which resulted in increased cost for the other consumers. The court held that "there is no longer any question as to the power of a state to fix rates for a public utility service which will supersede rates for such service previously fixed by private contracts between the consumer and the company. It has been conclusively settled that the interference with private contracts by the state regulation of rates is but a legitimate effect of a valid exercise of the police power which neither impairs the obligation of a contract nor deprives of property without due process of law."

Local Freight Problem at New York

Extracts from a paper, "The Transportation Problem of the Metropolitan District," by J. J. Mantell, regional manager, Erie R., before the New York Railroad Club, Feb. 18, 1921.

COMMENDATION is due the New York-New Jersey Port and Harbor Development Commisison for its untiring efforts and for the valuable statistics, contained in its recent report, some of which were not previously available. While certain concrete and specific recommendations are made, the most disappointing thing is that there is no immediate relief in sight. The principal objection to the commission's plan for the "automatic-electric system," is that it involves an unwarranted expenditure.

The plan is based on the general principle of a moving platform placed underground resembling a railroad but functioning more as a conveyor, linking up the New Jersey railroads by a belt line and building a joint yard or transfer station on the Hackensack meadows. The automatic-electric tracks, starting from this yard and passing under Bergen Hill and the Hudson River, would serve nine or ten multiple-story warehouses covering from four to six square blocks in Manhattan. Who is going to finance the project and how can a facility of this kind be made to pay at an estimated original cost of $240,000,000? It would be confined to only certain kinds of domestic freight: small package freight not including heavy pieces of structural steel, building materials of various kinds, machinery, other heavy articles, and particularly coal. It would simply be a small package railroad to release water-front piers.

It is generaly admitted that something must be done at New York. I think it is agreed that we must proceed along lines that will give some immediate relief and plan a gradual development which will reduce the cost of handling freight. Under existing conditions the handling of domestic freight, both from a railroad and merchant standpoint, cannot be done economically. There is pier congestion; there is waiting in line; there is loading and unloading. The average truck in New York is only moving from 25 to 30 per cent of the time. There is duplication in cross hauls.

The problem can be solved and this would be advantageous to both the merchants and the railroads. My recommendation is that we give serious thought to a plan which would provide for the handling of freight from existing and centralized freight stations in New Jersey to warehouses and store-door delivery in New York on practically all carload business, which amounts to at least 40 per cent; creating inland stations in the metropolitan district suitably located in proper zones for receiving and distributing less carload freight. These inland stations would be equipped with specially arranged bodies or containers where the assortment for particular consignees and particular destinations could be made, the stations to be equipped with proper mechanical appliances for prompt handling of these removable bodies to and from tractor trailers. In other words, you can do your business on wheels; keep your motor tractor turning over; increase its efficiency; do away with the waste of rehandling on the railroad and the trucking waste which at present exists in New York, and effect a real store-door delivery. A man today who is operating trucks would be surprised at the benefits, not only the benefits in the line of service that would be derived, but in the decreased cost of handling his goods. This can be brought about by collective effort on the part of the merchants and railroads to demonstrate the practicability of such a scheme.

Canvas Carpet Keeps Truck Body Clean

Using a dry mix, Lee bodies on trucks hauling concrete for road work in Walla Walla County, Washington, were kept clean by a canvas carpet attached to the front edge of the body and covering the entire bottom to the rear edge. Before each new load the body was washed clean with water. Maximum hauls of 9,800 ft. were made in 20 min., 12 min., with load, and 8 min., return time empty. A Guthrie & Co., St. Paul, Minn., were the contractors.

Filter Underdrains, Sand Bed and Wash Water Experience

Discussion of Symposium on the Subjects Published in "Engineering News-Record" of Nov. 11 and 18, 1920

By Malcolm Pirnie
Of Hazen, Whipple & Fuller, New York City

THE "Symposium on Current Practice and Operating Success with Various Details of Mechanical or Rapid Water Filtration Plants" published in *Engineering News-Record*, Nov. 11 and 18, 1920, pp. 934 and 984, is of great interest to designers and operators of filtration plants. It sets forth varied designs for accomplishing the same result, most of which are satisfactory or have been made satisfactory by slight changes. There is no standard design for mechanical filters in spite of the fact that the fundamental laws governing successful designs are identical for every plant, and it is probable that there never will be a standard design because these laws may be obeyed by a multitude of details especially adapted to local conditions. It is essential to have a clear understanding of the performance of a filter bed, both in filtering and in cleaning, in order that the details of construction shall be as simple and cheap as possible and still satisfy the principles governing continuous efficient operation.

When the size and depth of filtering material and rate of filtration have been determined to treat a given water, the filter design must provide for two primary requirements. First, during filtration, the water must pass through every unit of filtering area at a uniform rate; second, the provision for cleaning must be such that the entire bed shall be uniformly cleaned and left uniformly graded at the end of the cleaning operation. In almost every design the first requirement is dependent upon the second, so that a mechanical filter equipped to wash and grade uniformly the filtering material will filter water uniformly; and conversely, a filter not uniformly washed and graded will not filter evenly, and the efficiency during the first part of the run will be considerably reduced. The primary problem is the selection of proper details for supporting the filtering material and uniformly grading and cleaning it.

The next step is to determine the rate of wash water required and whether or not the aid of air agitation of the surface is necessary. The maximum effective wash-water rate depends upon the size and specific gravity of the filtering materials. Uniform washing, when sufficient to suspend the bed, is simply the reverse of sedimentation—the water rising upward past the particles at the same velocity that the particles would fall downward through water in the process of settling. If the rate of wash water is increased above what is necessary to suspend the bed, the particles simply readjust themselves with increased voids, so that the velocity of water passing them remains the same, exerting an upward force on them just balancing their weight. Thus a rate of wash water greater than is required to suspend the bed will not increase the scrubbing action on the individual particles. Therefore, when the size and specific gravity of the filtering material have been selected, a wash-water rate just high enough to suspend the portion of the bed subjected to clogging may be determined. This rate will give the maximum cleansing effect, while higher rates will consume more water and will not clean the bed any faster or better. The higher rates may serve in some cases to carry into the gutters some dirt that otherwise would settle back on the surface after washing, but the expulsion of this dirt should be provided for by restricting the area between gutters in order to increase the velocity above the agitated sand.

Part the Gravel Plays

To produce a uniform wash the water required must be delivered to every unit of area at the bottom of the filter in equivalent quantities and above the bottom there must be sufficient baffling to destroy all eddies and a uniform resistance throughout the entire area must be exerted on the rising water to distribute it evenly at the point where it enters the main filtering material. Furthermore, the filtering material must be supported in such a way that it will not penetrate the supporting and distributing portion of the bed. Gravel support for sand has become almost universal, but there is a wide variation in the sizes, number of grades and depths used. The selection of gravel should depend upon the spacing and size of the unit wash-water inlets which also determine the velocity of the entering stream. If the inlets are large and far apart the gravel surrounding them should be large to avoid clogging the inlets and to allow distribution of the wash water over the areas between them. The final layer of gravel should not be lifted by the maximum rate of wash water, unless the lower grades are sufficient to maintain the uniform rate of wash. Now the first grade of gravel allows the distribution of the wash water through the voids over the entire filter area and begins the baffling action on the eddies created by the relatively high velocities of entrance. The superimposed layers of smaller gravel must introduce sufficient resistance to complete the destruction of eddies and to cause a uniform upward entrance velocity, or at the entrance to the final gravel if the wash rate is high enough to suspend it. This effect can be accomplished only by the most careful grading of the gravel at the time of construction. Each layer must be of uniform material and thickness and absolutely level so that the resistance to the rising wash water will be the same in every part of the bed.

Uniformity Essential

When the bed settles after wash is turned off, there exists a uniformly separated mass of sand with particles of equal size lying in the same horizontal planes, the finest at the top and the coarsest at the bottom. The surface of the bed is absolutely level and is uniform as to color and size of sand. If the wash were not uniform, the surface of the bed after washing would not be level, and there would be apparent dark spots where coarser sand was exposed to view. These spots would mark the places where the upward velocity of wash water was greater than at the other portions of the bed. With the uniformly graded and clean bed there will be a uniform resistance offered to filtration, and the water will pass through all parts of the bed at the same rate; but in beds where shafts of coarse sand have been introduced by an uneven wash, the water will pass through these shafts directly to the gravel and underdrains at a relatively high velocity. Restricting the size of openings in the underdrains to control equal filtration will have little effect, as water piercing the sand bed in spots at high velocities can pass laterally through the large voids in the gravel and enter several openings in the

underdrains. This fact leads to special constructions of filter bottoms to limit lateral flow, such as parallel or intersecting ridges or plate baffles. These cannot be entirely effective in stopping lateral flow during filtration unless they project to the surface of the bed.

The largest proportion of the head lost is in passing through the dirty surface layers, and, if there is opportunity for rapid passage in spots, lateral flow can take place in the relatively coarse lower portions of the sand (although to a less degree than in the gravel). Therefore, the most effective way to insure uniform filtration is to construct the bed so that it can be uniformly washed at a high rate to suspend and clean the sand and leave it uniformly graded. In this case, the strainer system should be designed properly to distribute the wash water without introducing too much disturbance at entrance and the gravel should be deep enough to destroy all eddies.

Perforated-Pipe Factors

The perforated-pipe underdrain system above a plain floor with the perforations on the under side of the pipes is becoming very common. The even distribution of wash water over the bottom is obtained by restricting the size of the perforations to cause a relatively large loss of head at these points of entrance. The main force of the jets hits the floor and is broken. The water spreads out through the voids of the large gravel surrounding them and the superimposed uniform layers of finer gravel introduce the resistance necessary to distribute the rising wash water evenly over the entire area of the bed. This seems to be the simplest way of producing the desired results, but certain special bottoms and upward or lateral discharge strainers have been successful, although requiring deeper layers of gravel, screens or other devices to break up and distribute the entering jets before they reach the sand. The question as to which of many successful designs should be adopted for a given case should be decided on the basis of comparative costs. It is difficult to find a strainer system less expensive than the perforated-pipe design and this has led to its use on a large scale.

Perforated-pipe underdrain systems which lie within the following limits of design have been successful. Throats from 6 to 12 in. apart, all pointed downward. Loss of head of wash water through throats, from 6 to 10 ft. Area of main drains twice the area of all the throats supplied by them and area of lateral piping from 2½ to 3 times the area of all the throats supplied by them. Gravel in the first layer should be about 4 in. thick. It is absolutely necessary that each layer of gravel should be composed of uniform material, should be the same depth over the entire area of the filter and should be perfectly level. Failure to secure the utmost care in placing the gravel means failure in the operation of the filter. Too much importance cannot be given to this fact. The total depth of the gravel bed may be from 16 to 24 in., depending upon the throat velocity selected. These depths might be reduced, but it is better to allow a fair margin of safety to overcome irregularities in construction. The most effective wash-water rate for ordinary mechanical filter sand is between 1¾ and 2 cu.ft. per minute per sq.ft. of filter area.

A great many experiments have been made on differnt types of underdrains and supports for the filter bed, and they have been most useful in directing successful designs for large filtration plants. Still more experiments, with wide publicity given to the results, are desirable, but it must be borne in mind that it is difficult, if not impossible, to secure the same perfection in the construction of a large plant that it is in the construction of a small experimental unit. Furthermore, there are conditions existing in a large filter bed that are not duplicated in a small bed. Therefore, it is reasonable to give greater weight to designs that have been in successful operation on a large scale for a number of years than to the results of a relatively short period of operation of an experimental plant. There is still a great deal to be learned about mechanical filter construction and operation, and nothing can be more valuable to the designers than a knowledge of the experiences of the operators of mechanical filters throughout the country.

Physician and Engineer Needed to Control Yellow Fever

By C. G. Wigley

With Clyde Potts, Civil and Sanitary Engineer, New York City

The final report on Yellow Fever Control in Ecuador, by M. E. Conner, M.D., Field Director International Health Board, contains the following paragraphs that should be of interest to engineers engaged in water-supply engineering in tropical or semi-tropical areas:

As a result of the yellow fever work in Ecuador, it was possible to arrive at certain well-defined conclusions. With the idea that they may be of more than general interest, they are here set down:

The only endemic center of yellow fever in Ecuador was in the city of Guayaquil.

The principal factor in the eradication of yellow fever at Guayaquil was the mosquito-proofing of fresh-water containers, especially tanks.

When tanks are used in homes for storing fresh water, they will be the preferred breeding places of the stegomyia mosquito.

Fish as mosquito-larvæ consumers produce excellent results in barrels and similar containers, and are an economical means of mosquito-proofing this class of fresh-water receptacle. Fish are not recommended for use in tanks, because the latter are placed high up to gain head pressure, and it would be necessary for the inspector to use a ladder whenever he inspected the tank to be sure that the fish were still alive. The necessity of all this extra labor is eliminated by covering and "sealing" the tank. Again, when the water is low in the tank there might not be enough to keep the fish alive.

Yellow fever has been eradicated from Ecuador, and if it should ever again become endemic it would be because it was introduced from a focus outside of the country.

It would seem that this is an additional field for co-operation between the physician and engineer for the greater welfare of the human race. Success in eliminating typhoid fever and cholera has been due to the efforts of physicians and engineers operating more or less separately. In work relating to the control of malaria and bubonic plague they now work together more effectively.

The conclusions given in the quotation lead one to believe that cities in Ecuador need the services of sanitary engineers. In a country having some 50 in. of rainfall per annum it would not seem an impossible task to provide for a city of 60,000 or more inhabitants, a water-supply system in which the objectionable storage tanks would be eliminated. It is believed that by utilizing the machinery and equipment now available such a system could be readily devised.

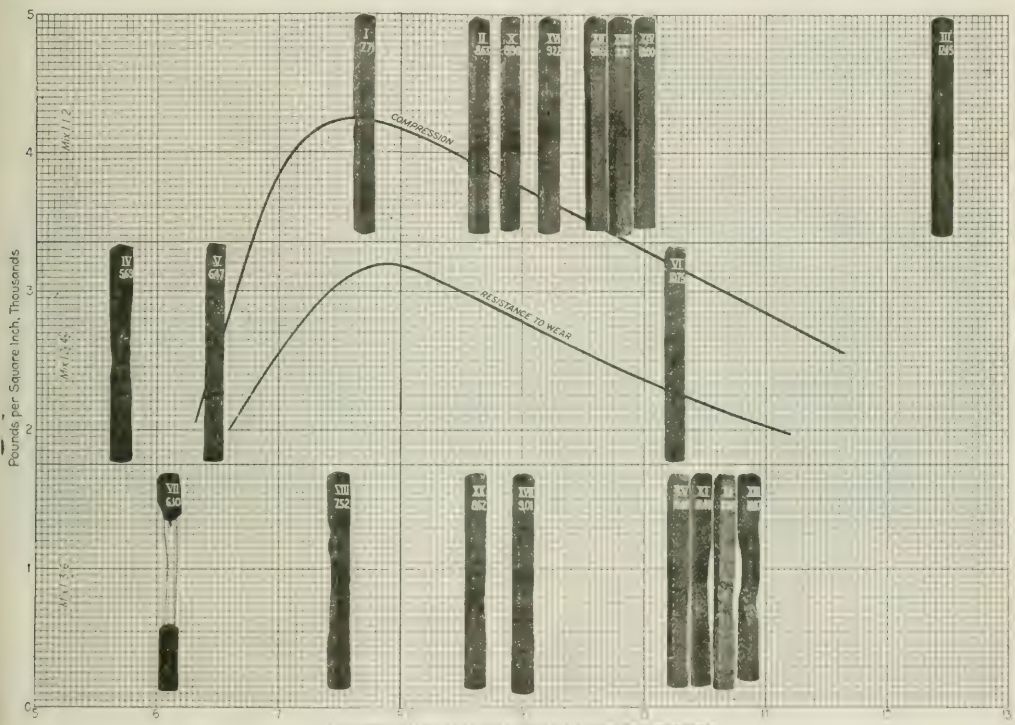
Water Content Affects Wear of Concrete Test Pieces

By Dan Patch
Aserthaw Construction Co., Boston, Mass.

In studying the latest inspection report of the behavior of the test pieces placed by the Aberthaw Construction Co. in Boston harbor in 1909, the effect of water content in concrete has seemed to be important. The accompanying diagram has been prepared to illustrate the results observed; it should be read in connection with the more complete data on the tests published in *Engineering News-Record*, Jan. 20, 1921, p. 121. The photographs of the test pieces as taken from the water in 1920 are re-arranged on this diagram in such a way that the engineering lessons may be best seen. From the data of the mixtures used in making the test piles, each has been reduced to an equivalent percentage of water based on dry aggregate. The photographs have then been arranged by mixes on a scale of water percentages. By this arrangement it will be seen that there is much more variation in any one mix, due to varying the quantity of water used for the mixture, than there is between the mixes at the proper percentage of water.

It is evident from the photographs that in these tests the best percentage of water for a mix to resist the action of the tidal water is from 9 to 10. As the test was not made with an intent to study the effect of the variation in quantity of water used in mixing concrete, it does not lend itself entirely to making such a study, but judging from the excellent condition of pile No. 3 of 1:1:2 mix, the percentage of water to be used for a rich mix may well be considerably higher than for a lean mix.

An interesting comparison is made by plotting through these photographs the typical curves for compressive strength and the reciprocal of the abrasive wear, obtained from data in Bulletin No. 2 of the Structural Materials Research Laboratory, Lewis Institute, Chicago, the tests being made at an age of four months. Considering the age of the specimens photographed, there is a remarkable agreement between the location on the water scale of the maximum resistance to wear and the best specimens of piles.



10-YEAR OLD SEA WATER TEST PIECES ARRANGED ACCORDING TO PERCENTAGE OF WATER IN CONCRETE

Court Decides That City in Washington May Take Water From Oregon

The Supreme Court of the State of Washington has recently decided that the city of Walla Walla may legally acquire property for water-supply purposes in the Wenaha national forest in the State of Oregon. The court was divided 5 to 4 and the decision supported a decision of the lower court. It appears that on Feb. 23, 1909, the Oregon Legislature passed an act authorizing cities in Washington to acquire property for public use within the State of Washington, and that on Feb. 26, following, a reciprocal measure was passed by the Washington Legislature.

Trailers in Municipal Service

How They Are Used for Garbage and Ash Disposal and Street Repair Work — Their Possibilities for Snow Removal Not Yet Fully Developed

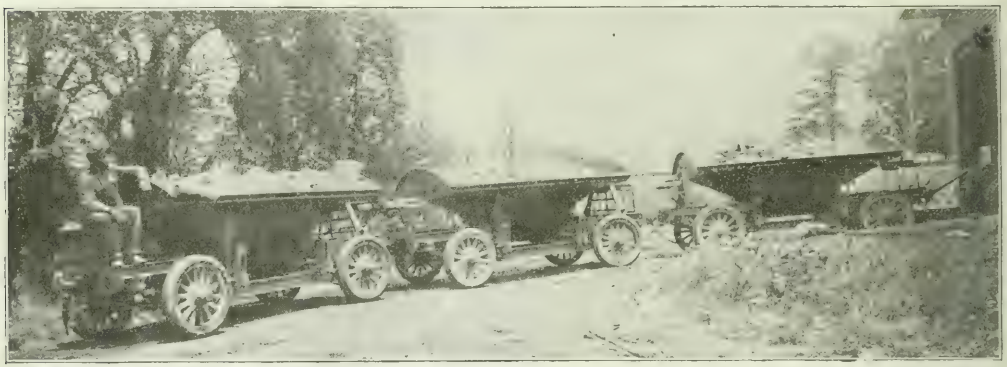
By Harry Wilkin Perry
General Manager, Trailer Manufacturers Association of America, New York City

TRAILERS first came into use by cities years ago when fire departments began motorizing their equipment. The old horse-drawn fire engines, ladder trucks and standpipes became motor trailers when first electric and then gasoline tractors were substituted for the horses. Some years ago the street cleaning departmen of the City of New York put into service several huge, specially built semi-trailers for collecting street sweepings. These are drawn by electric and gasoline tractors of the short-wheelbase truck type. The trailers have long, low frames arranged to receive 10 or 12 rectangular steel receptacles in two longitudinal rows. These are easily filled from the sides of the trailers and when the outfit arrives at the dock the receptacles are picked up one by one by a crane and the contents emptied into a barge in the river to be towed to sea and dumped. Although the city has completely motorized its fire department in the last 10 years there has been no further development of or improvement in the street cleaning system of the metropolis. The city recently purchased about 250 motor trucks and tractors for snow removal and other work, but no trailers were included in the contract let.

Cities Using Trailer Systems—Meanwhile a dozen or more smaller cities have outdistanced the leading cities of the country in the matter of garbage and ash removal. For more than a year the city of Utica, N. Y., has used motor-trailer equipment in this work with results that are highly satisfactory. The Utica system was described and illustrated in *Engineering News-Record* Oct. 30-Nov. 6, 1919, p. 810. Other cities that have adopted the trailer system are Indianapolis, with an equipment of 25 trailers; Bridgeport, Conn., with 16; Syracuse, with 40; Dallas, Tex., with 30; Memphis, Tenn., with a fleet; Norfolk, Va., Cleveland and Akron, Ohio; Detroit and Highland Park, Mich.; Gary, Ind., and Kenosha, Wis.

Buffalo recently awarded a contract for the purchase of trailer equipment, and Savannah, Philadelphia and a number of other cities are experimenting with the use of trailers in garbage and ash removal. Newark, Hoboken, Jersey City and Passaic in New Jersey are investigating.

Method of Operation—Briefly, the method of operation with trailers is as follows: Single trailers, drawn by teams and accompanied by one driver and one helper each, are assigned to designated zones in the city, where they make collections, from house to house. From 1½ to 2½ hr. is required to collect a full load of 4 to 5 cu.yd. The trailers are then driven to a central point in each zone, where they meet a motor truck drawing three or four empty trailers. These are disconnected and the truck couples up to a train of three or four loaded trailers, the operation taking 10 to 15 min. The teams are hitched to the empty trailers and proceed with collection, while the trucks haul the loaded trains to the municipal incinerator plant, as in Memphis, to the city dump, as in Bridgeport, or to a pig farm outside the city, as in Utica.



TRAIN OF GARBAGE COLLECTION TRAILERS AT MEMPHIS TOWED BY TRUCK TO INCINERATOR

Thus the highest efficiency is attained, as the trucks are used for long hauls with loads of 12 to 20 cu.yd. at a speed of 8 to 10 mi. an hour, and the horses are used for the slower work of collecting and the shorter daily mileage. All waiting time of the truck, with its relatively high fixed and operating charges, is avoided. Rehandling of the material is also avoided by use of the trailers for both collection and disposal. Fixed and operating charges for the trailers are but a fraction of those for the trucks, so that their use in collection work is little, if any, more expensive than collection with wagons. The higher interest on investment as compared with wagons is offset by the greater ease and speed of loading, due to the 5-ft. level of the body sides and to their greater load capacity.

The following is a record of results obtained in Utica with this system: In eight months, from April to

November, 1919, collections were increased from three a month under the old horse and wagon system to two a week; complaints of non-collection received decreased from 1,350 under the old system to 158 for the corresponding period in 1918; length of haul increased from 1.6 to 4 mi.; tons of garbage collected increased from 5,000 to 6,283; and average cost per ton-mile decreased from $2.36 under the old system to $1.26 under the new. In the eight months the trucks covered 11,000 mi., or a little more than 50 mi. a day. The route to the pig farm was over an unimproved country road, with grades of 7 to 8 per cent in places, but little trouble has been experienced at any time in pulling the trains of loaded trailers.

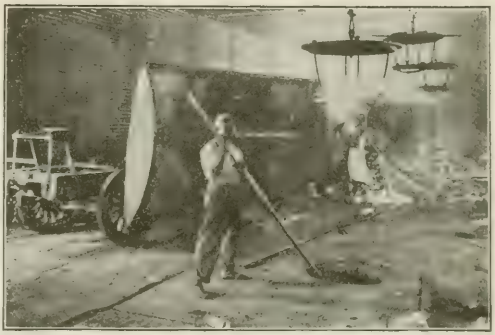
Hoboken's Refuse Disposal Problem—Hoboken, N. J., is trying to find the best solution to its refuse disposal problem and is investigating various methods. At present the work is done under the contract plan with twelve 2-horse, 2-yd., bottom-dump wagons. The dumps are on vacant lots in the center of the city. These city dumps can no longer be tolerated, as the city permits

MULES HAUL TRAILERS FOR HOUSE COLLECTION OF GARBAGE AT MEMPHIS
Loaded trailers are made up into trains and hauled to incinerator by motor truck

indiscriminate mixing of garbage, ashes and papers and the refuse piles are offensive, particularly in hot weather.

The authorities have considered disposal by trolley, by railroad, by barges towed from the waterfront out to sea, by incinerator plant and by truck and trailer. The last-named method seems to be most feasible and economical. An incinerator plant would cost many thousands of dollars to build and would be objectionable, not only to the citizens of Hoboken but to adjoining communities. Removal by trolley would require establishment of a city loading place, with sidetracks and ramps for wagons or trucks. All dockage space on the waterfront is owned or under lease by private interests, thus preventing use of the barge plan. The city is hedged in on the north and south by Weehawken and Jersey City, and on the west by the high Palisades, crowned with the town of Union Hill. The nearest available dumping ground is the Hackensack meadows, at Secaucus, a haul of 3 or 4 mi. Hoboken has a population of about 70,000 concentrated in an area of 1½ sq.mi. It has about 48 mi. of streets and collections are made six days in the week. The maximum amount of material to be hauled per day is 480 cu.yd.

If the twelve horse-drawn wagons now in use haul this amount of material daily it means an average of 40 yd. each—twenty trips with 2-yd. loads to the dump in the center of the city. If trailers are substituted they should haul an equal yardage to the center of the city, but the 6- or 8-mi. round trip to the Secaucus dump would consume an hour. It is, therefore, likely that



UNLOADING AT MEMPHIS INCINERATOR

an equipment of fifteen to twenty trailers and three to five tractors would be needed. This would involve an expenditure of $50,000 to $75,000.

State Law an Obstacle—One difficulty that stands in the way of adoption of the trailer system at present is a provision in the state motor-vehicle laws of New Jersey which prohibits the towing of more than one trailer by a motor truck or tractor. The Commissioner of Motor Vehicles holds that he has no authority under the law to make an exception of equipment owned and operated by cities. Cost of garbage and ash collection with horses and wagons has increased to such an extent, however, and the necessity of disposing of refuse at considerable distances outside of incorporated cities is so urgent that it is probable pressure will be brought on the state legislature to amend the law so as to permit two or three trailers to be operated in a train.

Trailers on Winnipeg Road Work—An interesting example of municipal use of trailers in road construction work is furnished by Winnipeg, Canada. The Greater Winnipeg Water District, which supplies water to the city and surrounding communities, has developed gravel pits along the aqueduct for city road building. The material is brought into the city by rail and discharged into bins, erected by the water district. From these bins it is distributed to the road jobs by six 3½-ton trucks and six 4-ton trailers equipped with steel side-dump bodies. The gravel trailers, however, do not have drop frames, as loading does not have to be done over the sides by men, but is by gravity from chutes.

The average round-trip haul is 8 mi., mostly over

TRUCK AND 1 TON SIDE-DUMP TRAILER FOR ROAD REPAIR AT WINNIPEG

COMBINATION STREET FLUSHER AND SPRINKLER

paved streets. During last August all of the trucks and trailers operated an average of 18 hr. a day every day in the month. The total yardage hauled was 11,700, or an average of 450 yd. a day, half of which was carried on the trucks. A record of operating costs shows an average of 17½ cents per cubic yard per mile. With reference to the performance of the equipment the Greater Winnipeg Water Commission says:

"The trucks when hauling trailers make about 75 per cent as many trips as they make without trailers. This is due to loss of time in turning around on streets that are torn up for paving. Otherwise there would be no loss of time. Gas consumption is about the same. Six yards are hauled per trip with truck and trailer and only three yards per trip when trailer is not used."

Street Repair Work—City street departments and county highway commissions use trailers of various types for street and highway construction and maintenance. The four-wheel, dump-body type is most used for repair work. The end-dump body is perhaps most common, as it is convenient for dumping and spreading material on spots to be resurfaced. Where counties have much new road construction and operate their own equipment the work can be done most economically with trains of slow-speed bottom-dump trailers drawn by tractors. Half a dozen such trailers, carrying 25 to 30 tons, are often hauled by the tractor on each trip.

Snow Removal—City-owned trailers operated by the public-works or street departments are used for various other purposes than ash and garbage removal. Frequently they haul coal or other supplies for hospitals, schools and other public buildings, bridge materials or snow. Snow removal work offers a field of great utility. During storms motor trucks are needed for plowing the snow and their time is largely wasted in hauling the snow away to be dumped. As the snow is light one truck could ordinarily haul one or perhaps two trailer loads in addition to its own load, thus saving much time.

Eventually some engineer will probably devise a plan whereby motor snow plows will raise the snow from the street as they proceed and deposit it directly into trailers towed behind or hauled alongside by another truck, thereby avoiding leaving piles at the sides or center of the street to be shoveled later by hand into wagons, trucks or trailers. This will not only save the expense of hand shoveling but will leave the street entirely clear for traffic immediately after the plows have passed. Piles of snow will not be allowed to stand and freeze over night, often causing great traffic confusion and remaining sometimes for a week or more, as not infrequently happens under present inefficient methods.

[One machine of the general type referred to in the foregoing paragraph was described in *Engineering News-Record* Jan. 27, p. 176.—EDITOR.]

Wood-Block Paving in St. Louis

By John Stanley Crandell
Consulting Engineer, General Tarvia Department, The Barrett Co., New York City

THE present specifications for wood-block pavements of the American Wood Preservers Association are the result of fifteen years' experience in the industry covering all parts of the country. They represent the best practice for average conditions. When some extraordinary condition arises modifications may be in order, but the utmost care must be used and the best expert opinion obtained before any substitutes are tried.

Two important papers appeared during 1920 in *Engineering News-Record*, Apr. 22, p. 714, and Oct. 7, p. 686, by W. W. Horner, chief engineer, Sewers and Paving, St. Louis, Mo., describing in detail the trouble that has been experienced in that city with wood-block pavements and how these troubles have been overcome. The troubles have been somewhat unusual, while the methods used to overcome them were unique and ingenious. The deductions that may be drawn from his two papers, and from the address of Dr. Hermann von Schrenk, given at the A. S. M. I. convention held in St. Louis, are apt to be misleading, and, if acted on without taking into account all the circumstances, might result in serious mistakes.

Methods of Treatment

The latest article by Mr. Horner makes it appear that green lumber, cut into blocks, treated with creosote oil and laid, will inevitably shrink, and that therefore only thoroughly seasoned lumber should be used. Dr. von Schrenk argued for seasoned lumber, and showed pictures of green lumber in which the sapwood had decayed. He said that green blocks might not get good penetration, and therefore might rot, so that this was an additional argument for the use of seasoned lumber.

From Mr. Horner's article and from Dr. von Schrenk's talk the conclusion would be drawn that the trouble with wood-block pavements is shrinkage, instead of expansion. This is contrary to the experience of the majority of those who have studied the subject.

Paving blocks are usually given a "full cell" treatment. This means that a predetermined amount of oil is forced into them. When this amount is injected, the treatment stops, irrespective of whether or not the blocks are uniformly treated. The amount of oil that has been recommended until recently has been 16 lb. per cu.ft. The tendency now is to reduce this amount to 12 to 14 lb. It must be kept in mind that Southern pine will, in paving-block form, take a treatment up to 28 lb. Well-seasoned sapwood has far less resistance to penetration of oil than heartwood. Therefore, if seasoned blocks are treated, and the pressure is discontinued when 14 lb. of oil have been forced into the wood, it is inevitable that the sapwood must absorb most of the oil, leaving the heartwood untreated. The heartwood is therefore not impregnated, and will be subject to early decay. Hence it is dangerous to specify a seasoned block, unless a change is made in the specification for treatment.

By using the "empty cell" specification, seasoned lumber may be used satisfactorily. This means that the blocks are treated with creosote oil under pressure to refusal, when a vacuum is drawn, which removes the excess oil from the cells. Yet the oil will be well

distributed through the blocks, help waterproof them and prevent decay.

It is not possible to waterproof paving blocks thoroughly with any known treatment of creosote oil. Hence, if the blocks are thoroughly seasoned, and therefore contracted, even though they get a modified treatment by the empty-cell method, they will expand in the presence of water. If, then, they are laid close together and jacked up, as shown in Mr. Horner's illustrations, and water flows over them, they will certainly swell, and eventually the pavement will blow up. This may not happen the first year, when the presence of oil may keep out some of the water, but later, when the oil has evaporated to some extent, there is sure to be trouble.

Another result of jacking up the blocks so closely is that no filler can get into the joints, but water can and will. Dr. Felix Kleeburg made some interesting experiments three years ago—which I was fortunate to see—in which he showed that with blocks laid hand tight, no attempt being made to force them together, pitch filler penetrated the joints scarcely an inch, and asphalt filler much less. It was after watching his experiments that I conceived the idea of the cardboard spacer for wood-block pavements which assured the filling of the joints (See *Engineering News-Record*, Sept. 4, 1919, p. 463.) If the filler does not prevent the entrance of water into the joints, then, with a seasoned block it may be confidently expected that blow-ups will occur, for water will find its way into the joints and will be absorbed by the blocks.

St. Louis' experience has been different from that of other cities. Minneapolis, Toledo, Cleveland, Akron, Detroit, Springfield, Mass., and Lebanon, Pa., have laid blocks under the pitch-paint-coat specifications, and in none of them has any trouble like St. Louis' developed.

Conclusions

McPherson Avenue is one of the streets referred to by Mr. Horner. The conclusions to be drawn from this job are valueless. The blocks were delivered, stacked, and laid during a protracted hot spell. The pitch-paint coat was spread ¼ in. thick over rough concrete. In fact, an attempt was made to level up the irregularities of the concrete by spreading the pitch thicker over the very rough spots. The extreme heat prevented the pitch-paint coat from hardening. The blocks were laid in the soft pitch, often with wide joints, some of them being ⅝ in. wide. These wide joints were filled with pitch, and an excess was used, so that it flowed under the blocks. Then more pitch was put into the joints when they were empty. As a result the pitch ran to the gutters where it collected in lakes and had to be removed.

This job emphasized the necessity for securing an even surface on the concrete base, the application of a very thin pitch-paint coat which should not be used to equalize irregularities in the surface of the concrete, and the use of a pitch-sand mastic to fill up any such irregularities if they could not otherwise be prevented. It also indicates that the present specifications should be modified to the extent of calling for a high melting point pitch in Southern cities where the paving work is done during the summer. It would be well to specify a melting point of 175 deg. F.

The extremely effective waterproofing qualities of the pitch-paint coat method of construction may, in some cases, necessitate a modification of treatment. But it would not be wise to throw away the experience of years and substitute new specifications for the present ones, simply because St. Louis has had such a peculiar experience, due solely to certain local conditions that would obtain nowhere else.

[The foregoing comments by Mr. Crandell were submitted to Mr. Horner, whose reply follows.—Editor.]

I have read with much interest the letter of Mr. Crandell concerning recent articles on wood-block paving by myself and Dr. von Schrenk. As noted by Mr. Crandell, both Dr. von Schrenk and I arrived at the conclusion that seasoned lumber should be used for wood-block paving. Our conclusions came from different viewpoints, however, Dr. von Schrenk being interested primarily in the treatment of the wood, while my interest was in the method of laying.

General Considerations

I think we will all agree with Mr. Crandell that the treatment of over-dry timber will undoubtedly result in poor treatment of the heartwood. I should like very much to see wood block treated by the empty-cell specification, and hope that we may eventually come to this if the increased cost is not too considerable. In the question of laying, however, Mr. Crandell has apparently misunderstood my impressions. I agree with him that creosote oil does not waterproof paving block. My point is, however, that our paving methods, in which the blocks are laid on pitch and surrounded by pitch, or by asphalt, do waterproof the block on five of its six sides. The upper side, which is the roadway surface, is more or less sealed by the brooming effect of traffic, and, in any case, is not in contact with water for long periods. In fact, it has been well demonstrated that the absorption of water on the upper surface of wood block has never been serious, and most of our blow-ups have been occasioned by the absorption of water in the sand cushion under the block. I think it is fair, therefore, to say that, with the present pitch-paint-coat specifications, our pavement—not the wood block, but the wood-block pavement—is reasonably waterproof, and that the absorption of water and consequent expansion will never be serious. In fact, I doubt that any cases of expansion can be cited in which this specification has been used. The fact that the block would shrink during dry weather has not only been proven, but is entirely logical.

Mr. Crandell's statement as to the McPherson Avenue job is in error. The conditions he describes as to the pitch-paint-coat and width of joints, apply to the pavement after shrinkage and not before. It is true that the joints in this job were not forced tight, that lug block were used, and that the lugs were not always tight against adjoining block, but I doubt that there were any original joints which greatly exceeded a quarter of an inch. On the other hand, the actual measured shrinkage of a single block was as much as three-eighths of an inch.

Mr. Crandell has raised one very good point, and that is the fact that the filler cannot be gotten into the joints after block have been jacked tight. It is unfortunately true, however, as he illustrates, that neither can the filler be gotten into the joints when they are laid in the usual way, and that some separator such as he has devised is of great advantage. Of all

the combination of laying I should like to see the block laid loosely, filled, then jacked up to take care of ultimate shrinkage.

While the writer is not an expert in paving pitches, and has the greatest respect for Mr. Crandell's opinion, he rather doubts that the recommendation for 175 deg. F. melting point pitch would be satisfactory on account of the cold winters in this climate. It might, however, be highly advisable for the south.

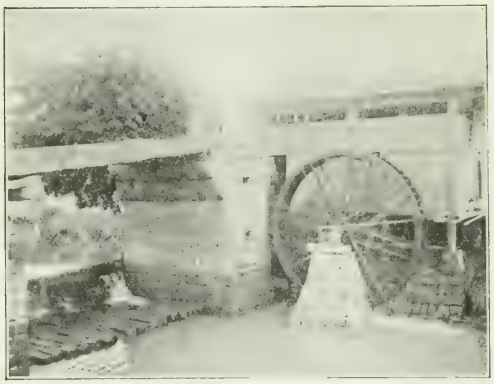
The writer has no desire to disparage our wood-block pavements, which are undoubtedly one of our finest types, and certainly will be continued to be used wherever high-class improvements are warranted. He has intended his criticism to be constructive, and has hoped that some definite suggestions for further improvement on this type of pavement might result from discussion. He is not at this time prepared to offer any changes in specifications, but would like to see a further study of the action of wood block laid under the pitch-paint-coat method in various climates, and a scientific study made of the results.

A Chinese Tidal Power Plant

By J. R. West

Engineer-in-Chief, Min River Conservancy, Foochow, China

THE Chinese have long been given credit for many inventions, such as the mariners' compass, explosive powder and the process of printing from movable type, but so far as the writer knows they have not been given credit for having utilized the energy of the tides.



IMPULSE WHEEL IN CHINA DRIVEN BY TIDAL POWER

This, however, they are doing near Foochow and probably also at many other places where the conditions are favorable. The accompanying picture shows a rice mill operated by tidal power and gives a fair idea of the general arrangement.

The plant is located on a small tidal creek which discharges during the ebb tide toward the right. When the tide starts to rise the stop logs are removed and the creek fills up to the level of high tide. The stop logs are then inserted in grooves cut in the stone piers and hold up a considerable volume of water as the tide falls. When the tide has fallen on the lower side of the dam to about the level of the lowest point of the wheel the outlet gate is opened and the water discharges through a wooden flume and impinges against the buckets in the rim of the wheel which actually operates as an impulse wheel.

The wheel itself is about 18 ft. in diameter and 2½ ft. wide. It is made entirely of wood, formed around a square hardwood shaft. The bearings for the shaft are also of hardwood and are lubricated by water which is carried in a bamboo trough from a point a little above the center of the wheel and just a little outside the rim where the drip from the rising wheel is collected by another trough parallel with the face of the wheel.

The wheel is set so that the lowest point is several feet above the level of low tide. This, of course, makes the maximum operating head less than the tidal rise, but it also makes it possible to operate the plant for several hours at every low tide. In fact this particular mill can operate five or six hours at each low tide or ten to twelve hours out of the twenty-four. The power is used for running a crude rice cleaning and polishing machine so there is little disadvantage in its intermittence.

While the amount of power developed is small, still the plant effects the application of tidal power in a useful way and the entire construction shows mechanical ingenuity and skill of high order.

Illinois Sewage Testing Station

EXPERIMENTAL work on the treatment of sewage from Champaign was started in the fall of 1920 by the State Water Survey at the University of Illinois utilizing the Dorr-Peck modification of the activated-sludge process. The plant is located west of the old septic tank built in the nineties and later used for activated-sludge tests in 1916.

The station equipment includes a Dorrco screen, two combined aërating and settling tanks of the Dorr-Peck type, a sludge-storage tank and a steam boiler. An Oliver continuous filter adapted from the mining fields and a Tolhurst centrifuge are being used for sludge-dewatering experiments. Weirs, meters and manometers for measuring the flow of air and water are provided.

The screen is 4 ft. in diameter, 8 in. wide and revolves in a trapped chamber to which the sewage flows by gravity. The flow is from the outside into the barrel of the screen, from which the effluent is discharged at one side. The screen revolves at 23 r.p.m., giving a peripheral speed of 325 ft. per minute. The metal drum consists of a punched plate with perforations ½ in. by $\frac{1}{16}$ in., the long axis perpendicular to the circumference of the screen barrel. Approximately 50 per cent of the screen barrel is submerged when treating 200,000 gal. of sewage per 24 hours. The screened solids accumulate in the trapped chamber and are scooped out once or twice a day with a perforated bucket. Loss of head through the screen is about 3 in.

The Dorr-Peck equipment consists of two round wooden tanks, each 17 ft. in diameter by 13 ft. deep. The settling tray in the second tank is 1 ft. lower than that in the first tank. Each tank contains 36 filtros plates. The mechanism for moving sludge revolves once in 9 minutes. With a flow of 100,000 gal. per 24 hours, the aëration period in the first tank was 3.2 hours, settling 18 hours, aëration in second tank 2.8 hours, settling 2.2 hours, giving a total time of passage through both tanks of 10 hours with 6 hours' aëration. Less than 1 cu.ft. of air per gal. is required to treat Champaign sewage, which is a rather heavy domestic sewage. The experiments are being carried out under the direction of Dr. Arthur M. Buswell, chief, State Water Survey.

Early Measurements of Rainfall and Stream Flow

THAT problems which now occupy the attention of engineers are in no wise new is well illustrated by the measurements of rainfall and stream flow of the drainage basin of Seine River which were made in the 17th century by Perrault (1628-1703) and Mariotte (1620-1684), both members of the Academy of Science under Louis XIV. These measurements were made chiefly to disprove the old and very persistent assumption that the water which falls as rain and snow is entirely too insignificant in quantity to supply the volume carried by rivers, and therefore the water of springs and streams must have some mysterious internal origin.

The following extracts, describing the work of these two pioneers in quantitative hydrology, were translated by the late A. J. Ellis, geologist, U. S. Geological Survey, from a volume by L'Abbe Paramelle entitled, "L'Art de decouvrir les sources," first published in 1856:

Perrault was the first who made use of the rain gage to determine the amount of meteoric water discharged annually on the earth, and he found that the mean quantity which fell at Paris during the years 1668, 1669 and 1670 was about 19.2 inches.

* * * *

Perrault examined and measured the basin of the Seine from its source to Aignay-le-Duc, in Burgundy; this basin is about three leagues long and two wide, which gives an area of six square leagues, making 31,245,140 square toises [1 square toise = 36 square feet]. Supposing that during one year all the rain water which falls on the basin accumulates there, remaining in place and suffering no loss by evaporation or otherwise, on the last day of the year that area would be covered by a sheet of water having a thickness of 19.2 in., which would make 224,899,942 muids of water [1 muid = 8 cu.ft.]. One-sixth of this amount would be sufficient to furnish the ordinary flow of the Seine at Aignay-le-Duc during the whole year following, even though, by supposition, the basin should not receive an additional drop of water; for at that place the river has, in mean terms, a flow of about 1,200 in., which gives 99,600 muids of water in 24 hr. and 36,453,600 in a year; likewise the quantity of water contained in this basin, supposing it to be 224,899,942 muids, and the amount flowing in a year being only 36,453,600 muids, it follows that the water which passes in the channel of the Seine at Aignay-le-Duc during one year is, within a trifle, only a sixth of that which during the same time falls on its basin.

Following Perrault, Mariotte made observations and calculations to estimate the quantity of water that falls each year upon the entire drainage basin of the Seine above Paris. His work is described as follows by Paramelle:

Mariotte measured all that part of the basin of the Seine which is above Paris, and, making allowance for the numerous irregularities in its perimeter, he estimated this surface to be 60 leagues long and 50 leagues wide, which makes 3,000 square leagues. Abandoning the high quantities which the observations already made furnished him he was content to suppose that there fell on the basin 15 in. of water each year, which makes 45 cu.ft. of water per square toise. A league being 2,300 toises long, one square league contains 5,290,000 toises, which multiplied by 45 gives 238,050,000 cu.ft. of water per year, and the 3,000 leagues of surface give 714,150,000,000 cu.ft. of water per year.

Mariotte's stream-gaging methods and the use he made of the results are then described by Paramelle as follows:

In order then to determine what quantity of water passes Paris every year in the channel of the Seine and to compare it with that which falls on its basin Mariotte proved that when the water of that river is at its mean elevation it is 400 ft. wide and 5 ft. deep. By throwing into the water a body light enough to float, such as a small block of cork, dry wood, wax, etc., he found after many experiments that the body floated, and consequently the water in the river flowed at a mean rate of 100 ft. per minute, which makes 6,000 ft. per hour. Multiplying the 400 ft. width by 5 ft. depth one gets a section of flowing water of 2,000 ft., which multiplied by 100 ft., which it flows each minute, gives 200,000 cu.ft. each minute, 12,000,000 per hour, 288,000,000 per 24 hours and 105,120,000,000 per year; which is not, he concluded, a sixth part of the water which falls in one year on the lands which furnish the water of the Seine at Paris. If instead of 15 in., which were taken in this calculation, 18 had been taken, there would have been obtained for each year 856,980,000,000 cu.ft., which gives eight times more water than the river carries at Paris.

Fees for Structural Engineers in Illinois

A CODE of practice or ethics and a schedule of minimum fees for professional work have been adopted by the Structural Engineers Association of Illinois, the charges being based upon a per-diem rate, a retainer fee, a percentage of cost of work or the actual engineering cost plus a fixed fee. The schedule is given herewith, practically in full:

Per-Diem Rate—The minimum charges for professional services for consultations, studies, investigations, reports and for expert testimony and preparatory work incident to law suits, shall be as follows: (1) For short engagements, $100 per day; (2) for preliminary studies, investigations and reports made to determine whether the engineer can support the claims of the client, as for example prior to a law suit, $50 per day; (3) for submitting a report and reviewing the design prepared by others for existing or proposed work, $100 per day for the first week, $75 per day for the next week and $50 for each day thereafter.

The above charges are intended to cover professional services only, unless otherwise previously agreed. Any expense incurred in connection with a specific engagement, such as transportation and subsistence, salaries paid assistants engaged on the work, office and field supplies, and general office expense, shall be charged the client in addition to the above fees.

Retainer Fee—Where a member has been retained for general advice by a firm or corporation for a long term of engagement, he may accept such retainers at a compensation not less than that indicated above.

Percentage of Cost of Work—Minimum fees, as percentages of cost of the work, shall be charged as follows: (1) For preliminary examinations, studies and reports on new projects or for review study and reports on existing or pending projects previously dealt with by others, 3 per cent; work under this head may be charged for under the per-diem terms if preferable; (2) for investigations, plans and specifications necessary to secure an intelligent bid from contractors, 5 per cent; (3) for final working drawings and specifications, together with necessary consultation and general advice during construction, 7½ per cent; (4) for professional services, including preparation of final plans specifications and contract forms, award of contracts, superintendence during construction, testing of materials and general supervision of work, 10 per cent; (5) for professional services incident to engagements involving repairs or alterations to existing buildings or other structures, 10 per cent.

	$10,000 to $250,000	$250,000 to $500,000	$500,000 to $1,000,000	$1,000,000 and upward
1	[illegible]	2	1	[illegible]
2	[illegible]	4	4	3½
3	7	6	6	5
4	8	7½	6½	5½
5	8	7½	6½	5½

The above percentages shall be construed as applying to work not exceeding $100,000 in cost. The minimum percentages to be applied on larger work shall be as in the foregoing table.

The percentages are to be computed upon the total cost of the completed work, exclusive of engineering, or upon a bona fide estimated cost or bid pending the completion of the work, with an adjustment when the actual cost is known. The "cost of work" refers only to such part or parts of the whole work or project for which the engineer has been engaged; clearly excepting, however, all buildings and other similar structures, for which the fee shall apply to the entire cost of the building, not including special machinery, lighting, heating, plumbing or ventilation, unless these items require special consideration by the engineer, in which event the percentages shall be applied in whole or in part to any or all of these items as circumstances may direct. The percentages include all the charges mentioned at the end of paragraph on per-diem, unless previously otherwise agreed.

Engineering Cost Plus Fixed Fee—An engagement may be accepted on this basis, which contemplates a charge to the client to cover the salaries of assistants engaged on the work, and general office expense, with an addition of 50 to 100 per cent for overhead. In addition, the charge to the client shall be increased for the professional services of the engineer, an amount equal to not less than 50 per cent of the fees indicated under "Percentage of Cost of Work."

It is recommended that members require of the client a written agreement stating clearly and fully the conditions of the engagement, the period during which the work is to be executed, the amount of remuneration to be paid the engineer and the terms of payment. Where changes in plans, specifications or contracts are required by the client after work has been commenced thereon, an additional charge may be made for such changes at actual cost plus a percentage, as indicated in the preceding paragraph.

No recommendation is made to cover this contingency, and members are urged to reach a fair and equitable agreement with the client without recourse to legal proceedings or arbitration. Where an engagement has been accepted by an engineer with the expectation of an immediate start and the work is delayed by the client, the engineer may ask for additional remuneration, if proceeding with the delayed work would entail an additional financial burden on him.

Members may enter into competitions providing that the conditions provide for a reasonable compensation to cover the cost of preparing the competitive designs, and that the conditions surrounding the competitions conform to the provisions of the code of practice relating thereto. Drawings, specifications, notes, letters, exhibits, etc., as instruments of service, are the property of the engineer, and shall be returned to him at the conclusion of any specific engagement. The cost of surveys, when required, is not included in any of the fees mentioned in this schedule and is to be paid for by the client, unless otherwise specifically agreed to by the engineer.

Lincoln Highway Completely Marked

The Lincoln Highway Association in 1920 completed the permanent marking of the road from the east coast as far west as Omaha, Neb. The work cost $30,000. The western section of the highway to the Pacific coast had been previously marked.

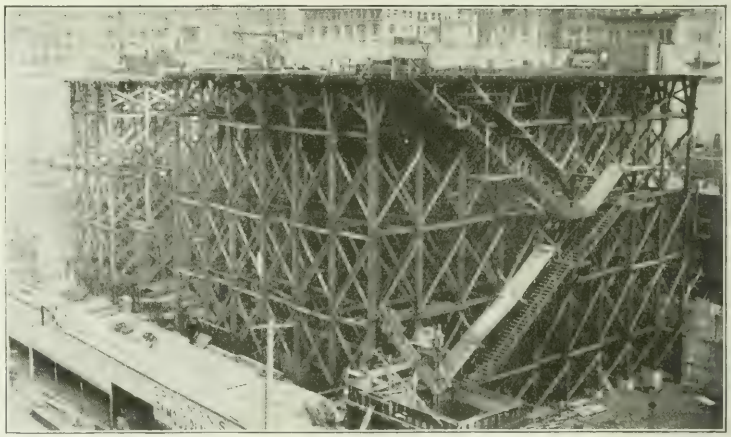
Large Timber Frame to Support Concrete Truss Forms

Los Angeles Theater Will Have 126 Ft. Proscenium Trusses for Which Heavy Platform Has Been Built

By Roy C. Mitchell
Engineer, With Edwin Bergstrom, Architect, Los Angeles, Cal.

EXCEPTIONALLY long reinforced-concrete girders and trusses are being used in the new Hill Street Building, now being erected at Sixth and Hill Sts., Los Angeles, Cal., and to carry some of them during construction there has been built a very large timber frame which is shown in the accompanying view and drawing. The details of the girders and trusses themselves will be described in a later article.

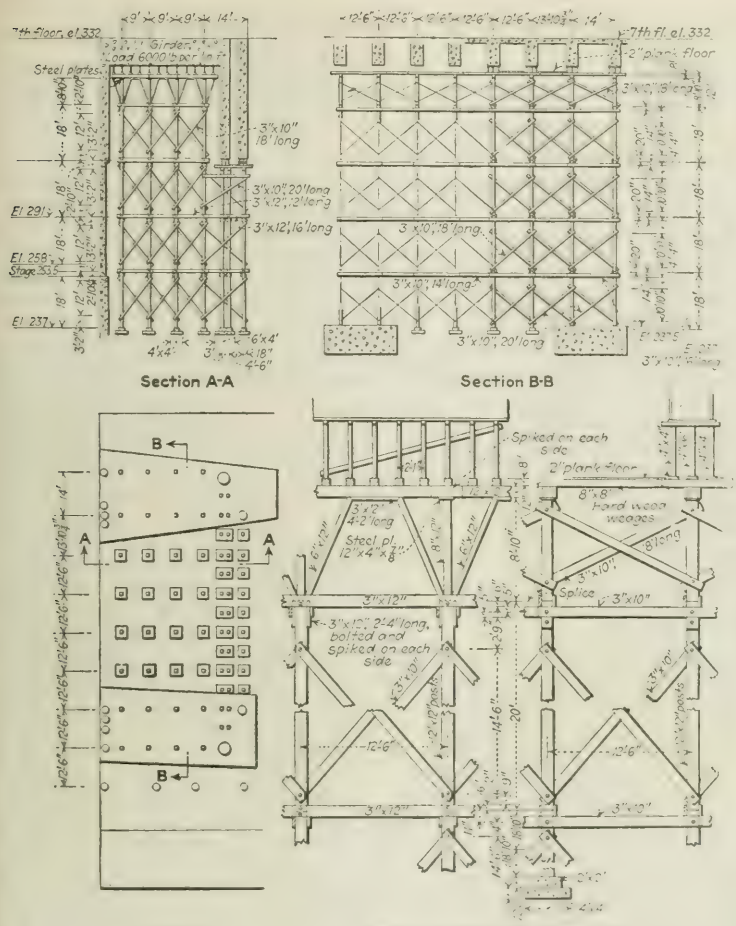
The structure, 13 stories in height with a basement and boiler room, will be for office and theatre purposes. Grauman's Metropolitan theatre will occupy the greater part of the first eight stories, the auditorium of which will be 125 x 137 ft. and the stage, 48 ft. x 127 ft. There will be stores on the first floor and above them 106 offices in the first eight stories and 355 offices in the five stories above. The upper tier of offices will be arranged in a U shape, forming an open court on the Hill Street frontage, the north wing of the U, 48 ft. deep, being over the stage and suported by the trusses over the stage, and the center wing 50 ft. deep, on the alley supported on the trusses over the theater and auditorium.



TIMBER FRAMEWORK ON WHICH 126 FT. CONCRETE TRUSSES WILL BE BUILT

The entire structure will be of reinforced concrete with brick and terra-cotta facing. The noteworthy structural features are a girder of 126 ft. 6 in. span, carrying the cantilever balcony, a truss of 87 ft. 6 in. span over the stage proscenium arch, supporting the ends of the eight girders over the stage. These in turn support the five stories of offices above. There are besides ten trusses each of 126 ft. 6 in. span carrying the auditorium roof and the five-story tier of offices above along the alley side.

The falsework required for supporting the forms and concrete for these girders and trusses is of unusual design and size. Each truss over the auditorium weighs



DETAILS OF TIMBER PLATFORM FOR HILL STREET BUILDING TRUSSES

10,000 lb. per lin. ft. and will be supported on 10 posts spaced 12 ft. 6 in. centers, requiring in all 100 posts to carry the forms for the auditorium trusses; the stage girders and proscenium truss forms require 67 posts. The falsework is 90 ft. high made up in five bents of 12 x 12 in. timbers for posts with 3 x 10's and 3 x 12's for bracing and ties, bolted together with ¾ in. bolts. The posts will set on concrete footings which will later carry the auditorium floor.

The entire top of the falsework is covered with 8 x 8 in. sleepers spaced about 2 ft. centers on which is laid a 2 in. floor. This framing will carry the forms for the trusses and girders and will make a working floor for the men. This floor will be reached by a 5-ft. covered stairway built on the side of the falsework, with landings at each floor level of the building. Hardwood wedges are to be used on top of the 8 x 8 in. sleepers for leveling up the forms and for releasing the load before removing the falsework. About 425,000 ft. B.M. lumber is required for the falsework which was received direct from the mills by boat to Los Angeles harbor, then by truck as required for erection. The framing for the falsework was all laid out from templates and the holes bored with hand electric driven bits before erecting. Erection was started at the southwest corner by erecting a bent of three columns each way for the entire height with hand A-frame. Erection was then carried forward with a small, stiff-leg derrick set on top of this bent and operated by an electric hoist in the basement. About 25 posts with bracing and ties, one tier in height, were set in one day with a crew of 12 men. Special care was taken in the design and layout so as to give the maximum salvage from the lumber when taken down, as there is a ready sale for this material for mine shoring and tunnel work.

This falsework has been laid out so that the concrete can be placed in the trusses before the columns and walls are built, as the forms and concrete for the auditorium floor and balcony will have to be placed after this falsework has been taken down. A saving in time of about 90 days will be made by having this falsework in place, ready for the general contractor to begin work on the forms for the trusses immediately after the contract is let.

Bins for the storage of rock, sand and cement have been built in the basement along Hill Street side. Trucks drive directly off the street on a platform and dump their loads in the bins beneath. There will be two mixing plants; each will be supplied with material by a system of belt conveyors, elevators and mixing hoppers without handling.

The falsework was erected by the Winter Construction Co. The falsework, bins and conveyor system was designed by the writer in the office of Edwin Bergstrom, the architect.

Colorado Free Employment Bureau for Engineers

For the ten months ending Dec. 31, 1920, the free employment bureau of the Colorado Society of Engineers listed 214 positions and filled 148. Of the latter 95 were civil engineering places, 31 mechanical, 13 mining, 2 electrical, 3 chemical and 4 miscellaneous. Of the 321 non-member applications 222 were from civil engineers. The average salary of positions filled was $170 and the average cost of placing each applicant $5. The estimated saving to the engineers of Colorado was $14,000 over the usual fee charge.

Thoroughfare Plan and Program for Cleveland, Ohio

Includes Widening 98 Streets 190 Miles and Extending 37 Streets 23 Miles, Besides Under- and Over-Crossings, Bridges and Speedway—Estimated Cost of 20-Year Program $20,000,000, Excluding Bridges

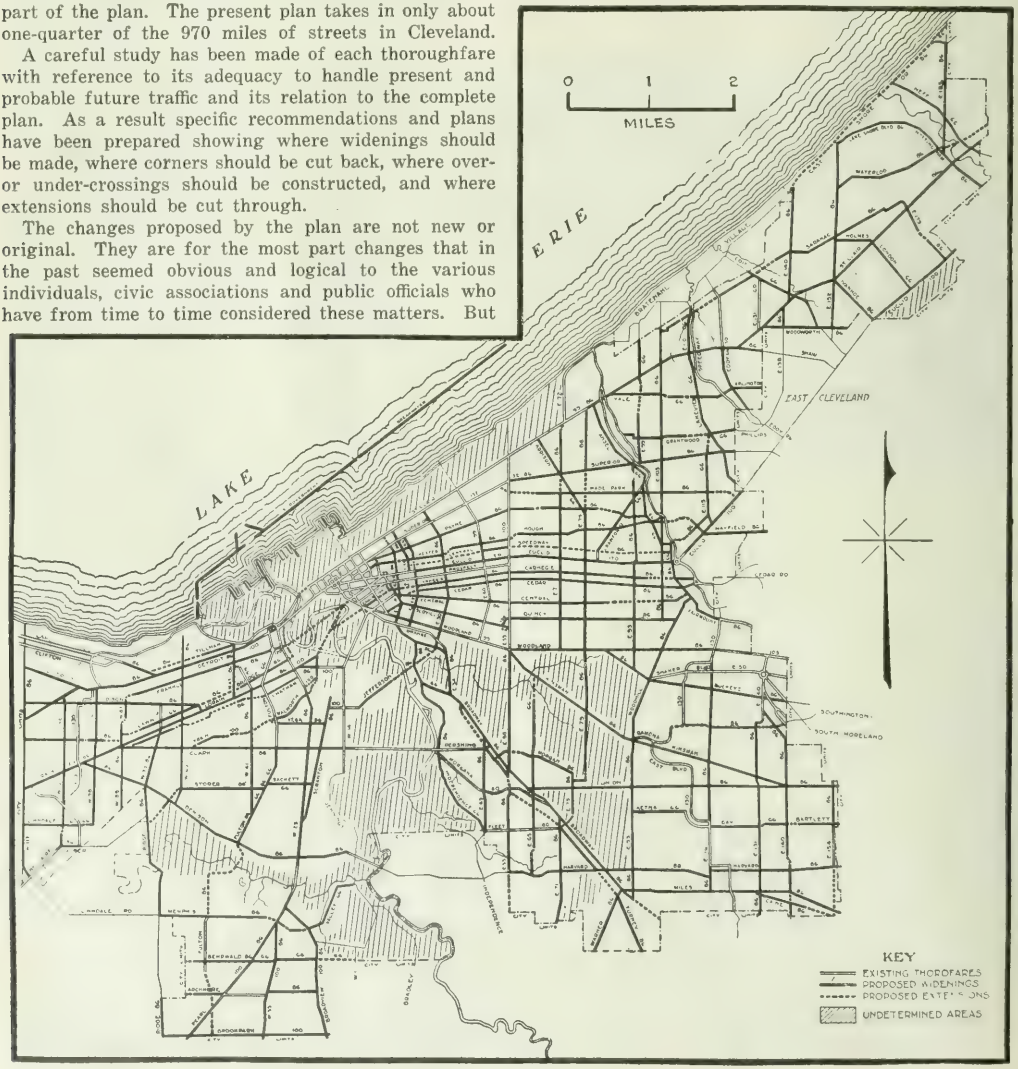
By Robert H. Whitten
Advisor, City Plan Commission, Cleveland, Ohio

The Cleveland thoroughfare plan is intended to constitute a fairly complete system of traffic arteries for the area within the present city limits. The term thoroughfare as here used includes all streets that form the main framework of the general street plan. The thoroughfares collect the traffic of the local streets and carry it to all parts of the city. Local streets that are used chiefly for immediate access to the residences or industries of a small area are not a part of the plan. The present plan takes in only about one-quarter of the 970 miles of streets in Cleveland.

A careful study has been made of each thoroughfare with reference to its adequacy to handle present and probable future traffic and its relation to the complete plan. As a result specific recommendations and plans have been prepared showing where widenings should be made, where corners should be cut back, where over- or under-crossings should be constructed, and where extensions should be cut through.

The changes proposed by the plan are not new or original. They are for the most part changes that in the past seemed obvious and logical to the various individuals, civic associations and public officials who have from time to time considered these matters. But now, for the first time, they are sifted, assorted and brought together as parts of a complete and carefully co-ordinated plan. Presented in this way the importance of each to the general system is at once apparent.

The plan submitted is by no means ideal. The area included is already largely built up and it seemed altogether impracticable to proceed except with constant regard to the expense involved and the danger of creating burdens in excess of the economic benefits and of



PROPOSED THOROUGHFARE PLAN FOR CLEVELAND, OHIO

the ability of the city to finance. The plan, however, will provide with reasonable adequacy for traffic needs for a considerable period of years. As compared with most other big cities, Cleveland's position as regards traffic conditions will be relatively advantageous. The plan, while far from ideal, constitutes a great improvement and its substantial achievement is well worth striving for.

Street Widening—The plan provides for the widening of 98 thoroughfares having a length in the portions proposed to be widened of 190 miles.

Existing thoroughfares have to a very large extent been opened and improved without regard to a general plan. This accounts for the frequent jogs in alignment, the lack of adequate connections and above all the entirely inadequate widths that are so general over the major portion of the city. Important traffic routes have been opened and improved apparently as purely local residence streets. Old country roads have been built up at their original widths of 66, 60, 50 or even 40 ft. Double-track car lines have been placed in 50-ft. streets with no provision for street widening.

A large part of the street railway trackage is located on streets and roadways of inadequate width. To provide reasonable freedom and speed both for street cars and for other traffic a roadway wide enough for one line of moving vehicles on either side of the car tracks, in addition to space for vehicles standing at the curbs, is absolutely essential. For this purpose a roadway width of 56 ft. is needed. This, with a sidewalk width of 15 ft., gives a total street width of 86 feet.

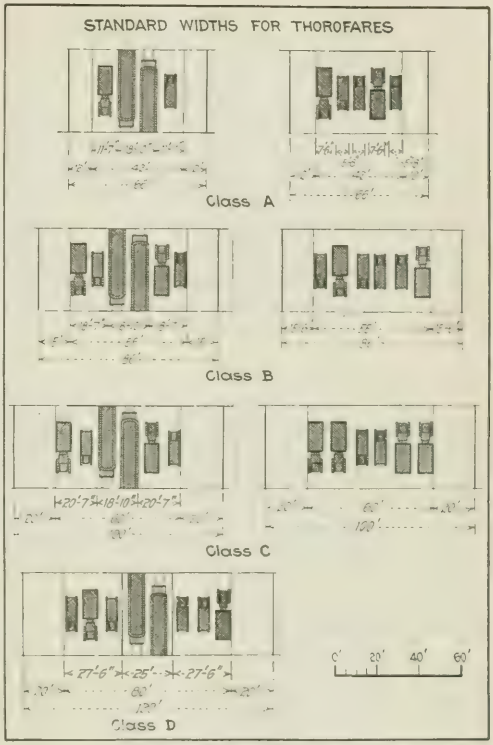
The plan submitted proposes the eventual widening to a minimum width of 86 ft. of most of the important thoroughfares and of practically all of the thoroughfares on which street railways now are or may be located. All such thoroughfares should be widened so as to provide for two lines of moving vehicles in each direction. Unless this is done, with the increase in traffic and the increase in the number of standing vehicles, the speed of all vehicles will be reduced to the speed of the slowest. Automobiles and street cars will be compelled to trail behind the slow-moving horse-drawn vehicles. A thoroughfare of that kind is very unsatisfactory for passenger automobiles, for street cars and for motor trucks.

Street Widths and Traffic Capacity

The normal development for a car-line street is retail business. Lorain Ave. is perhaps typical of the traffic and the kind of business development that will come to most of these thoroughfares. With business comes an increase in the number of vehicles standing at the curbs that makes it essential to have a clear central roadway width for two lines of moving vehicles in each direction. Unless this is done the speed of the street cars will be reduced to the speed of the slowest trucks, and automobiles will be compelled to trail behind the cars. Nothing could be more inimical to the future prosperity of the city than to permit these main arteries of traffic to be solidly built up at their present inadequate widths.

The relation between traffic congestion and street car operation is well set forth in a report to the City Council by street railway commissioner Fielder Sanders, Jan. 25, 1917:

It can easily be seen without argument that the downtown streets are saturated with traffic—street cars and vehicles. The street car traffic has been so delayed by this



STANDARD WIDTHS FOR CLEVELAND THOROUGHFARES

great excess in vehicle traffic that in order to prevent tie ups and gaps on the line it has been necessary to increase the running time on several of the lines so that the cars may remain properly spaced. This is very expensive for the car riders. The public service commission of Massachusetts stated this obvious truth in the following language:

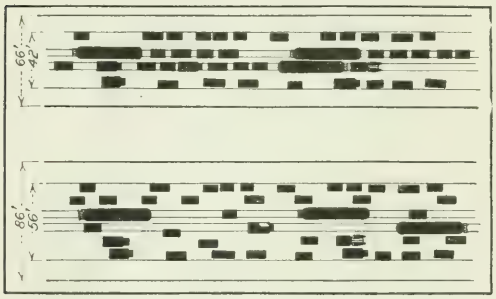
"Economy demands the largest possible car mileage in proportion to car-hours and this makes the speed at which cars are operated very important. This fact is generally recognized by street railway managers at the present time and upon well operated roads every effort is made to increase the average speed. The better the speed, also as a rule, the greater the traffic."

It has been one of the distinguishing characteristics of the Cleveland Railway Co. that it has operated its cars very fast. It has the highest schedule of surface railroads in the country and this in large measure has not only made service attractive but has made also three-cent fare possible. It is this cheapness of operation also which has so far made five-cent rapid transit tube operation financially impossible in Cleveland. This speed is now breaking down on account of being interfered with by traffic, the system is slowing up, but only to some slight degree, however, away from the congested districts.

It is only by giving attention to the widening of many thoroughfares that the present high car speed outside of the center of congestion near the public square can be long maintained. Unless this is done street cars on many important arteries will be compelled to crawl along behind slow-moving trucks. It will be impossible to keep the trucks off the tracks, because with the increase in the number of standing vehicles at the curb there will be no space in these narrow roadways other

than the tracks in which the trucks can move. This will mean increased cost of street railway operation and increased fares and loss of time to the car riders. It will also mean continual interruption to automobile traffic and increased trucking costs.

On many of the thoroughfares that are listed for eventual widening the buildings are at present set back from the street line. There is no urgent need for their immediate widening. The important thing is to insure



TRAFFIC EFFICIENCY OF 86- AND 66-FT. STREET

The 86-ft. thoroughfare takes but 30 per cent more land than the 66-ft., yet it is four times as efficient. It will pass twice the traffic at two or three times the average speed.

that future buildings, stores or apartments shall be kept back from the present street line a sufficient distance to allow for a future widening. The widenings proposed would in many cases injure the use of the houses for residence purposes by cutting off the front lawns and bringing the street too close to the houses. The use of many of these streets will, however, gradually change from private dwellings to apartments or business buildings. When this time comes the street can be physically widened without injury to such apartment or business use. In the meantime, the fixing of a permanent building line back of the present street line will serve to protect the existing dwellings from serious depreciation owing to the possible erection of an apartment house on the present narrow street line and projecting out beyond the present dwellings. And when traffic has so increased that the street must be widened, it is more than likely that the street will no longer be desirable for private residence purposes and the private dwellings will have been replaced by apartments or by business buildings. Provision for future widening through the establishment of a setback line can therefore be made while the future traffic thoroughfare is still a residence street, with advantage to all owners, and when the time comes to widen the street to meet traffic needs this too will usually be to the advantage of the owners. By thus imposing the setback line and then widening the street at the very time that these things can be done with advantage both to the owners and the city, the widened thoroughfare can be secured at a minimum expense.

Many of the thoroughfares listed for widening are already in the transition stage. The former residences are being gradually replaced by apartments and stores. Most of the stores and some of the apartments are being placed out beyond the residences on the street line. Now is the time to stop this development before the exceptional example becomes the rule. Many of the structures already built out to the line are temporary wood buildings or "taxpayers." Eventually they will be replaced and if in the meantime other buildings have been kept back on the established line the street can be widened with comparatively slight expense and a minimum delay to the usual traffic.

Street Extensions—Thirty-seven street extensions are proposed, having an aggregate length of 23 miles. These extensions will necessarily be more expensive than the widenings. Recommended extensions are therefore carefully limited to the connections deemed necessary to secure a fairly complete thoroughfare layout. In no section of the present city should thoroughfares be more than a half mile apart. Owing to existing building development, this minimum standard has not been attained in a few sections of the city. Wherever possible without too great cost existing streets have been connected by short extensions so as to form through routes. Many of these extensions, if not provided for now, will be cut through in later years at enormously increased cost.

Central Thoroughfares—The central section of the city lying between Fulton Road on the west and E. 105th St. on the east and lying north of the valleys of Walworth Run, the Cuyahoga River and Kingsbury Run will embrace the principal business and community center of the Cleveland metropolitan area. The topography of the city is such that the bulk of the traffic to, from or through this business and community center must pass in a generally east-and-west direction. This section will therefore require all the increased east-and-west traffic capacity that it is now practical to secure.

In all large cities the demand is for more routes leading into and through the central business district. In Cleveland, the traffic difficulties are in large measure due to the reliance on a few main thoroughfares converging at or near the public square. The remedy lies in the provision of more thoroughfares of adequate width coming from the outskirts of the city into and through the central business section and out to the city boundaries on the opposite side. The central business section of the city should have an approximately rectangular layout each street constituting the central portion of a main radial thoroughfare.

The street widenings and extensions proposed in this central section of the city will take care of the estimated increase in traffic for a period of thirty to fifty years.

Central Bridges—Locations for the construction of future bridges across Cuyahoga Valley are recommended as follows:

1. Old Superior Viaduct to be connected with St. Clair Ave. at W. 9th St.
2. Proposed Huron-Lorain Bridge to be constructed with a connection to Eagle Ave. at Ontario St. to meet the proposed westerly extension of Carnegie Avenue.
3. Additional high-level bridge from Huron Road and Ontario St. to Franklin Ave. to connect a great through route made up of Euclid Ave. and Huron Road on the east side and of Franklin Ave. and Madison Ave. on the west side.
4. A high-level bridge from E. 30th St. and Pittsburg Ave. to Jefferson Ave. and W. 5th St. This will provide an East Side-West Side belt-line route.

The construction of all of these bridges will be required to meet traffic demands within thirty to fifty years.

Standard Thoroughfare Widths—The following standard thoroughfare widths and cross-sections, expressed in feet, are recommended:

Class	Street	Roadway	Sidewalk
A	66	40–42	13–12
B	86	55–56	15.5–15
C	100	60	20
D	120	76–80	22–20
E	140 and over		

The 66-ft. thoroughfare is undesirable unless traffic is light, unless the number of vehicles standing at the curb is negligible, unless there are no street car tracks, and unless the traffic using the thoroughfare is predominately either of the fast or the slow type. It will seldom be wise to apply the 66-ft. standard in laying out a city thoroughfare in as yet undeveloped territory. It is, however, a standard that it will frequently be expedient to apply in replanning the thoroughfare system of a built-up area. In the plan submitted, the 66-ft. standard is applied to a considerable number of narrow thoroughfares where the existing development seemed to make it inadvisable to attempt to secure a more adequate width.

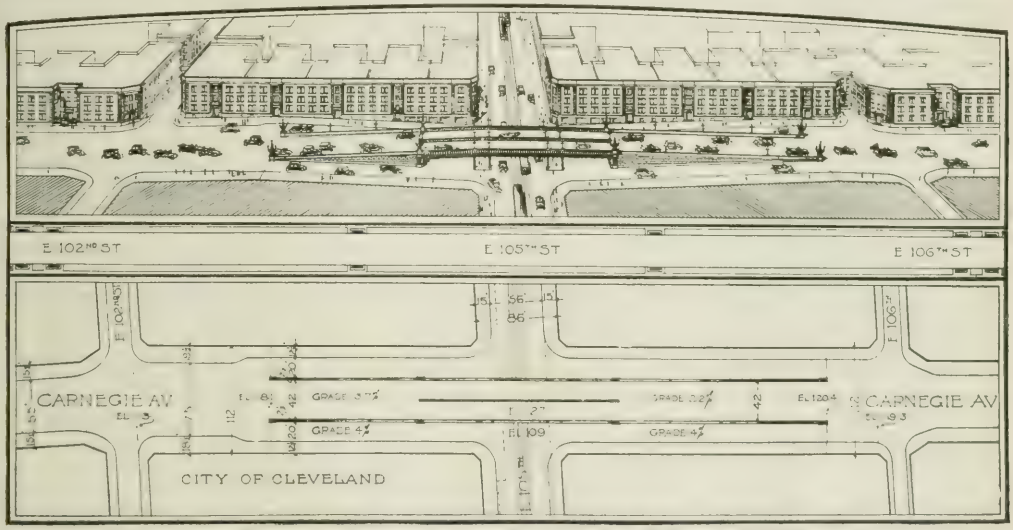
The 86-ft. thoroughfare, with a 56-ft. roadway, provides for two lines of moving vehicles in each direction in addition to space for vehicles standing at the curbs. In the plan submitted the 86-ft. standard is applied to most of the routes recommended for widening or extension. It is the minimum width that seems at all adequate for any but minor thoroughfares. It should at least be a minimum for all main thoroughfares and for most street car routes and for all routes crossing the entire length or breadth of the future central business district.

It is recommended that the traffic ordinance be amended to require a special license for any vehicle more than 7½ ft. wide.

Over- and Under-Crossings—Various methods of separating grades at street intersections have been devised and a number have been applied. Where applied, however, it has usually been to meet exceptional demands of topography or traffic and not to solve the problem of a typical busy intersection. A separation of grades is comparatively simple if provided for at the time the streets are laid out and the grades established.

In the case of the typical busy intersection a complete separation of grades is not practicable. The intersecting routes cannot be completely separated as in the case of a steam railroad and a highway. Freedom of interchange of traffic between the two intersecting streets must be retained. The most that can be done is to carry the through traffic of one of the streets over or under the intersection. The intersection itself will still be complicated by the interchange traffic of both streets and by the pedestrian traffic of both streets.

In the extension of Carnegie Ave. it is recommended that an over-crossing be constructed to carry its through traffic over E. 105th St. Over-crossings are also recommended for eventual construction in Superior Ave., both at E. 30th St., where a car line has been authorized, and at the E. 55th St. transfer point. The width of Superior Ave. (132 ft.) and the comparatively undeveloped condition of the street frontage affected greatly simplifies the construction of over-crossings in these locations.



PROPOSED CARNEGIE EXTENSION OVER-CROSSING AT E 105TH ST., CLEVELAND

Speedways—In city railway transportation the elevated road and subway have not superseded the street surface railway but have merely supplemented it. The evolution of vehicular traffic may be somewhat similar. As traffic is slowed down and the average length of haul increases the problem of providing a number of high-speed routes to carry traffic through the more congested areas will become urgent. Unless such routes are planned long in advance of their actual need, they will be almost prohibitively expensive when at length they are imperatively required. Cleveland's topography is favorable to the development of a number of speedways radiating from the heart of the city. The river valley and its branching ravines furnish possible locations for such routes. The lake front also may be

used for this purpose. These possibilities should be further studied in connection with plans for terminal and rapid transit development and in connection with plans for lake front improvement.

A plan is submitted for the construction of a three-mile speedway in the partially undeveloped area immediately north of Euclid Ave., between E. 21st St. and East Boulevard.

The Traffic Problem—Street traffic is increasing much more rapidly than population. If the growth of street traffic merely kept pace with the growth of population the problem of making adequate provision for the future would be sufficiently difficult. It is probable, however, that the street burden will under normal conditions increase twice as fast as population; i.e., while population is doubling the street traffic will be trebled.

The traffic problem is chiefly one of average speed and not of the number of vehicles it is physically possible to move through the streets. Even with all the interruption due to cross traffic there is abundant street capacity in so far as number of vehicles that it is possible to pass through the streets during any 2- or 12-hour period is concerned. All the traffic offering can doubtless be taken care of—the only question is with what delay and with what average speed. If an average speed of 2 to 6 miles an hour will suffice, there is no traffic problem now and possibly never will be. But if an average speed of 10 to 20 miles is demanded, the traffic problem is extremely urgent and difficult.

Extreme congestion means not only that street car service is disrupted but also that all trucking and commercial traffic is slowed down. The cost of trucking is a much larger factor in the cost of most goods than is railroad freight. Many products are transferred by vehicle through city streets a half dozen times before they reach the consumer. If through street congestion, as is undoubtedly true in parts of Chicago, New York and London, the time and cost of trucking goods is doubled, the toll due to congestion is certainly enormous. It is paid in part by the public in higher prices. It also places a serious handicap on the commerce and industry of the city.

Method of Carrying Out the Plan—The entire plan here proposed is not suggested for immediate execution but as a twenty-year improvement program. Most of the street extensions proposed should be made soon as there is no other way of preventing their being blocked by the erection of expensive buildings. The widenings, however, can for the most part be made gradually, as and when new buildings are constructed or existing buildings are reconstructed. In this way the widened thoroughfare can eventually be secured (probably by the time it is imperatively needed) and the value of the existing buildings will be saved. It is proposed that the plan shall be submitted to the city council for approval as the official thoroughfare plan of the city.

The cost of carrying out the plan is dependent on various factors not clearly ascertainable at the present time. Probably the cost will not be less than $20,000,000, not including the proposed Cuyahoga valley bridges. A financial program authorizing the expenditure of from one to two millions annually should be adopted in order that the most urgent features of the plan may be carried out and the erection of any buildings that would seriously interfere with the eventual carrying out of the plan prevented.

The Cost of Delay—Chicago is now spending more than $80,000,000 in the widening, extension and improvement of a few main thoroughfares. Most of this expense would have been saved if Chicago had prepared a thoroughfare plan when it was the size that Cleveland now is and had adhered to it ever since. Cleveland in a few years will be compelled to expend similar amounts for improvements that can now be provided for at comparatively trifling cost.

There is nothing quite so permanent and difficult to change materially as a city's streets after they have once been solidly built up with business buildings or apartment houses. Buildings have come and gone but the streets of central Boston and lower Manhattan retain most of their original crooks and turns. On many of the streets included in the proposed thoroughfare plan for eventual widening, the buildings are for the most part set back from the street line. Now is the time to provide either for the immediate widening of these thoroughfares, or for their eventual widening—say, when new buildings are constructed or the present residences are replaced by stores and apartment houses. Cleveland is building up and spreading out so rapidly that every year's delay in the adoption and enforcement of a thoroughfare plan will mean an enormous loss to the future city both in money outlay and in commercial and industrial efficiency.

The plan outlined in this article has received the tentative approval of the City Plan Commission and is now being presented to the public for its study and criticism. The plan has been prepared by Robert H. Whitten and Frank R. Walker, the advisors of the commission, in close co-operation with Robert Hoffman, city engineer. C. E. Conley, engineer of the commission, has had immediate supervision of the work and has contributed largely to the plan as now presented.

Extent of Irrigated Area in California

During the past two years, 25 new irrigation districts have been organized in California and one has been dissolved, making a present net total of 68 districts, according to the seventh biennial report of the state department of engineering. The area of these districts ranges from 192 to 603,840 acres, with a total of 3,008,000 acres under district organization. Of the 1,535,000 acres on which there is bonded indebtedness, the amount varies from $3.48 to $106.45 per acre and aggregates $39,900,000; an average of $26 per acre. During the last two years the bond issues approved totaled $14,788,000. Of the area in the state incorporated in irrigation districts, slightly over 2,000,000 acres is in the great central valley of California, i.e., the Sacramento and San Joaquin basins. In the Sacra- 350,000 Valley the irrigation districts comprise about 350,000 acres and in the San Joaquin Calley about 1,712,000 acres. The sources of water supply in this central valley and in the Pit River basin are as follows:

	Acres
Area supplied by pumping from streams	227,019
Area supplied by natural flow, gravity canals	766,126
Area supplied by stream flow with storage	1,171,124
Area supplied from underground sources alone	55,578
Total	2,219,847

Most of the 68 districts are now in operation; several have not yet completed their work, while a few have not been able to acquire the necessary water or begin construction.

Incomes in Engineering Profession Compared with Others

Iowa Engineering Society Investigation of Net Income of Doctors, Lawyers and Dentists Indicates Engineers Low

DO PRESENT fees and salaries enable the engineer and his employees to maintain a scale of living fair in comparison with that of other professions? The answer to this question was sought by a committee on compensation of the Iowa Engineering Society during the past year. The results obtained from sending out 1,500 inquiries, with 35 per cent replied to, were presented to the recent annual meeting by L. J. Canfield, secretary.

The committee does not favor the establishment of maximum salaries but believes that an engineer, if he

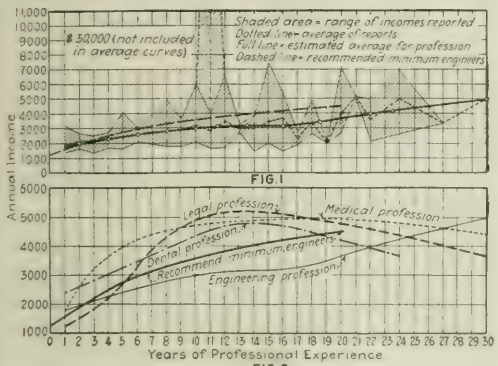


FIG. 2
COMPARISON OF AVERAGE INCOMES OF THREE PROFESSIONS COMPARED WITH ENGINEERS

is at all worthy of the profession, should not be forced to drop below a minimum net income which will enable him to advance and to maintain a respectable standard as a professional man.

As to fees charged it was the opinion of the committee that little can be done until services rendered have been defined or standardized. It held something should be done in this direction since minimum fees charged by practicing engineers materially govern the net incomes of men in private practice and their employees.

Fig. 1 gives the net income of engineers from all branches of the profession according to the years of experience. The latter were considered equal to years spent in college. The points governing the location of the estimated average were obtained by averaging the reports for several years together and plotting at the center of the range of years considered. Near the high end of the curve as many as six years' reports were averaged together on the assumption that men of several years' experience could easily be six years apart in their attainments. This number was gradually reduced to a minimum of three years at the low end of the curve. This method of averaging has practically the same effect as increasing the number of reports and, in fact, gave the same values as the exact average of reports near the lower end of the curve where a sufficient number of reports were received to give a smooth curve. The recommended minimum was obtained by plotting the values given in the table. Similarly curves were drawn for the other professions. In Fig. 2, which shows the comparison of all the professions, engineers seem finally to surpasse all three professions after the first quarter century.

BASIS FOR RECOMMENDED MINIMUM NET INCOME

Years of experience	0	3	5	7	10	20
No. in family	1	2	3	4	5	5
Food:						
Groc., meat, ice	....	$30.50	$36.25	$43.50	$51.00	$56.00
Milk	.....	4.50	6.25	9.00	9.00	9.00
Meals out	30.00	5.00	7.50	7.50	10.00	20.00
Total	$30.00	$40.00	$50.00	$60.00	$70.00	$85.00
Clothing:						
Man	$15.00	$12.80	$12.50	$12.50	$15.00	$18.00
Woman	.....	12.50	15.00	15.00	17.50	20.00
Children	.....	.....	5.00	8.00	10.00	25.00
Laundry	5.00	2.00	6.00	6.00	7.50	10.00
Total	$20.00	$27.00	$38.50	$41.50	$50.00	$73.00
House maintenance:						
Rent	$12.00	$40.00	$45.00	$50.00	$60.00	$65.00
Furniture	.....	12.00	12.00	12.00	10.00	10.00
Phone	.....	.....	2.50	2.50	2.50	3.00
Fuel, light, water	.....	12.00	12.00	14.00	14.00	16.00
Total	$12.00	$64.00	$72.50	$78.50	$86.50	$94.00
Personal:						
Health	$2.50	$5.00	$10.00	$10.00	$10.00	$8.00
Recreation	7.00	8.00	6.00	6.0	8.00	20.00
Books	1.00	1.50	1.50	1.50	2.50	5.00
Magazines, papers	2.50	3.00	3.00	3.00	3.00	4.00
Travel	2.00	4.00	4.00	5.00	5.00	10.00
Clubs, societies	2.50	3.00	4.00	6.00	8.00	10.00
Church gifts	5.00	5.00	5.00	6.50	9.00	14.00
Tech. books, etc.	2.00	2.00	2.00	3.00	4.00	4.00
Life insurance	7.00	10.00	15.00	17.50	20.00	15.00
Taxes	1.50	1.50	2.50	4.00	5.00	8.00
Incidentals	10.00	13.50	16.00	17.50	19.00	25.00
Total	$43.00	$54.00	$69.00	$80.00	$93.50	$123.00
Monthly total	$105.00	$187.50	$230.00	$260.00	$300.00	$375.00
Yearly total	$1,260.00	$2,250.00	$2,760.00	$3,120.00	$3,600.00	$4,500.00

The basis of the minimum suggested is shown in the table in which the committee attempted to take into consideration the following facts: An engineer must be assured the necessities of life; and in order to progress and maintain even a humble station as a professional man he must be allowed certain other things such as memberships in engineering societies, the purchase of books and magazines and a reasonable amount of recreation. This table is not intended to be an exact minimum for engineers in all localities but is intended to be a reasonable minimum under the prevailing costs during the year 1920 in the State of Iowa, for the conditions assumed as to number of years of experience and the number in a family. The assumptions as to experience and number in a family are believed to be about the average conditions and due allowance should be made when these assumptions do not apply. The table does not provide for any savings account or unusual expense.

Timber Combination Highway Bridges

Combination truss bridges with timber top chords and posts and steel bottom chords and diagonals have been used extensively for highways in Montana, but the State Highway Commission now recommends them only for secondary roads. Where timber is to be used the Howe type of truss, with both chords of timber, is considered preferable. The principal reason for this preference is that in the combination truss, the timber top chord does not function properly with the steel bottom chord, so that it is difficult to retain the camber after a year or two of service. No Howe truss bridges have been built by the Commission and it is not likely that any standard designs will be made for such structures, as a recent ruling of the U. S. Bureau of Public Roads would eliminate consideration of timber bridges on Federal-aid road projects.

Cost-Plus Contract Gives Low Cost on Ashland Filters

By L. R. Howson
Principal Assistant Engineer, Alvord & Burdick, Chicago, Ill.

By adopting a cost-plus sliding-fee contract for intakes, a dry well and a coagulating basin at Ashland, Ky., the city saved nearly $20,000, compared with the lowest bid on a unit-price contract; the contractor made a fee of 10 per cent, with no hazard other than a possible reduction in fee, and both parties to the contract are well satisfied.

Early in 1919 plans for filtration works were prepared. The work was divided into several contracts, including one for intakes and structures. This contract covered two intakes into the Ohio River, a concrete tunnel 120 ft. long from the well to the river bank, a coagulating basin, clear well and filter house.

Bids were first received in July, 1919. Only one bid on the intake and structures contract was received and that was informal. The amount of the bid was $144,000.

The work was readvertised and an effort made to interest contractors who specialize in that class of work. When bids were opened but two proposals were received —for $125,000 and $113,000, respectively. As the funds available for this part of the entire construction were insufficient for either bid they were again rejected. After careful consideration, it was determined to omit the filter house and clear well in the belief that the available funds would be sufficient to carry out the work on that plan, and that later it would be possible to finance the construction of the part omitted.

When bids were received on the smaller amount of work it was found that the totals were but little reduced, being from $90,000 to $106,000, and all being much higher than the engineer's estimate. The small reduction in the prices bid, for the work omitted, clearly indicated that the contractors considered the construction hazard in the intakes, tunnel, and dry well as being great, and that it would be impossible to secure better bids on the fixed-price basis. This fact was pointed out to the Board of Water Commissioners of the City of Ashland. It was explained that in the engineer's opinion the bid of $90,000 included too much for contingencies; that the city should itself assume the hazard, pay for it if it existed, and profit if it did not. The board authorized the engineer and the low bidder to draw up and submit a contract on a "cost-plus-fee" basis.

A working contract was developed including the following principal articles: (1) Cost, including all labor, small tools, repairs to equipment, etc., was estimated at $65,000. The contractor was allowed a fixed sum of $2,000 for the use of major tools and equipment; (2) based upon actual cost agreeing with estimated cost, the contractor's fee should be $6,750; (3) any saving in cost below $65,000 would be shared equally by city and contractor, and (4) if actual cost exceeded $65,000 the first $1,500 excess was to be paid by the contractor; above $1,500 the contractor was to pay 20 per cent and the city 80 per cent until the fee was reduced to $3,000, after which there should be no further reduction.

The construction work was executed under this contract at practically the estimated "cost," although the Ohio River, due to the abnormally heavy rains of the fall of 1919, flooded out the work ten times. Based on the average, not more than two or three floods would have been expected. These floods caused an added cost of several thousand dollars, which would have been shared by the city and contractor under normal water stage conditions.

The Ashland contract was executed by the Joseph E. Nelson & Sons of Chicago and Kansas City. Alvord & Burdick were engineers for the city of Ashland, being represented by Roy H. Davis, as resident engineer. The writer prepared the contract under which the work was performed.

Power Commission Favors Potomac Project

Recommends That Great Falls Power and Water Supply Be Developed In Accordance with Tyler Report

In a special communication to Congress, the Federal Power Commission urges the prompt development of the water power at Great Falls on the Potomac, and the immediate prosecution of a separate project looking to the increase of the water supply for the City of Washington. In its recommendation to Congress, the commission says in part:

The Federal Power Commission is of opinion that the question of supplementary water-supply for the District of Columbia should be separated from that of power production, both for the reason that an immediate addition to the water-supply of the District of Columbia is imperatively demanded and also for the reason that the separation of the two projects involves no substantial loss of either time or money if the Congress should determine to carry out both suggestions.

For the reasons given by Major M. C. Tyler, who made the report for the Federal Power Commission, the commission is clear that the Potomac rather than the Patuxent water-supply should be developed and it earnestly recommends to the Congress the urgency of the need of the district that this project be at once undertaken.

The plan for the development of hydro-electric power from the Potomac has these great advantages: (1) It contemplates a serial development of which the several elements can be separately and consecutively undertaken, with the result that the power resources of the district will be augmented from time to time as the capacity of the district for the absorption of the power developed increases; (2) the suggested conservation of use of existing steam installation for the production of power make it highly improbable that any substantial loss will accrue to those who have invested in steam power plants, and (3) the serial development of water power will render unnecessary extensive and costly additional steam power plant installations, which would be necessary unless existing power producing facilities are supplemented as here suggested by the early development of a large body of primary power from a dam erected near Chain Bridge.

The Federal Power Commission recommends to the Congress that it authorize an immediate start in the development of power in accordance with the Tyler report. Our study of the situation satisfies us that all the power so developed will find a ready market in the District of Columbia and the circumjacent territory to which it can be transmitted without disproportionate line loss or transmission system cost.

The complete development of the Potomac with dams located at Chain Bridge and Great Falls and with the great water reservoirs for storage will constitute a national asset of incalculable value. It will save coal, labor and transportation. It will free the national capital from de-

pendence upon steam power production which is increasingly costly, and is subject to much greater likelihood of interruption at critical times due to shortage of coal. It will produce an immense body of primary and secondary power of increasing value and may well aid materially in the development of a power district about the great commercial and industrial cities from Philadelphia to Richmond, in which a steady and uniform supply will stabilize and encourage further industrial development. The project when completed will stand as an illustration to the country generally of the immense value of water-power development in the conservation of our national resources. For these reasons the Federal Power Commission concurs in the reports transmitted.

Comparison of Small House Costs for 1914, 1920 and 1921

ACCORDING to figures compiled by the Philadelphia Operative Builders Association and explained at the recent conference of all elements in the building industry called by the Industrial Relations Committee of the Chamber of Commerce, a two-story six-room dwelling, which in 1914, in that city, cost $2,969.30 to build, during 1920 cost $8,346.26, and, according to the wage schedules and material rates existing, would cost $6,676.04. The figures are based upon an operation of 100 houses. The figures included herewith were presented in chart form to show where the excessive costs still lie and to indicate savings that could be accomplished through reduction in the cost of various items.

Land upon which the house is constructed cost in 1914 $500 and in 1920 $600, and would cost $600 this year. That is considered a conservative estimate and is the cost of a lot with a 20-ft. frontage and a 40-ft. depth. The comparative street improvement costs are as follows:

	1914	1920	1921
1—Sewer	$22 50	$60 00	$60 00
2—Water pipe	15 00	30 00	30 00
3—Curb (plain)	6 00	16 50	16 50
4—Cartway paving	25 00	90 57	90 57
Total	$68 50	$197 07	$197 07

In comparing the general conditions, it was found that the greatest increase in any item was that concerning the placing of the first and second mortgages. In 1914 it cost $20 to place a first mortgage and $23 to place a second mortgage. In 1920 these costs had risen to $220 and $278 respectively and had decreased again to $108 and $128 respectively in 1921. Taxes and interest were also high and the conference decided to attack these costs with a view to securing a material reduction. The comparison of the items included under general conditions is as follows:

	1914	1920	1921
1—Plans	$1 00	$2 00	$2 00
2—Survey	3 50	5 00	5 00
3—Building permits and affidavits	5 00	7 50	7 50
4—Water permit (brick and stone)	1 80	1 80	1 80
5—Electric service			
6—Gas service		4 00	4 00
7—Fire insurance on building material	10	10	10
8—Fire insurance on buildings	1 60	3 87	2 88
9—Plant and tools	5 00	15 00	12 00
10—Sales expense	64 00	176 00	144 00
11—Advertising	32 00	88 00	72 00
12—Office expense	29 40	78 60	65 50
13—Compensation insurance		7 93	6 80
14—Taxes	11 25	85 00	77 45
15—Interest	101 25	263 00	219 40
16—Title company's charges	69 75	150 25	123 75
17—Deed—acknowledging, revenue and recording	4 00	8 50	8 00
18—Expense of placing first mortgage	20 00	220 00	108 00
19—Expense of placing second mortgage	23 00	278 00	128 00
20—Supervision	18 00	36 00	36 00
21—Supplies	5 00	15 00	12 00
Total	$395 65	$1 444 [illegible]	$1 036 18

In the actual construction work 1920 costs showed an increase over 1914 costs of 204 per cent. In 1921 this figure had decreased until the construction cost was 126 per cent above the 1914 level. The comparison of the actual construction costs in the three years is:

	1914	1920	1921
1—Excavation	$40 95	$99 45	$93 60
2—Stone masonry	145 54	408 70	354 42
3—Brick masonry	226 25	703 67	659 71
4—Rough carpentry	255 42	955 41	555 67
5—Finish carpentry	266 00	850 00	610 00
6—Plastering	104 61	385 04	269 42
7—Cement work	83 00	258 54	198 76
8—Cut stone	7 70	16 00	16 00
9—Structural steel	11 80	48 47	33 63
10—Roofing and spouting	50 00	120 00	110 00
11—Plumbing and gas fitting	167 00	545 00	448 00
12—Heating	166 00	440 00	368 00
13—Electric wiring	30 00	81 25	65 00
14—Stairwork	37 50	166 00	125 00
15—Labor, general	25 00	50 00	50 00
16—Tile work	5 50	12 00	9 90
17—Iron fence and clothes poles	17 00	30 00	29 00
18—Sheet metal work	35 00	105 00	88 00
19—Cabinet work	22 70	56 00	40 00
20—Hardware—finish	11 00	35 00	32 00
21—Hardware—rough	11 00	33 00	24 00
22—Painting and glazing	100 00	225 00	215 00
23—Art glass	8 75	15 00	15 00
24—Range and connection	21 50	65 00	65 00
25—Gas water heater and connection	12 00	35 00	26 00
26—Parquetry floor	48 60	143 75	129 60
27—Flue lining and crocks	2 10	8 85	8 85
28—Grading, general	3 15	6 65	6 30
29—Paperhanging and decorating	42 75	110 00	106 88
30—Lighting fixtures	44 25	90 00	83 00
31—Sodding and seeding	2 43	4 86	4 05
32—Numbering houses	65	1 00	1 00
Total	$2,005.15	$6,103.64	$4,842 79

Adding the totals for ground, street improvements, general conditions and construction, the cost of a two-story six-room house which in 1914 sold for $3,200 was $2,969.30. In 1920 this cost had increased to $8,346.26 and the house would be sold for $8,800. The 1921 house, costing $6,676.04, would be sold for $7,200. In 1914 a first-mortgage value on the $3,200 house was $2,000, the second-mortgage value being $700. These respective values were in 1920, $4,400 and $2,500, and in 1921, $3,600 and $2,000.

The rates of labor paid in these operations are set forth in the accompanying table. For 1914, the rates were the prevailing rates, though non-union. In 1920 and 1921 they are the actual union rates in effect. The cost of labor and that of materials are given, per hour and per unit, respectively, in the following tables:

COST OF LABOR

	1914 Per Hour	1920 Per Hour	1921 Per Hour
Common labor	$0 17½	$0 50	$0 40
Carpenters	40	1 12½	1 00
Carpenters' helpers	20	60	50
Plasterers	50	1 25	1 25
Plasterers' helpers	35	1 10	1 00
Bricklayers	50	1 30	1 30
Bricklayers' helpers	35	1 00	1 00
Stone masons	45	1 30	1 30
Painters	40	1 00	1 00
Roofers	40	1 10	1 10
Roofers' helpers	25	70	65
Cement finishers	50	1 00	1 00
Cement laborers	20	60	60
Tile setters	65	1 00	1 00
Tile setters' helpers	40	80	68
Plumbers	44	1 15	1 15
Plumbers' helpers	20	75	75
Steam fitters	36	1 10	1 10
Steam fitters' helpers	24	75	75

COST OF MATERIALS

Material	Unit	1914	1920	1921
Foundation stone	Perch	$1 40	$4 00	$3 00
Brick	M	7 00	20 00	18 00
Cement	Bbl	1 55	5 25	4 50
Rough lumber	M ft b m	20 00	70 00	46 00
Flooring	M ft b m	30 00	80 00	60 00
Sash, frames, doors, 4 p	M	[illegible]	20 00	9 50
Builder's lime	Bbl	25	70	64
Common plaster	Bbl	2 00	6 25	6 25
Sand	Yd	1 00	2 96	2 80
Lime	Bbl	25	35	35
Structural steel	Cwt	40	5 75	4 00
Tile	Box	8 20	22 00	22 50
Belt	Cwt	30 00	110 00	[illegible]
Lath	C	70	2 00	2 [illegible]
Cement	Cwt	3 00	7 50	4 75
Sash cord	Ft	[illegible]	1 [illegible]	80
Tile floors	Sq ft	30	1 00	82

The comparison in the amount paid to the subcontractors is indicated in the last table. The year 1914 was taken as a base, and the actual amount of money paid out to each sub-contractor for a specific job used as 100. Compared to that base were the 1920 and 1921 amounts.

COSTS OF SUB-CONTRACTS

	1914	1920	1921
Hardware (finish)	100	318	290
Plumbing	100	326	268
Heating	100	265	222
Painting	100	225	215
Paperhanging	100	257	250
Parquet floors	100	295	267
Roofing	100	240	220
Sheet metal work	100	300	250
Electric wiring	100	270	217
Millwork	100	315	221
Plastering	100	368	258
Gas ranges	100	300	300
Excavations	100	243	228
Rough stone foundation walls	100	308	270
Face stone work	100	226	190

The costs reproduced herein were gathered mainly by Daniel Crawford, Jr., president of the Philadelphia Operative Builders Association, who agreed to build without profit 100 such houses for laborers who could finance the actual construction.

Timber Floor Rapidly Destroyed By Dry Rot

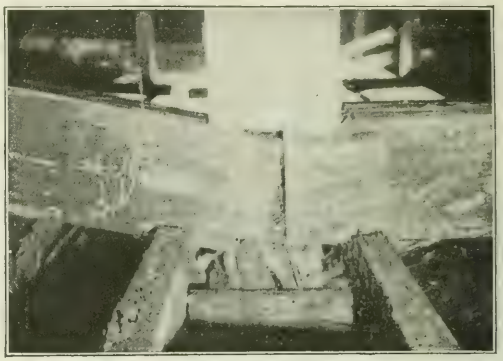
By Wilson Fitch Smith
Engineer, Merchant Shipbuilding Corporation, Harriman, Pa.

A REMARKABLE example of the rapid and complete destruction of timber by dry rot is the floor of the restaurant building of the Merchant Shipbuilding Corporation, agent for United States Shipping Board, Emergency Fleet Corporation at Harriman, Pa.

The shipyard and adjacent housing development were built during the fall and winter of 1917-18 under the unusual conditions that prevailed during that war period. (See *Engineering News Record*, Jan. 3, 1918, p. 17.) One of the last buildings erected was a one-story frame stucco restaurant with seating capacity for 2,600 people. The plans called for a concrete floor throughout the building, but in order to reduce the cost of the building just before construction was commenced it was decided to substitute a timber floor in the large cafeteria section covering an area 95 x 187 ft. The natural ground surface under this section was a dry sandy loam from 3 to 8 ft. below floor grade.

The original plans showed concrete piers spaced 15 ft. 6 in. c. to c. in both directions, to elevation of the floor level. These supported the columns, which carried the roof. The floor was 4 in. of concrete laid on a compacted fill. The plans were revised to omit the fill and show the tops of the concrete piers 2 ft. 2 in. below the finished floor grade, carrying 9 x 12-in. y.p. floor girders made up of three 3 x 12-in. pieces spiked together. These girders carried 3 x 12-in. y.p., or hemlock floor beams spaced 18 in. c. to c. on which was laid ⅞-in. rough pine flooring, a layer of building paper and ⅞ x 2-in. tongue-and-groove maple flooring. Owing to the scarcity of lumber the most readily available was used and it is probable that much of it was not seasoned properly. In order to support the roof columns which had been designed to foot on the top of the concrete piers at the finished floor level 10 x 10-in. y.p. blocks 14 in. long were placed on the girders over each pier, with grain vertical, and the cast-iron column shoes were spiked to these blocks.

The construction was started in April, 1918, and the building completed by August, 1918. In the haste of the war period the change in type of flooring was made on the plans but no change was made in the drawings for the foundation walls. These were concrete, 10 in. thick to the sill level and were continuous around the entire area. Although all of the other buildings with timber floors built at this time were provided with proper ventilation windows in the foundation walls, this precaution was overlooked by the construction force who followed the plans exactly and apparently no one realized the necessity of providing ventilation. As a result the space beneath the floor was air-tight.



TIMBER FLOOR DESTROYED BY DRY ROT

In the winter of 1920, or about 18 months after the completion of the building, the floor began to sag between columns, then the columns began to settle irregularly. The deterioration was so rapid that in March, 1920, the section was closed and an investigation made. This investigation revealed that practically the whole area was infected with the fungus growth that induces dry rot. Many of the girders had become so weakened that they had broken in mid-summer. The yellow pine column footings had crushed into the ends of the girders and in many cases had themselves disintegrated so that the columns had settled 10 in. or more. The rough flooring was practically gone and the under side of the maple flooring, to a depth of half its thickness, was decayed so that the integrity of the floor was preserved solely by the upper fibers of the maple flooring.

There was hardly any of the exposed timber that was not affected but generally the greatest destruction was in the center, away from the exterior walls. The soil was comparatively dry and no moisture visible anywhere. In many places the mycellium of the fungi spread out in a thick network over the ground sometimes extending several feet beyond the scrap of wood in which it was rooted. It is apparent that the timber was infected at the time it was erected, but proper ventilation would certainly have arrested its development.

It is probable that those concerned with the design of the buildings had knowledge of the phenomenon of dry rot as ample provisions for ventilation had been made in all of the other buildings of similar nature, and the failure to provide suitable ventilation was evidently due to the haste of construction under war necessity.

This is a striking example of the costly failure that may result from the hasty modification of a plan, even though it be in the interest of economy, unless the consequences are carefully followed through to the end.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Exchange of Silver Coin at German Border—A Protest

Sir—We acknowledge receipt of copy of *Engineering News-Record* of Nov. 4, 1920. The article which concerns us contains so many erroneous statements that we take the liberty to correct them as follows:

The export of silver money is prohibited by law. Travelers passing the border are therefore obliged to produce the silver money they possess. At our exchange department in the station all foreign money is exchanged as well as silver coin. The traveler can either deposit his silver coin there or exchange it. We want to call attention to the fact that foreign silver money is not calculated at its exchange value for notes, but at the world market price for silver.

The official announcements of these quotations by the Reichsbank are shown to every traveler who wishes to see them. At the time in question the price amounted to 8 marks for one silver gulden.

You were therefore not compelled to exchange your silver money but could have deposited it or sent it to somebody known to you in Germany. If you received silver money in Berlin at the paper money rate, we, on the other hand, are not obliged to change your silver into paper money and accept the loss ourselves.

On the strength of these facts we must object energetically to your accusation of the robbery of travelers and suggest that you get into communication with the bank in question in Berlin to straighten the matter out. As far as your further serious accusation of a collusion between the bank employees and the revenue officers is concerned, we have presented this matter to the proper authorities.

Although our experience has shown us that everything which can discredit Germany is being published broadcast and in distorted fashion by our former enemies, we express the hope that your paper will assume an objective standpoint and also publish the other side's views.

Bentheim, Germany. BARMER BANK-VEREIN,
Dec. 13, 1920. HINSBERG, FISCHER & CO.

[The statements referred to were made in an article by the editor written from abroad. He stated that he had received only 20 marks at the German border city of Bentheim for a 2½ gulden piece (Dutch) for which he had paid 37½ marks the day before in Berlin. He characterized the procedure as robbery.

The intimation in the rejoinder is that the real cause of the loss was the selling bank in Berlin, that it charged for Dutch silver at the rate for Dutch notes, which presumably is at some point between the silver and the gold rates. If that were the case—and we have not the data at hand to verify or deny the point—it is obvious that on a later exchange the seller would lose. He would get merely the silver price.

Of this, though, we are certain: whether the selling banks in the interior or the buying bank at Bentheim is at fault, the effect on the traveler is the same—he leaves Germany smarting under what he considers an injustice. The editor stated that his case was not isolated, that other travelers made the same complaint. The situation is unfortunate for Germany, for this system is sending people out of the country with the feeling that they have been unfairly treated.—EDITOR.]

Cross Sectioning and Good Judgment

Sir—In your issue, Dec. 30, 1920, p. 1272, appears an interesting article on railroad cross-sections taken with the Beaman Stadia Arc.

The Western District, Interstate Commerce Commission, on grading measurements, experimented with several types of cross-section instruments, but found nothing superior to the hand-level, rod and metallic tape, with occasional use of the small Reed slope board, which gives the graphical solution of a right triangle when the slope distance is measured. In wide yards a dumpy replaced the hand-level.

In this connection it must be born in mind that in measuring grading the object is not to take a cross-section with superfine accuracy, but to determine as nearly as possible the volume of earth lying between that section and the preceding one. If too much attention is paid to niceties of instrumental work the engineer has not the opportunity of judging the natural ground slopes and properly placing the section to arrive at the correct volume closely. The purpose is to fit a number of prisms to a somewhat irregular body of earth in order to compute the cubic yardage.

To arrive at a fair figure on old grading work it may be necessary to estimate to some extent the original toe of slope which might be covered by silted ground or eroded.

For these reasons a hand-level gives best results.

Extreme accuracy of cross-sections is not as important as good judgment in selecting the point at which the section should be taken, and estimating the original surface of the ground, and no set rule for placing the sections at uniform distances apart can be adhered to. A. A. ROYCE.

Bocas del Toro, Republic of Panama, Jan. 15.

No Need to Curtail Iowa Road Work

Sir—In your issue of Jan. 6, p. 41, there is a letter by John Wilkes making a plea for higher automobile taxes, and also for the temporary curtailment of road improvements. In this article I find the name of the state of Iowa coupled with the fact that this State has the largest number of automobiles in proportion to the population; also that the people in this State borrowed the largest amount from the Federal Reserve Bank in this district in proportion to its quota of the usual crop-moving loans. In the same paragraph is mentioned the fact that South Dakota, which also ranks high in the number of automobiles in proportion to the population, is having a great many bank failures. These statements, while perhaps true, sound without a word of explanation rather derogatory to Iowa.

To begin with Iowa, being an agricultural state, and one of the best in the Union, wealth is more generally distributed among the population than in states containing large manufacturing centers. Iowa has prospered immensely the last three or four years, due to large yields and high prices. The increase in the automobiles owned in this State in that time has been enormous. Referring to the large amount of money which the people of Iowa have borrowed this year during the crop-moving season, this is traceable to a falling produce market and one of the biggest crops in years. The produce instead of going to market as is usual this time of the year is being held for better prices. This necessitates bigger loans for meeting current needs.

Iowa greatly increased its income from license fees a year ago when a law taking effect Jan. 1, 1920, based the fee collected on the cost of the car and its weight. One per cent on the cost of the car and 40c. per hundred weight is collected, the idea being that the heavier car does the most damage to the road surface. This makes the lowly "jitney" pay only $10 while a car costing $7,000 and weighing 5,000 lb. pays $90 a year for the use of the public highways if registered in Iowa.

Iowa now has a very efficient highway department under whose supervision this money along with other current funds and federal-aid funds available are being spent. In such a case there is no unusual burden being placed on the people. Iowa is going ahead steadily, spending these funds and pulling itself out of the mud. There is no occasion here for any great curtailment of road expenditures such as

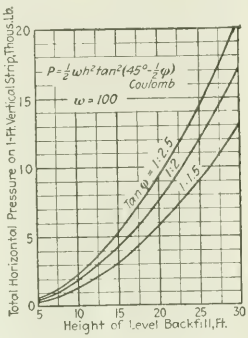
might be desirable were funds obtained solely from bond issues being sold under the present adverse financial conditions. Absolute curtailment of all road expenditures would tend further to upset present conditions.

A. P. MUNSEN,
Bridge and Paving Contractor.

Marion, Ia., Jan. 10.

Earth-Pressure Curves by Coulomb's Formula

Sir—The curves shown herewith were made up by the writer in order to have done once and for all the computation for earth pressure on retaining walls. A statement of Baker's may be recalled, that no matter how carefully earth pressure may be figured some very broad assumptions must be made to start with, so that you might almost as well assume the thickness of the wall. Coulomb's formula, however, even though it may be incorrect, gives very reliable results on a subject that is so uncertain. To simplify its application the curves were plotted only for the standard angles of repose 1 on 1½, 1 on 2, and 1 on 2½. This is as close as most of us know the slopes of materials used in construction, and, as a general rule, it is not known what material will go into a backfill until after the wall is designed and built. In such cases the curve representing a 1 on 2 angle of repose is safer than the lower one. This middle curve also agrees very closely with tests on sand, as published in *Engineering News-Record* several months ago, in which the lateral pressure was found to be 42 per cent of the vertical pressure at all depths. For the curves shown here the weight of earth is taken at 100 lb. per cu.ft., and may be easily corrected for other values. In computing the overturning moment the total pressure is to be applied at one-third the distance up from the base.



EARTH PRESSURE AGAINST RETAINING WALLS

Mason City, Iowa. A. W. BEDELL.

The Special Library Link

Sir—The New York *Times* of Sunday, Jan. 9, 1921, in its Editorial Section has a very interesting article on "Engineers Join in Research Work" with a sub-head "Agencies Co-operate in Effort to Salvage Knowledge Gained in War." While the aim of this article is to make known the co-operation of the several large engineering societies of this country in linking together their members into a vast potential force for the solution of the various problems confronting the manufacturer and scientist, it has left out a very important link in this chain of research. I refer to the library link.

We all know that today as never before scientists and manufacturers are depending more and more upon records of others as found in the printed word. Witness the growth of the service of the United Engineering Society, the generous response to the Chemists Club for increased funds, the expansion of the Technology room of the New York Public Library and, most important of all, the tremendous increase in special libraries organized since 1917 to aid large and small industries in the solutions of their problems.

With the linking up of this vast reservoir of salvaged knowledge gained from the war together with knowledge that has been made available throughout past years what greater ally to industrial research could be found?

To go back to March 20, 1915, p. 351, the *Engineering Record* published an article the text of which was: "There are today in this country a large group of engineering libraries of great value *collectively* but not suitably co-ordinated." This article finishes by saying that: "To do the work would necessarily require considerable expenditure, but it would be time and money well spent."

It is not altogether unlikely that the following circumstance will be repeated many times and to avoid it we should make a national effort to harness it. I refer to a happening in an industrial city where a large manufacturing concern had been experimenting on a special process, resulting finally in failure. One of the men working on this process was talking with the librarian of the city about it. A smile crept over the librarian's face as he told the man that "that very experiment had been tried out before and found a failure. We have a record of that failure right here in one of our books." So because this concern went ahead blindly they lost some thousands of dollars and were no further ahead.

So it goes and so it will continue to go—wasting thousands of dollars annually simply by failing first to find out whether or not the proposed process, operation, or whatever it may be has ever been done before and if so what is the best way.

There are two ways that this "library link" can aid materially: (1) By published weekly an index of abstracts of articles in current technical papers. (2) By founding a large central catalog of all technical books, pamphlets, trade catalogs, and translations carefully analyzed for every item of value in them. Such a catalog would be a large undertaking but by no means impracticable. A long start has been made in the Library of the United Engineering Societies, in the Library of Congress and John Crerar Library of Chicago. This proposed library has its prototype in the International Institute of Bibliography at Brussels, which fortunately escaped the ruthlessness of the Germans and recently filed its 12 millionth card.

Additional co-operation could be gained by linking up the several hundred special libraries devoted to special industries by making them sponsors for picking out all items of pertinent value in their collections and sending copies of cards indexing these items to the proposed central catalog.

New York City, Jan. 11. K. C. WALKER.

Hydrated Lime Test Specimen Very Lean Mix

Sir—I have noted in your issue of Jan. 20, 1921, p. 121, a tabulation, giving the results of the third inspection of the specimens of concrete exposed to the action of seawater at the Boston Navy Yard. We are, of course, especially interested in the report of the action of specimen No. 22, which was the one containing hydrated line, but we feel that, as presented, the data will be misleading to the great majority of your readers who have not followed the subject closely or who have forgotten about the former reports as to the specifications and fabrication of this specimen.

The proposed specifications for these tests first appeared in *Engineering News* (Dec. 24, 1908, p. 730) in which it was proposed to use 90 per cent of average cement, made from a mixture of several cements, and 10 per cent of hydrated lime to 3 parts of sand and 6 parts of coarse aggregate. The description of the fabrication of these specimens appeared in *The Engineering Record* (Aug. 19, 1911, p. 230) from which description we find that for specimen No. 22 a mixture of nine parts of average portland cement to one part of hydrated lime was used, with 3 parts of fine bank sand from South Acton, Mass., and 6 parts of crushed trap rock, from Malden, Mass. From the same article, we find that the sand weighed 97.18 lb. per cu.ft. with 34.2 per cent voids, and that the stone weighed 90.24 lb. per cu.ft. with 50 per cent voids. The consistency was reported as being quaky with slight tamping. We further note that the specimen was cracked in handling and suspending, though no details were given as to where the crack was. This was the only specimen reported as having been injured in handling.

Throughout the reports, this specimen has always been alluded to as being of 1:3:6 mixture with 10 per cent of

hydrated lime added; as a matter of record, the hydrated lime was substituted for portland cement to the extent of 10 per cent, so that this was the leanest mixture of the entire series, the actual mixture being 1:3.33:6.66. Besides being the leanest mixture we find that, as previously noted, it was broken prior to suspension in the water.

Under date of Dec. 22, 1909, we find a report that the interior of the 3-in. cored hole was absolutely dry after the specimen had been suspended (cracked) for about ten months. This is of especial interest, in view of the facts that the specimen was the leanest mix of the entire series and that a simple calculation will show that the voids could not be completely filled, theoretically, by the cement and matrix, respectively.

Several other specimens were prepared with true 1:3:6 mixes and in 1920 we find that No. 9, 11 and 13 are in very bad condition, 15 and 17 fairly solid, No. 19 "missing," No. 7 and No. 22 entirely gone in mid section and remaining concrete rotten.

Taking into consideration the facts that hydrated lime was substituted for portland cement in specimen No. 22 and as a consequence this specimen represented the leanest mixture of the entire series, and further that the specimen was cracked in placing, it is not as much a cause for wonder that the specimen disintegrated as it did, as it is of astonishment that this specimen showed a record which compares so well with specimens made of a richer mix, and that it took over ten years for the mid-section to be entirely disintegrated. The writer would have predicted this disintegration to have been completed in three years at the outside, since calculating from the voids, as given, this specimen must have been very porous and so have allowed entire permeation of the mass by the sea water.

TYRRELL B. SHERTZER,
Construction Engineer, Eastern Bureau of National Lime Association.
New York, Feb. 2.

Stresses in Reinforced-Concrete Chimneys

Sir—Mr. Fleming's interesting article on "A Few Lapses in Textbooks" in *Engineering News-Record*, Jan. 20, 1921, p. 125, puts the writer in mind of a disagreement between two textbooks as to the stresses in a reinforced-concrete chimney when eccentrically loaded.

Hool & Johnson's "Concrete Engineer's Handbook" on p. 407 describes a graphical method as given by W. S. Wolfe, instructor in Architectural Engineering, University of Illinois, in *Engineering & Contracting*, April 25, and May 23, 1917. Under the conditions given the maximum stress in the concrete is found to be 479 lb. per sq.in. and the maximum stress in the steel is 10,650 lb. per sq.in.

Turneaure & Maurer's "Principles of Reinforced-Concrete Construction," third edition, gives a diagram, Fig. 5 on p. 419, from which the maximum stresses in the concrete and steel due to an eccentric load caused by wind pressure (the vertical component of the wind and dead load being the same in amount and location as that in Mr. Wolfe's illustration) are found to be 517 and 8,760 lb. per sq.in., respectively, as nearly as can be read from the diagram.

These results do not agree very well and in very large chimneys the difference in the stresses as found by the two methods are apt to be much greater. A case recently came to the writer's attention of a chimney about 20 ft. in diameter at the base and about 200 ft. high in which Wolfe's method gave nearly twice as much stress in the concrete and several thousand pounds per square inch more in the steel than Turneaure & Maurer's. In the latter case Taylor & Thompson's method agreed fairly well with Turneaure & Maurer's results.

In Turneaure & Maurer's method the assumption is made that the steel reinforcement is in the form of a cylindrical shell located in the center of the concrete shell and in this respect deviates somewhat from the facts.

As far as the writer can see Mr. Wolfe's method is practically accurate and yet, in the case of the large chimney before mentioned, it is difficult to account for the results obtained. In that case the line of the resultant pressure came close to the edge of the kern, indicating compression over the entire shell, but the diagram based on Wolfe's method showed much higher tensile stresses in some of the steel bars than would seem possible under the circumstances. The man who made the diagram stoutly defended its accuracy and the variation in results of the different methods was the cause of considerable discussion.

The writer would be much gratified if someone who has the courage, time and mathematical talent would analyze the different methods and determine which should be considered the standard one to use. FRANK S. BAILEY.
Boston, Mass., Feb. 17.

A Thrust Boring Machine

Sir—Your issue of Oct. 14, 1920, contains on p. 772 an article on a thrust boring machine. A somewhat similar, but cruder machine was designed by the writer about the year 1898 to push pipes through three earth dams, the object being to replace 4-in. siphon pipes by 4-in. gravitation pipes without intrefering with the water level of the reservoir.

The method was to put a concrete block against the puddle wall, the concrete block having a hole through it that would allow of the free passage of 4-in. screw pipes such as those used for lining bore holes. A pointed iron head fixed onto the end of the leading pipe was then pushed through the hole in the concrete block, other pipes being added and pushed on until the pipe emerged into the water. When everything was ready the piercing head had to be removed and the flexible joint carrying the floating intake pipe put on by divers. The object of the concrete block was to prevent any creep of water along the pipe through the puddle. W. H. SHIELDS,
Perth, Western Australia. Consulting Engineer.
Nov. 23, 1920.

An Old Water Turbine

Sir — In the onward march of science it is sometimes worthwhile to pause and review the work of our predecessors. Occasionally we receive a shock when we discover that some of the principles which we believe to be of recent origin were in reality employed years ago.

In the accompanying photograph, taken a few years ago, is shown an old water turbine. It occupies its original position, but the former mill with its equipment is entirely gone and the dam seen in the distance is in the last stages of decay. The developed head was apparently about 8 ft.

The turbine was set on the bed of the river and the unique thing about it is the discharge of the water upward and outward, with no draft tube. The runner buckets remind one of the Francis runner in principle. There were evidences of a 6 ft. power flume. A cast-iron gate is shown, admitting the water to a plate spiral casing. The turbine shaft with coupling on top clearly indicates that the turbine rests in its original position.

The plate visible on the gate casing bears an inscription somewhat as follows: "Geo. H. Jones Little Giant Turbine, Mfg. by J. C. Wilson & Co., Pictou, Ont., 1870." The power site is at Paquetteville, Province of Quebec, Canada, on a stream tributary to Hall Stream, in turn tributary to the Connecticut River. D. M. WOOD,
Boston, Feb. 21. Engineer with Stone & Webster, Inc.

Almost a Sacred Occupation

Appreciation of the value of a potable water supply was indicated recently in a paper before the Indiana Sanitary and Water Supply Association by H. O. Garman, chief engineer, Indiana Public Service Commission, in the following terse terms: Few committees appreciate that it is but one step from the home to the cemetery and that your place in a home or in the cemetery is absolutely in the hands of some obscure, unknown, underpaid and too often unappreciated employee of the purification department of our water utilities. The management and operation of a water utility is almost a sacred occupation.

HINTS FOR THE CONTRACTOR

Mixing Plant Mounted on a Motor Truck

A MIXING plant mounted on a 6½-ton motor truck, as illustrated in the accompanying view, has been used successfully for small concreting jobs by C. S. Edwards, contracting engineer of Jersey City, N. J.

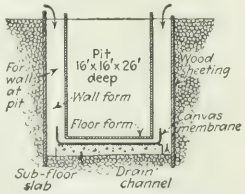
TRUCK MOUNTED MIXING PLANT FOR SMALL JOBS

The ½-cu.yd. mixer, with an elevating loading skip and a chute discharge is mounted on the rear of the truck and the remainder of the space is occupied by the stone and sand bins and the water tank. Space under the bins provides for the storage of twenty-five bags of cement. The stone bin is of 4½ cu.yd. capacity the sand bin 2½ cu.yd., and the water tank 280 gal. Briefly, about enough material for a 5 cu.yd. of concrete is carried, which is sufficient for a majority of small jobs.

Watertight Concreting in Wet Gravel

PITS and conveyor tunnels in water-bearing gravel at the Samson Tractor Co., Janesville, Wis., necessitated special methods in securing watertight concrete construction, a canvas membrane being embedded in the concrete for part of the work. Ashpits adjacent to the smokestack at the heating plant or power house constituted the most difficult problem, the largest pit being about 16 ft. square and 26 ft. deep below grade and the other 15 ft. deep.

After the general basement excavation had been taken out with a steam shovel and teams the pits were started, using tight wood sheeting all round. At first the bracing was framed and assembled in advance and driven down with the sheeting, but later the ordinary practice was adopted of driving the sheeting and then placing wales and braces as the pit was excavated. The former method was satisfactory but was found to have no advantage over the ordinary method. Sheeting was driven by hand and by a type of small air hammer on which the operator stands while driving. No jetting was used in this coarse water-bearing gravel. Pumping was done continuously by three 6- to 8-in. steam vacuum pumps and two 6-in. centrifugal pumps, one steam and one electric.



CONCRETE FLOOR OF PIT POURED FROM TOP

For the concreting a 24-in. subfloor was poured first, leaving a channel all round between it and the sheeting to carry water to the sump, as shown in the drawing. In spite of this the water flowing over the floor washed out a part of the cement in places and small springs were formed in the subfloor. Wall forms were hung in position and the reinforcing steel was placed within them. Then upon the concrete subfloor was laid a waterproofing membrane of heavy duck soaked in paraffin oil, this membrane being turned up 18 in. in the middle of each wall. Reinforcing rods for the floor proper were then placed and covered with a top form 12 in. above the sub-floor. Concrete was poured continuously from the surface of the ground until the floor and the walls were completed. A 1:2:4 mix was used, made with washed gravel and having added to it 10 lb. of hydrated lime for each sack of cement. Special care was taken to have the concrete well puddled after placing in order to form a dense mass. These pits have proved thoroughly watertight.

Tunnels and pits under a large portion of the foundry are required for the numerous molding machines and conveyors. Concrete for their floors was poured first, drain tiles being laid on the sub-grade to carry the water to sumps from which it was pumped. A groove 2 x 4 in. was cast in the floor under each wall, and was filled with oakum and tar before pouring the wall concrete. This method did not prove as satisfactory as that employed for the pits described above.

The contractors for the buildings were J. P. Cullen & Son, Janesville, Wis., and the DuPont Engineering Co., Wilmington, Del. All construction work was under the supervision of Frank D. Chase, Inc., engineers, Chicago; Horace S. Baker was engineer in charge and F. M. Reynolds was superintendent of construction.

Stench Warns Underground Workers

THE SYSTEM of warning workmen by stench in tunnels or mine shafts employs a vile smelling liquid which is injected into the main compressor air line near the surface. The air current quickly vaporizes the liquid and carries the odor to every part of the work where compressed air is being used. Thus a general alarm, warning the workmen to come to the surface can be given very quickly. Five California mining companies have recently employed this means of communication with excellent results.

Two substances used for this purpose are ethylmercaptan and amylacetate. The former is reported to be preferable; it has a disagreeable skunk-like smell and less than 0.01 per cent by volume of its vapor in air will give a strong odor. It costs about $2.25 per pound. This is used in the proportion of 1¾ pints per 100,000 cu.ft. of free air. The amylacetate or artificial "banana oil" which is easier to obtain is used in the proportion of 3½ pints per 100,000 cu.ft. of free air. It does not evaporate as quickly as the other compound and as it has a rather pleasant odor is considered less suitable than a stench for warning purposes.

NEWS OF THE WEEK

New York, March 3, 1921

Object to Early Creation of Port Authority

Jersey City Protests Against Recommendations of Harbor Development Commission's Report

In a report issued Feb. 21, 1921, the Board of Commissioners of Jersey City, N. J., definitely oppose the creation at the present time of a port authority for the metropolitan port district of New York. The opposition is directed at the recommendations of the report of the New York-New Jersey Port and Harbor Development Commission made some weeks ago. The Jersey City report was prepared by the Jersey City Development Plan Board of Engineers and approved by the Board of City Commissioners.

The basis of the opposition is made on the following counts: (1) There should have been submitted to the people of New Jersey before the New Jersey Legislature was called upon to create any port authority a complete plan and report showing definite plans for development of every part of the New Jersey portion of the metropolitan district; (2) the commission's report is not a complete report, since it has been presented practically simultaneously with the introduction of the treaty bill; sufficient time has not been allowed for the general public to become thoroughly familiar with its details; (3) the Development Commission has shown a breach of faith with the Governor of New Jersey in presenting its treaty bill less than three weeks after the publication of the summarized version of its report, contrary to a promise alleged to have been made a year ago; (4) while the treaty bill leaves to subsequent legislatures the matter of adopting the comprehensive plan, it does create in the port authority a body which will in effect dominate all future plans that may be made for rail or waterfront improvements in the New Jersey part of the metropolitan district, and the subsequent development of any of the New Jersey part of the district will be subject to the approval and control of this authority; (5) the Jersey City representatives contend that the comprehensive plan of the commission comprises mainly the construction of its automatic electric system and its tributary inner and outer belts, all of which are more directly a part of New York's development and may be detrimental to New Jersey's point of interest.

The Jersey City representatives further point out that the comprehensive plan is in effect largely a West-Side Manhattan scheme and that it does not even take care of that in toto because it has no provision for other than package freight. They maintain that the commuting travel across the Hudson is not taken care of in the comprehensive plan nor is there any appreciation of the necessity for the Hudson River bridge.

Federal-Aid Bill Killed

With the defeat of an effort to attach the $100,000,000 federal-aid road bill, which was passed by the House, to the agricultural appropriation bill, the last chance to secure this additional federal-aid appropriation at this session of Congress is lost. An unsuccessful effort had been made previously to suspend the rules and attach the House bill to the post office appropriation bill. The bill passed the House, 230 to 30.

N. C. License Bill Passes

The North Carolina legislature has passed the engineers' license law prepared by and introduced at the instance of the North Carolina Assembly American Association of Engineers.

December Record in Car Loading

A new record in average car loading was attained during the month of December, 1920, according to statistics compiled by the Bureau of Railway Economics, showing that 31½ tons was the average loaded into each freight car during December, which was 0.7 tons more than that attained in November, when a new mark also was reached.

Experimental Tunnel for Ventilation Tests

As part of the co-operative investigations of vehicular tunnel ventilation which are being conducted by the New York and New Jersey Bridge and Tunnel Commissions and the U. S. Bureau of Mines an experimental section of tunnel 400 ft. long, equipped with ducts, is being constructed in the bureau's experimental mine at Bruceton, Pa., just outside of Pittsburgh. Tests on diffusion of exhaust gases, temperature conditions and their physiological effects will be made.

Senate Passes Rivers and Harbors Bill as House Framed It

The Senate, on Feb. 25, passed the annual rivers and harbors appropriation bill carrying $15,000,000 of new appropriations and authority for the expenditure of $47,000,000 in unexpended balances during the next fiscal year. The bill was passed by the Senate without any alteration of the measure framed by the House. The bill allows $2,850,000 more than was carried for the present year.

Conference Urges Publicity for Engineers

Problem of Educating the Public in Technical Matters Discussed at A.A.E. Meeting

Engineers, technical journal publishers and editors, college professors, magazine writers and daily newspaper men met on the common ground of educating the public at the publicity conference of the American Association of Engineers held in Chicago Feb. 25. The conference emphasized three main points: (1) Co-relation of the various avenues of publicity; (2) possible co-operation of the various agencies; and (3) details of how to go about the task.

Dr. F. H. Newell, following an exposition of the wrongs inflicted on the engineer in public service because of a lack of appreciation of his work, indicated that the engineer mostly deserved the attacks because he had not told the people what he is doing. Progress reports in terms understandable by the layman must be made continually.

R. W. Krum, engineer of materials and tests, Iowa State Highway Commission, spoke of the success of the Iowa plan whereby the small-town newspaper editor was cultivated by the local engineer, the latter being furnished news from a central bureau. W. W. De Berard, Western editor, *Engineering News-Record*, emphasized the same idea of local contact in his plan for a national bureau of publicity.

A description of a course of engineering journalism at Iowa State College by H. E. Pride, led several editors to the point of saying they proposed to work for similar courses elsewhere.

John G. D. Mack, State chief engineer, Wisconsin, indicated a number of problems, particularly of a research nature, which, if generally known, would not only benefit the public but would react to the good of the profession.

C. R. Thomas, newly-chosen head of the publicity affairs of the association, described the legitimate field of the publicity man who stands in commercial and public organization today as an ambassador of information to the public.

Harvey V. Deuell, city editor, *Chicago Tribune*, emphasized the fact that real news cannot be kept out of the newspapers. He indicated that editors were always receptive to personal calls but he advised testing news which the caller brings by its appeal to the "man on the street." Too often an engineer's writing, he held, is heavy because he

wants the bones of his structure to show, whereas the public is only interested in the outline, general appearance and interpretation.

Richard H. Waldo, manager *Hearst's Magazine*, New York City, indicated that if half the program outlined at the conference, which he stated was practical, were carried out it would be a success. But, he added, it must be adequately financed; otherwise it would only fatten some printer. Policy plus personnel will always produce publicity, because publicity is rooted in policy. He indicated clearly that voluntary effort was of value beyond comprehension if directed by a well-organized central bureau. He especially cautioned against sending out a constant stream of mediocre bulletins which only cluttered the avenues of publicity and prevented getting attention when the big story broke.

F. M. Feiker, vice-president, McGraw-Hill Co., pledged the help of the technical press. The technical journals, he said, are the media which must be used to inform the great body of engineers before they can go out and educate the public.

Ivy L. Lee, adviser in public relations to the Pennsylvania R.R. analyzed in detail the meaning and purpose of publicity.

President Signs Bill for Partial Payment of Railroads

The Winslow bill authorizing partial payments of the Government's indebtedness to the railroads was signed by the President Feb. 26, 1921, following its passage last week in the Senate over the strenuous opposition of Senator La Follette. The bill as it came from the House was not amended in any respect. It provides immediate payment to the carriers of minimum amounts due them by the Government for the guarantee period, as quickly as certified by the Interstate Commerce Commission. It is estimated that at least some $300,000,000 is now so due.

The previous ruling of the Treasury Department against making such partial payments has, according to many railroad companies, impaired their credit to such an extent that they have been unable to meet current obligations for some operating expenses.

Vote Additional $1,000,000 for Railroad Valuation

A bill has been passed by Congress and signed by the President voting an additional $1,000,000 to the credit of the Valuation Division of the Interstate Commerce Commission to carry on the physical valuation of the railroads in accordance with the valuation and transportation acts. It was stated that funds to the credit of the Valuation Division had been practically exhausted. The appropriation was put through the Senate and the House in one day, and was signed by the President on the following day.

Want Board Named to Pass on Belle Isle Bridge Plans

In a communication of the executive committee of the Detroit Engineering Society to the city council request is made that a board of engineers be appointed to pass upon plans for the Belle Isle bridge. The committee says:

"We believe that the first and foremost consideration should be to build the best bridge possible for the purpose. The city does not want a cheap or unsubstantial structure. On the other hand, if one type of design offers legitimate economies over another this matter should be decided upon by a competent, impartial board of engineers. We therefore recommend that you select an engineering committee of about five members to pass upon all plans and data which may be submitted for this bridge. We attach a list of men recognized as eminent bridge engineers:

"A. Burton Cohen, consulting engineer, New York City; H. S. Crocker, secretary American Society of Civil Engineers, New York City; B. H. Davis, consulting engineer, New York City; A. M. Felgate, consulting engineer, Cleveland, Ohio; Prof. G. A. Hool, Madison, Wis.; F. A. Howard, Erie R.R., New York City; Prof. H. S. Jacoby, Ithaca, N. Y.; H. R. Leonard, Pennsylvania R.R., Philadelphia; J. L. Miller, New York Central R.R., New York City; Prof. C. T. Morris, Columbus, Ohio; T. G. Pihlfeldt, Chicago; F. D. Richards, consulting engineer, Cleveland, Ohio; L. K. Sherman, consulting engineer, Washington, D. C.; Prof. George Swain, Cambridge, Mass.; Prof. A. N. Talbot, Urbana, Ill.; Max Toltz, consulting engineer, St. Paul, Minn."

Public Health Service To Study Pollution of Illinois River

An intensive study of the stream pollution and stream purification conditions of the Chicago Main Drainage Channel and Illinois River has been inaugurated by the U. S. Public Health Service. The work is to be done in cooperation with the Illinois State Board of Health and the Sanitary District of Chicago. The headquarters and main laboratory is at Peoria but three branch laboratories will be equipped at other points.

It is proposed to learn (1) the extent and nature of the pollution in definite terms, (2) amount of dilution provided at all points and (3) the effect of the pollution and the power of the stream to recover. To determine these points will require (1) accurate surveys of the nature and extent of polluting wastes, (2) hydrometric studies of the daily flow, (3) enough laboratories to get prompt analysis of samples at frequent intervals along the length of the stream and (4) special studies of related subjects.

The work is under the general direction of Surgeon W. H. Frost with J. K. Hoskins, associate sanitary engineer, in immediate charge.

A. R. E. A. Convention Program

Following the annual address of the president and reports of the secretary and treasurer on the first day of the annual convention of the American Railway Engineering Association, Congress Hotel, Chicago, March 15-17, the following committee reports will be received and discussed: Signals and interlocking; ballast; stresses in railroad track; electricity; track; rail; standardization, and uniform general contract forms.

Committee reports for the second day are signs, fences and crossings; ties; iron and steel structures; water service; economics of railway labor; economics of railway operation; economics of railway location; shops and locomotive terminals, and buildings.

On Thursday, the third day of the meeting, the following committee reports will be received: Masonry; roadway; wood preservation; wooden bridges and trestles; yards and terminals; rules and organizations; records and accounts; conservation of natural resources.

John F. Wallace, consulting engineer, New York City, and David Kinley, president of the University of Illinois, will be the principal speakers at the annual dinner on the second day of the meeting.

The meeting will close, as usual, with a discussion of new business and election and installation of officers.

Proposals for Store-Door Delivery Go to Railroad Executives

Following resolutions adopted by the transportation committee of the Federal Highway Council railway traffic executives in the eastern territory now have before them proposals for store-door delivery and collection of freight. A motion has been adopted that "the committee deems it most advantageous to have the store-door delivery a carrier service, but at additional rates not included in the through rates," and also that "the carrier assume liability for the safe transfer by their representatives, a reasonable charge to be assessed for such service."

The subcommittee presenting the plan to the railroads is composed of A. E. Beck, general traffic manager Merchants' & Manufacturers' Association, Baltimore; J. C. Lincoln, general traffic manager Merchants' Association, New York; William J. Pitt, general traffic manager John Lucas & Co., Philadelphia; T. T. Harkrader, general traffic manager American Tobacco Co., New York; W. J. L. Banham, general traffic manager Otis Elevator Co., New York, and Dr. R. S. MacElwee, director Bureau of Foreign and Domestic Commerce, Washington, D. C.

A. A. E. Has 24,026 Members

The American Association of Engineers on Jan. 13 had 24,026 members. Two years ago on that date the membership was about 2,400.

The New Administration of the Am. Soc. C. E.

In this and succeeding issues of "Engineering News-Record" will appear brief biographical sketches of the newly elected officers and directors of the American Society of Civil Engineers, as announced in the issue of Jan. 20, p. 140, following the annual meeting.

Richard L. Humphrey, Director

Richard L. Humphrey, director, District 4 (Philadelphia), former chairman of the Joint Conference Committee of national engineering societies which created the Federated American Engineering Societies, was born in Marblehead, Mass., in 1869. After graduation as civil engineer from the University of Pennsylvania in 1891 he joined the engineering staff of the Philadelphia & Reading Ry. as draftsman and from there went to the Bureau of Surveys, Philadelphia, to design sewers and bridges.

RICHARD L. HUMPHREY

In 1892 Mr. Humphrey became engineer in charge of the Philadelphia municipal testing laboratory where he served until 1899, leaving the municipal service in that year to become engineer and general manager of the Buckhorn Portland Cement Co., in which capacity he served until 1903.

He entered consulting practice in 1903, specializing in the inspection of materials and examination of cement properties; he served as expert for the Pennsylvania R.R. in condemnation proceedings and as adviser to a number of cement companies. For five years, from 1905 to 1910, he acted as engineer in charge of structural materials testing laboratories at St. Louis, Pittsburgh, and Atlantic City, and from 1910 to date has been consulting engineer to the U. S. Bureau of Mines.

Mr. Humphrey has taken an active part in engineering society affairs and is a member of a great many organizations in which he has held office and served on committees. He was one of the organizers and the first secretary (1898-1900) of the American Society for Testing Materials. When the American Concrete Institute was organized Mr. Humphrey served as its first president from 1913 to 1915. Among his other society activities have been the following: Secretary, Joint Committee on Concrete and Reinforced Concrete, 1904-15; secretary, Committee on Uniform Methods of Tests for Cement and Committee on Concrete and Reinforced Concrete of the American Society of Civil Engineers; secretary, Joint Conference Committee on Uniform Methods of Tests and Standard Specifications for Cement; and chairman (1918 to date) Committee on Reinforced Concrete, American Society for Testing Materials. He was a member of the American Society of Civil Engineers' Committee on Development and served as chairman of the Joint Conference Committee representing the founder societies, which was instrumental in creating the Federated American Engineering Societies.

During the war Mr. Humphrey served as director of the Building Materials Division of the Council of National Defense.

Baxter L. Brown, Director

Baxter L. Brown, director, District 9 (St. Louis, Mo.), is a consulting engineer and former chief engineer of the St. Louis Valley Ry. He was born in Rush, N. Y., in 1864 and began engineering work in 1882 as axeman on the Continental Ry. He has had an extensive experience in railway engineering work, having served on location, construction and maintenance with a variety of roads in all capacities from axeman to chief engineer. He has, at various times, been connected with the Missouri Pacific, the Wabash, the St. Louis, the Iron Mountain & Southern Ry., and many others. Structures built under his direction include a 1,400-ft. steel viaduct 85 ft. high across the Kaskaskia River at Shelbyville, Ill.; terminals, piers and ship channels at Port Arthur, Texas; and a wide variety of other works incident to railroad construction and maintenance.

After twenty-three years of railway work Mr. Brown entered private practice as consulting engineer with offices in St. Louis, specializing in railroads and allied subjects. In 1912 he was retained by the City Plan Commission of St. Louis as consulting engineer to report on the development of the river front, and in 1916 was one of a committee of five engineers who reported to the Chamber of Commerce on the general industrial and civic improvement of St. Louis. As consulting engineer of the Aluminum Ore Co. Mr. Brown advised on river transportation on the Mississippi and on the construction of suitable terminals for the interchange of freight between river and rail.

BAXTER L. BROWN

Indiana Water Supply Meeting Strictly Technical

The two-day convention of the Indiana Sanitary and Water Supply Association, Feb. 16 and 17, in Indianapolis, was strictly a technical meeting. Even at the banquet the after-dinner moving picture entertainment got no farther away from the technical than to show six reels made (by animated maps) for the Sanitary District of Chicago of the former pollution conditions along the lake front and then of a trip the length of the channel to Lockport and, finally, the fishing and clam shell industries on the Illinois River.

Two round table discussions were held on problems of the superintendence, extensions and payment for service connections. Other main topics were: (1) Water purification of pollution conditions in the Calumet region, the tuning up experiences at the recently built plants at Whiting and East Chicago furnishing the point of these discussions; (2) city planning and its relation to utilities and housing development.

Two bills now before the State legislature relating to city planning and zoning, giving cities the power to establish city plan commissions, were approved by the only resolution acted upon. A committee on affiliation or amalgamation with the American Water-Works Association recommended that the question be laid on the table for another year.

The officers elected for the ensuing year are as follows: President, Charles Brossmann; vice-presidents, J. B. Marvin, H. E. Jordan, John C. Davis, George L. Smith and L. Elliott; secretary, C. K. Calvert; assistant secretary, Charles J. Miller.

Federation to Study Government Department Reorganization

The American Engineering Council, of which Herbert Hoover is president, has decided to enter actively upon a broad plan for the reorganization of federal government departments, it has been announced. Up to this time the organized engineers of the nation have confined their efforts principally to the Department of the Interior, which they seek to make over by establishing a national department of public works.

River Drainage Board Created

Governor McCray of Indiana has signed a bill to create a Kankakee river drainage commission, which will confer with a similar commission in Illinois to view the proposed straightening and deepening projects and report back to the Governor. The bill provides for an appropriation of $1,000 for expenses.

Sewage Tank Troubles Feature of Meeting at Trenton

A feature of the annual meeting of the New Jersey Sewage Works Association at Trenton, Feb. 18, was a discussion of single-story sewage settling tanks, with occasional remarks on two-story tanks. There was also an address on the "Biology of Sewage Disposal" by Dr. Thomas J. Headlee, of the State Experiment Station, New Brunswick, and a paper by Weston Gavett, New York City, outlining the development of sewage siphons, illustrated by charts and further elucidated by a demonstration with a model (see *Engineering News-Record,* Nov. 25, 1920, for an article by Mr. Gavett covering a part of the same ground).

C. M. Nichols, of the engineering bureau of the New Jersey State Department of Health, in his paper on the design and operation of "Single-Story Tanks" described a design for such a tank in duplicate, with a separate sludge-digestion tank between, and I. R. Riker, also of the bureau just named, presented considerable data on tank difficulties and means of overcoming them. The ensuing discussion by John R. Downes, of the Plainfield Joint Sewage Works, Mr. Collins of Collingswood, Mr. Molitor of the Chatham-Madison plant, and others, showed that the tank problem is a live subject in New Jersey. Later, Mr. Downes presented some Riensich-Wurl screen and Imhoff tank data from Plainfield.

Dr. Headlee, in the course of the address already mentioned, expressed the hope that the sewage research work being done at New Brunswick will throw light upon optimum conditions for the action of enzymes in changing organic to inorganic matter.

Chester G. Wigley, engineer with Clyde Potts, 30 Church St., New York City, was re-elected as president of the association and Myron E. Fuller, with Fuller M. McClintock, engineers, 170 Broadway, New York City, was chosen as secretary and treasurer.

Municipal Ownership for Chicago Street Railways

A municipal transportation district for Chicago, with power to issue bonds up to 5 per cent of the assessed valuation for the purpose of building or buying street car lines, is the proposal of a traction commission appointed some months ago by the mayor to find a method of providing a municipal street railway system and of operating it at a 5c. fare. At present such a bond issue would not exceed $80,000,000. Recognizing that a 5c. fare might not pay expenses, the plan authorizes the trustees of the proposed district to levy taxes to make up any deficit. A legislative bill has been drafted authorizing the creation of such a bonding district, the question then to be submitted for public vote for the acceptance of the plan and for the election of six trustees. The plan will go first to the Chicago City Council Committee on Local Transportation, and if approved the bill will then be presented to the State legislature.

Cornell Colleges of Engineering to Combine

At the recent meeting of the board of trustees of Cornell University the long projected consolidation of the various engineering colleges was ordered to take place at the close of the present term. This means that Sibley College of Engineering, which comprises courses in mechanical and electrical engineering, and the College of Civil Engineering will be merged in an Engineering College.

Professor D. S. Kimball, of Sibley College, has been chosen as dean of the newly created Engineering College, and the separate schools of mechanical, civil and electrical engineering will be headed by professors now in the respective schools. Herman Diederichs will be head of the school of mechanical engineering, Fred A. Barnes of civil engineering, and A. M. Gray of electrical engineering.

Sue to Void Bond Issue for Viaduct

Action has been begun by R. A. Baskin, retiring county prosecutor of Cuyahoga County, Ohio, to restrain the county commissioners from selling bonds for the proposed Lorain-Huron viaduct across the valley of the Cuyahoga River in Cleveland. A permanent restraining order is asked, on the ground that the 1914 referendum vote authorizing the issue of $5,000,000 for constructing the viaduct is void. It is urged that the county's bonded debt has increased, that the bonds now can not be sold unless they carry much higher interest than in 1914, that the amount of the authorized issue is no longer sufficient to build the bridge, and that the plan for the work includes river diversion, which was not covered by the referendum, which, it is contended, is necessary.

First Power License Issued by Federal Commission

On Feb. 28 the Federal Power Commission granted the first 50-year license under the new Water Power Act to the Niagara Falls Power Co. to use 19,500 cu.ft. per sec. from the Niagara River at Niagara Falls. This amount is now being used by the company under old permits. The international treaty at present in force limits the United States use at this point to 20,000 sec.ft.

Bridge Load Limitation by County Upheld in Ohio

Load limits placed on county bridges by the Commissioners of Mahoning County, lower than the state road law limit of 12 tons at the maximum weight of a truck, has been upheld as lawful by Judge Cooper of the Court of Common Pleas, Youngstown, Ohio. Suit was brought by trucking interests in a suit to enjoin the county from arresting persons attempting to cross the bridges wtih loads higher than the limit fixed. Their contention was that the county limitation conflicted with the state limitation. Judge Cooper held it a fact that there was no conflict between the laws and that the Commissioners at all times had the right to make regulations necessary to protect public property.

Wisconsin Engineers Want School for Architects

In the opinion of the engineers of Wisconsin, as expressed at the annual meeting of the Engineering Society of Wisconsin at Madison, Feb. 21 and 22, there is a deficiency of architects in that state. In consequence they recommended to the officials of the State University that a school of architecture be established.

Concurrence was also given with the recommendations of A. R. Hirst, state highway engineer, in the statement accompanying his recent resignation (see *Engineering News-Record,* Feb. 10, p. 265) that immediate steps be taken to insure efficiency and non-political control of roads and other public works. A resolution to this effect was directed to the state legislature. Another resolution addressed to the same body called for an annual appropriation of not less than $18,000 for the engineering division of the State Board of Health. Approval was given to the Great Lakes-St. Lawrence River deep waterway project.

Two sessions were held jointly with the Wisconsin State Drainage Association which resolved to work for the appointment of one of their members on the State Real Estate Board which, it is alleged, is selling off cut-over lands in preference to drainage lands.

The newly-elected officers are as follows: President, Charles I. Corp; vice-president, Jerry Donohue; secretary-treasurer, Prof. Leonard S. Smith, Madison.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Convention, March 15-17.

The San Francisco Section, Am. Soc. C. E., devoted its bi-monthly meeting Feb. 15 to a symposium on land improvement work in the central California flood basins. Fred H. Tibbetts, irrigation engineer, spoke on "Development Under Way and Projected"; F. S. Cooper of the Olympian Dredging Co., dealt with "Construction and Operation of World Record Dredges"; and Robert Shurman of the Byron Jackson Iron works, discussed "Installation of Large Drainage Pumps." The papers brought out the fact that in this flood basin the present value of more than 1,500,000 acres of rich land have been created almost entirely by engineering work and that dredges of unique design (booms up to 240 ft. long with 7¼ cu.yd. buckets) and pumps of enormous capacity (180,000 gal. per minute) have been developed to meet requirements peculiar to these valleys. The section endorsed the plan of urging the appointment of an engineer to the Interstate Commerce Commission and authorized sending a letter to that effect to Congressmen from California. It was voted unanimously to endorse the action of the special meeting on Feb. 4 at which the so-called Marshall plan (see *Engineering News-Record*, Feb. 10, p. 273) was condemned.

The Colorado Society of Engineers recently elected the following officers: President, F. C. Dreher; vice-president, R. M. Hosea; secretary, C. M. Lightburn. Educational extension courses are again being given in co-operation with the University of Colorado. In co-ordination with the Colorado Engineering Council the society has introduced a revised license law into the legislature.

The Southwest Water Works Association, Waco, Tex. will hold its convention May 9-12 at the Skirvin Hotel, Oklahoma City, Okla. Papers will be read by members of the State Boards of Health of different States. E. L. Fulkerson, Waco, Texas, is secretary of the association.

The New England Water Works Association, at its meeting March 9 in Boston, will be addressed by Nicholas S. Hill, Jr., on "Pipe Extension Charges" and by William R. Conard on "Cast Iron Pipe, the Method of Manufacture and its Inspection."

The Florida Engineering Society, at its convention held recently at Lakeland, elected the following officers: President, C. S. Hammatt; vice-presidents, G. R. Ramsey and W. W. Fineren; secretary, Dr. J. R. Benton; treasurer, C. H. Ruggles.

PERSONAL NOTES

A. G. WULFF has been appointed Cincinnati representative of the Highway Iron Products Co., of Ligonier, Ind.

ROBERT O. DERRICK has been admitted as partner to the firm of Brown, Preston & Derrick, architects and engineers, Detroit, Mich.

W. L. HOFFEDITZ, special paving engineer of the city of Twin Falls, Idaho, has been appointed city engineer of Colorado Springs, Col. During the war he was captain with the 23d (Highway) Regiment of Engineers and served as regimental adjutant.

DONALD C. ELDER has been appointed engineer of Marshall County, Iowa.

W. R. WEBSTER has resigned as assistant chief engineer of the Cambria Steel Co., Johnstown, Pa., to become general engineer of the Semet-Solvay Co., Syracuse, N. Y.

CHARLES SMITHLEY has been appointed engineer of Geary County Kan., to succeed G. A. Russell, resigned.

PATRICK PHILIP has been appointed chief engineer of the Public Works Department of British Columbia.

CLARENCE N. STEEVES of Sussex, N. B., formerly chief engineer Maritime Dredging & Construction Co., has been appointed assistant engineer of the Department of Railways & Canals at Cornwall, Ont.

GEORGE P. MACLAREN, formerly district engineer, Ontario Distdict, has been appointed engineer maintenance of way, Eastern Lines, Canadian National Railways.

S. W. DUDLEY has resigned as chief engineer of the Westinghouse Air Brake Co., Wilmerding, Pa., to accept a professorship in mechanical engineeering at Yale University.

R. F. MACDONALD has been appointed county sanitary engineer, Cuyahoga County, Ohio, in charge of a new department created under the county sewer district law of Ohio, for the purpose of designing and construction water and sewerage improvements in unincorporated sections of the county, and not county engineer, as recently announced. W. A. Stinchcomb is county engineer.

POWELL & JACOBS is the name of a firm of consulting civil engineers recently organized by Joseph Jacobs, formerly lieutenant-colonel, and Archibald O. Powell, formerly major, Engineers, with offices in Seattle, Wash. Special attention will be given to irrigation, drainage and diking, river and harbor improvement, docks and terminals, water works and sewerage systems, water powers, dams, also utility valuations and consultation in connection with engineering arbitrations and cases before the courts.

COL. FRANCIS A. POPE, Corps of Engineers, U. S. A., in charge of the U. S. District Engineer's Office at Duluth, has been transferred to Manila, P. I., where he will have charge of defensive works and command the 14th Engineers. Major Edwin R. Marks, Office of the Chief of Engineers, at Washington, will succeed Col. Pope at Duluth.

DONALD G. COOMBS, for three years with the Braden Copper Co., Rancagua, Chile, as assistant division engineer and office engineer on the construction of a 10,000-ton copper smelter at Caletones, Chile, has returned to the United States and will be permanently located in Seattle, Wash., he will continue in construction work. Mr. Coombs, before going to Chile, was for three years assistant superintendent of construction for the U. S. Reclamation Service on the construction of the Meadow Creek and Rimrock dams.

N. C. HOYLES has been appointed manager of the Cincinnati, Ohio, branch of the Pittsburgh Testing Laboratory. For the past year he has been assistant manager of this company's New York office and from 1909 to 1914 he was manager of the Birmingham, Ala., branch of the company. During the war he was overseas with the Canadian Engineers and was mustered out with the rank of lieutenant-colonel.

J. BROWER, JR., formerly with S. Diescher & Sons, engineers, Pittsburgh, Pa., is now designer with the Kelly-Springfield Tire Co., at its new plant at Cumberland, Md.

CARL C. WIDENER, former city engineer of Bozeman, Mont., and C. A. Truitt, formerly of Burns & McDonnell of Kansas City, have associated as consulting engineers with offices in Bozeman. They will specialize in municipal and hydraulic engineering.

ROBERT D. TRIPP, a former city manager and city engineer of Petosky, Mich., has been engaged as road engineer for Emmett County, Mich.

MAJOR G. T. LEMMON, for the past two years with the Virginia State Highway Commission as resident engineer in charge of work in 13 counties has been transferred to the Richmond

residency in charge of 15 counties. During the war he served in the army as major, Engineers.

WILLIAM B. REED, of Weedsport, N. Y., has been named third deputy commissioner of highways with headquarters at Albany to succeed Charles Van Amburg of Binghamton. He has been district supervisor of the highway department since 1910 in charge of the roads of seven counties in Central New York.

CHARLES F. PUFF, JR., has resigned as engineer in the Highway Bureau of Philadelphia to become secretary and general manager for the Associated Pennsylvania Highway Contractors, with headquarters at Harrisburg.

COL. W. G. ATWOOD, formerly chief engineer, Lake Erie & Western R.R., and section engineer, Base Section 1 of the A. E. F., at St. Nazaire, France, has been appointed manager of the newly established office at St. Louis, Mo., of the Woods Brothers Construction Co., of Lincoln, Neb., owners of the patents for the Bignell concrete pile.

OBITUARY

FREDERICK C. MIERON, an engineer with the New Jersey State Highway Commission, died Jan. 19 at Lakewood, N. J. He was a graduate of Princeton University.

FRANK C. PEARL, civil engineer, died Jan. 10 at Spokane, Wash. He was born in Oakfield, Iowa, in 1865. He was a civil engineer with the Great Northern Ry. and the Washington Water Power Co. During recent years he had been engaged in county road work.

JOSEPH P. ARP, building contractor, died Feb. 9 at Sioux City, Iowa. He was born in Comanche, Iowa, 1860. He constructed nearly 100 banks, churches and business blocks in northwestern Iowa.

JOSEPH C. ROCK, general agent for the United States Asphalt Refining Co., New York, and for many years an official of the Barber Asphalt Paving Co., died in New York at the age of 75. He was one of the pioneers of the asphalt paving business and introduced this class of pavement throughout many cities in the United States twenty-five and thirty years ago. He was president of a company which did a large amount of asphalt paving for the Borough of Manhattan. Mr. Rock served throughout the Civil War with a Vermont regiment. Subsequently he was connected with several government departments in Washington. He moved to New York in 1889 to accept the post of secretary with the Barber Asphalt Paving Co.

The Business Situation as Viewed from Three Special Angles

Long Period of Cautious Buying on Slowly Declining Market Seen—Foreign Situation Among Leading Factors To Consider

Believing they could well serve their respective readers through an interchange of thought upon the present and future condition of business, the editorial conference of the New York Business Publishers Association discussed at a luncheon Feb. 18 the situation in the so-called key industries. From the discussions there presented, the following three have been abstracted in order to present to Engineering News-Record readers, the opinions of those men in a position to judge of the conditions in their respective fields.—EDITOR.

IRON AND STEEL

BY A. I. FINDLEY, Editor, *Iron Age*

The iron trade did not function as a barometer in the early stages of the present readjustment. After Japan in May, 1920, pioneered in deflation through the collapse of the silk trade, other mercantile lines in the United States started price declines. The collapse in the steel trade did not come until October. Whether this means that the steel trade will still be readjusting when other lines have become fairly stabilized is yet to be determined. What is certain is, that the steel trade is today in a depressed state, and that those who in November looked for a moderate revival in the spring of 1921 are now setting the date for any marked improvement some months further on in the year. There is a growing belief that present conditions in the United States are due more than we were willing to believe last year to financial and industrial straits of Europe. As never before, leaders in industry and finance in this country see that we are linked up with the rest of the world for better or worse.

In view of its basic character, developments in the steel trade are important as an index to what is to be expected in 1921. Today there is about two-thirds operation of iron and steel works, with the possibility that with the coming of spring a temporary spurt in demand may bring the percentage up to 75. It has been found in other times of depression that wear and tear alone is good for about a 60 per cent operation in iron and steel.

PRICE SITUATION

At present a disproportionate share of the steel going into consumption is coming from plants of the United States Steel Corporation. The reason in brief is that the Steel Corporation ever since March 21, 1919, has adhered to the so-called Industrial Board prices which were announced at Washington on that date. Independent steel producers in the last half of 1919, and all through 1920 till the slump came, were able to get higher prices due to the inadequate supply of steel caused by various strikes and by the prolonged inability of the railroads to function normally. There was also at work a psychological scarcity due to the excited effort of automobile manufacturers and others to get hold of steel at any price to meet the apparently insatiate demand of the luxury spenders of 1919 and 1920. The exhaustion of the country's ability to consume steel at premium prices left some of the independent producers with little business on their books. Recently one of these companies decided to go out for business at prices below the Industrial Board level maintained by the Steel Corporation, and the immediate, and thus far unanswered, question before the trade is to what extent these cuts in prices will stimulate business. Wage reductions of 15 to 25 per cent have been made or are about to be made by most of the important independent steel companies. The Steel Corporation has not reduced wages thus far.

OUTLOOK

The outlook for an early and extensive revival of demand for iron and steel is not favorable. The fall in prices of agricultural products has reduced very much the demand for agricultural improvements. The implement works have considerable stocks of steel. The railroads, which, in average times, take from 20 to 25 per cent of the steel output, are buying little, rails and track accessories having been in best demand. Until the railroads are freed from the strangle-hold of the wasteful labor scheme imposed on them by the Government, they will not be free buyers of equipment. Today they have many idle cars with no early prospect of full use of their equipment.

A great many building projects would be put through if labor and materials in construction lines were at a point which would justify investing.

The automobile building program for 1921 can hardly be more than 40 per cent of that for 1920. The automobile industry has probably not taken more than 5 or 6 per cent of the country's steel output on the average, but its ramifications are such that it has been a very important sustaining factor.

Shipbuilding demand for steel in 1921 is likely to be considerably less than in 1920. Mining, whether of coal, iron or non-ferrous minerals, will be restricted in 1921. So far as iron, copper and other metals are concerned operations of the mines this year can hardly go beyond 60 or 70 per cent of last year.

Export trade in steel fell off rapidly in the latter part of 1920, with increasing competition from Germany, Bel-

gium and France in world markets, and with the reduced buying power of countries which do not have an iron and steel industry, it is not likely that the 1921 shipments from the United States will go beyond 60 per cent of those of 1920.

The most favorable indication industrially for the present year is the evidence of a return to economic production methods. It will be a good thing for producers to learn again how to sell their products. For a long time things have been bought rather than sold. There will be a great gain in the revival of the profession of salesmanship, and salesmanship will mean the right price, which is something the country has not known for a good while.

It would be a misfortune if any of the patent methods of restoring the industrial pace of early 1921 could be made to work. We shall not get rid in a month or in six months of the vicious practices which have controlled manufacturing, buying and selling in the United States during the war and since. The worker has been getting out of industry a good deal more than he put in. Profits in many lines have been inordinate. The Government paid the bill, meanwhile borrowing to the limit from the people. The game had a certain exhilaration while it lasted, but now the old way of working and saving must be learned over again. We may look for a good deal of progress along this old-fashioned road in 1921, and that, at the moment, is one of the most encouraging things in the outlook.

Chemicals

By Williams Haynes, Editor, *Drug and Chemical Markets*

The average price of twenty representative industrial chemicals was run up to a peak in July of 1920 that was 500 per cent above the pre-war level. Shortly after the Japanese panic, domestic demand for chemicals began to drop, as our rubber, fur, silk, woolen, cotton, and other industries began to curtail or shut off production. Reflecting the industrial stagnation of the country, since last July there has been virtually no sale for heavy chemicals. The fall in prices was very sharp, amounting to 60 per cent from last August until January of this year. Since then the decline has slowed up, which indicates that distressed stocks in second hands are being gradually absorbed and that producers are again gaining control of the market.

Prices are today a symptom and not a cause. Price cutting—even violent price cutting—has not resulted in sales, and it means nothing to buyers that many chemicals are selling today below the actual cost of production tomorrow. The situation in chemicals, as in other lines, depends primarily upon the absorption of existing stocks, which must be consumed before business will be resumed. In so wide a field as chemicals, there are always numerous exceptions, but, speaking broadly, chemical prices have been pretty thoroughly "deflated," and if there is a brisk consumer demand, may be expected to rise, temporarily at least, to offset the present cost of production. That prices, after existing stocks are cleaned out, will be much lower, is not possible until fuel, labor, and freight are reduced.

Forecast

Very recently there has been in the New York market a small, but marked demand from actual consumers. Reports from Boston and Philadelphia tell also of cautious orders for chemical supplies, but in Cleveland, Chicago, and St. Louis, the inquiry stage of business has, as yet, only been reached. These orders for chemicals from other industries forecast, if sustained, a resumption of industrial activity.

After existing stocks of finished products and crude materials have been consumed; when the depressed foreign exchange has been more nearly equalized; after labor costs and freight rates have been lowered—then, chemical prices will go lower.

The development of the coal-tar products gives us now a complete, self-contained American chemical industry, which makes every other American industry independent of foreign sources of these essential chemical supplies. The cost of chemicals to American manufacturers in all lines will eventually be brought lower because of increased selling competition among American chemical producers and constant improvements in chemical manufacturing processes.

The beginning of the end of the present readjustment period is indicated by the tangible demand for chemicals for industrial purposes, and after readjustment, we may expect a long period of gradually lowering prices coincident with gradually falling costs of labor, crude materials, power, and freight. In all lines similar conditions will obtain. American business faces a long period of cautious buying in gradually declining markets.

Temper of the Buying Public

By S. H. Ditchett, Editor, *Dry Goods Economist*

Because of the prolonged semi-cessation of buying by retailers, apprehension had been felt that when they reentered the markets for spring purchases there might develop a recurrence of the recent scramble for merchandise, resulting in a price boost. We did see a price advance put into effect by some manufacturers of cottons, and also in silks. But manufacturers' stocks were heavy because of recent cancellations, and distributors have not fallen over themselves to buy goods, and so—except in one or two lines of cottons and in one or two lines of silks—there has been no merchandise scarcity, no price flurry. For once, the retailers stuck to their determination, and, doing so, they bought conservatively.

What of the future? Too many factors are operative to permit of more than enumeration here. Our export trade, now declining, but with prospect of a broader, more intelligent, more co-operative effort for its development. The certainty of increased imports even after the enactment of a new tariff law. The continuance of the restrictions on the accumulation of capital through the action of the excess profits taxes and the income surtaxes. The uncertainty as to the reparations sum to be paid by Germany, including what the United States is to get. The delay in resuming trade relations with Russia, although, judging by the King's speech to Parliament, Great Britain appears to be on the eve of resumption. The labor situation in our own country, especially as regards the railroads and their employees, and in its direct relation to many department stores because of the dispute in the men's clothing industry. All these conditions have a pronounced bearing on supply and demand, on trade and on prices.

I, for one, believe we can look for no permanent advance of any importance in the prices of textiles. The recent stiffening in a few lines will be maintained perhaps, because they seem, prior to the advance, to have been marked too low. But with declining exports and increased imports the supply is going to increase. Remember that we produce in this country of products of all kinds 25 per cent more than we can consume. Remember, too, that on certain lines of commodities, notably, china, glassware, enamelware and other household stuff there have as yet been no price reductions, and that on other lines, notably furniture, rugs and carpets, the price reductions so far are inadequate.

Take all these facts into consideration, take the world situation, and I believe you will reach the conclusion that price changes will be downward.

The situation is a novel one to the present generation. But, as a Cleveland banker pointed out the other day, our fathers did business all their lives on a falling market. Even if prices should continue to decline for an indefinite period there is no reason to doubt that the merchants and manufacturers of today will succeed in adapting themselves and their methods to the needs of the hour.

Maps of Coal Mines Under Cities Must Be Filed

By resolution of the city council of Wilkes-Barre, Pa., coal-mining companies operating under the city are required to file maps of their workings with the city clerk. This ordinance is the outcome of demands by a delegation of housewives, who gave expression to general alarm felt in parts of the city over the liability of disaster from mine caving.

Spring Prices of Construction Materials Since 1913

Present New York Level 120 per Cent Above 1913—Freight Up 138 per Cent—Checking Up Our Thought of 1919

Engineering News-Record's Comparison of Spring Prices of Construction Materials was first published in the issue of Jan. 16, 1919, and again on Feb. 12, 1920. It has been brought up to date and is again offered in expanded form. The tabulation, instead of dealing solely with the New York market, as heretofore, includes Pittsburgh mill quotations for structural shapes, reinforcing bars and steel sheetpiling. The list is rounded out by the addition of the Southern pine base in New York.

The table should be carefully studied before using. It will be seen that in the case of cement, for example, the quotations, 1913 to 1918, inclusive, are "alongside dock," New York, whereas subsequent prices are "on the job" and include trucking charges. This is the reason why no general average is given for cement. Also, our cement quotations are exclusive of bags, the charge for which varies from 10 to 25c. For the last two years or so we have quoted cement net or exclusive of sacks, in the "Monthly Prices of Construction Materials," (see p. 406 of this week's issue).

First, compare present prices with those of pre-war days—the spring of 1913. Percentages above the levels of that period are as follows: Lumber, 31; structural shapes, Pittsburgh mill, 33; reinforcing bars, Pittsburgh mill, 50; bars, New York warehouse, 61; structural shapes, New York warehouse, 67; steel sheetpiling, Pittsburgh mill, 88; linseed oil, 99; tank plates, New York warehouse, 135; crushed stone, 139; sand, 150; cast-iron pipe, 169; building tile, factory, 170; gravel, 243; cement, net, 163; freight from Pittsburgh to New York or Chicago 238.

In January, 1919, we suggested that a reasonable price schedule might be the average spring prices from 1913 to 1918. We repeat that suggestion, tentatively: Would not a reasonable schedule for the spring of 1920 be in many instances the average spring prices from 1913 to 1920 inclusive? The steel and lumber industries, at least, appear to agree with this idea.

PRICE SITUATIONS IN SPRING, 1919 AND 1921
(+ indicates increase; — indicates decrease)

Materials	Per Cent Change, January, 1919, from General Average of Spring Prices, 1913–18	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913–20
Crushed stone	+ 42	+ 61
Sand	+ 100	+ 42
Gravel	+ 120	+ 111
Cast iron pipe	+ 91	+ 45
Structural shape	+ 52	+ 14
Tank plates	+ 58	+ 17
Linseed oil	+ 62	— 36
Freight Pittsburgh to New York or Chicago on finished steel products	+ 35	+ 95
Steel sheetpiling, Pittsburgh mill	+ 105	+ 10
Structural shapes, Pittsburgh mill	+ 56	— 6
Reinforcing bars, Pittsburgh mill	+ 58	+ 6
Reinforcing bars, New York warehouse	+ 51	+ 11
Average	+ 69	+ 31

ENGINEERING NEWS-RECORD COMPARISON OF SPRING CONSTRUCTION MATERIAL PRICES SINCE 1913
All Prices New York Except Otherwise Stated

	Portland Cement, per bbl. net, without bags	Southern Pine, 3x12 to 12x12, 20 Ft. and Under	Common Brick (per M.)	Crushed Stone, (per Cu.Yd., ¾ In.)	Sand (per Cu.Yd.)	Gravel (per Cu.Yd., ¾-In.)	C.-I. Pipe (6 In., per Ton)	Beams and Channels (3—15-inch per 100 Lb.)	Beams, Etc., Pittsburgh Mill	Reinforcing Bars, ¾-In. and Larger Pittsburgh Mill	Reinforcing Bars, ¾-In. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates ¼-In. and heavier per 100 Lb.	Hollow Tile (6x12x12 Per Block) Factory Perth Amboy, N. J.	Linseed Oil (Raw in Barrels)	Freight to Pittsburgh on Steel (per 100 Lb.)
April, 1913	$1 18	$42 00	$7 00	$0 90	$0 50	$0 85	$24 00	$2 15	$1 70	$1 50	$2 25	$1 60	$1 61	$0 084	$0 48	$0 16
May, 1913	1 18	42 00	7 00	90	50	85	23 50	2 15	1 65	1 50	2 25	1 60	1 61	084	50	16
June, 1913	1 18	42 00	7 00	90	50	85	23 00	2 15	1 50	1 50	2 25	1 60	1 61	084	48	16
Average	$1 18	$42 00	$7 00	$0 90	$0 50	$0 85	$23 50	$2 15	$1 62	$1 50	$2 25	$1 60	$1 61	$0 084	$0 49	$0 16
April, 1914	$1 18	.....	$5 50	$0 95	$0 50	$0 90	$22 00	$1 95	$1 15	$1 20	$2 25	$1 60	$1 31	$0 084	$0 54	$0 16
May, 1914	1 18	.....	5 50	95	50	90	22 00	1 85	1 15	1 15	2 25	1 60	1 31	084	54	16
June, 1914	1 18	.....	5 60	95	50	90	20 50	1 85	1 10	1 15	2 25	1 60	1 31	084	53	16
Average	$1 18	.....	$5 55	$0 95	$0 50	$0 90	$21 50	$1 85	$1 13	$1 17	$2 25	$1 60	$1 31	$0 084	$0 54	$0 16
April, 1915	$0 82	.....	$5 50	$0 90	.....	$0 85	$20 00	$1 90	$1 15	$1 15	$1 95	$1 60	$1 36	.....	.....	$0 169
May, 1915	82	.....	5 75	1 05	.....	85	20 50	1 90	1 20	1 15	2 00	1 50	1 32	.....	.....	169
June, 1915	82	.....	6 00	1 05	.....	85	22 00	1 90	1 20	1 20	2 00	1 50	1 37	.....	.....	169
Average	$0 82	.....	$5 75	$1 00	.....	$0 85	$20 75	$1 90	$1 18	$1 17	$1 97	$1 53	$1 35	.....	.....	$0 169
April, 1916	$1 32	.....	$8 50	$0 95	$0 40	$0 80	$30 50	$2 50	$2 50	$2 45	$3 10	$2 50	$2 50	.....	$0 81	$0 169
May, 1916	1 32	$31 50	7 25	95	40	85	.....	2 50	2 75	2 50	3 25	2 50	2 65	.....	81	169
June, 1916	1 32	31 50	8 00	95	50	1 00	.....	2 60	2 75	2 50	3 10	2 50	2 75	.....	.....	169
Average	$1 32	$31 50	$7 90	$0 95	$0 45	$0 90	$30 50	$2 55	$2 67	$2 47	$3 15	$2 50	$2 65	.....	$0 81	$0 169
April, 1917	$1 52	.....	$9 50	$1 20	$0 50	$1 25	$47 50	$3 75	.....	.....	.....	.....	$5 00	.....	$1 04	$0 169
May, 1917	1 80	.....	11 50	1 25	50	1 35	55 50	3 80	.....	.....	.....	.....	5 50	.....	1 21	169
June, 1917	1 80	.....	10 25	1 25	50	1 25	55 50	5 00	.....	.....	.....	.....	7 00	.....	1 31	169
Average	$1 71	.....	$10 40	$1 25	$0 50	$1 30	$51 70	$4 15	.....	.....	.....	.....	$5 80	.....	$1 19	$0 169
April, 1918	$1 99	$42 75	$10 25	$1 75	$1 25	$2 00	$55 35	$4 20	$3 00	$2 90	$4 09½	$3 10	$4 45	0 14	$1 55	$0 195
May, 1918	1 99	42 75	10 00	1 75	1 25	2 00	55 35	4 20	3 00	2 90	4 09½	4 00	4 45	14	1 55	195
June, 1918	1 99	43 25	10 25	1 75	1 25	2 00	61 35	4 20	3 00	2 90	4 09½	4 00	4 45	14	1 58	195
Average	$1 99	$43 00	$10 15	$1 75	$1 25	$2 00	$57 35	$4 20	$3 00	$2 90	$4 09½	3 70	$4 45	$0 14	$1 56	$0 195
April, 1919	$2 05†	$45 00	$15 00	$1 75	$1 25	$2 00	$57 70	$3 47	$2 45	$2 35	$3 37	$2 55	$3 67	$0 159	$1 55	$0 27
May, 1919	1 90†	45 00	15 00	1 75	1 25	2 00	57 70	3 47	2 45	2 35	3 37	2 55	3 67	153	1 63	27
June, 1919	1 90†	46 00	15 00	1 75	1 25	2 00	52 70	3 47	2 45	2 35	3 37	2 55	3 67	153	1 76	27
Average	$1 95†	$45 50	$15 00	$1 75	$1 25	$2 00	$56 03	$3 47	$2 45	$2 35	$3 37	$2 55	$3 67	$0 155	$1 65	$0 27
April, 1920	$2 80†	$72 00	$25 00	$2 00	$1 25	$2 25	$72 30	$5 00	$4 00	$4 00	$5 00	$3 65	$5 00	$0 2274	$1 87	$0 27
May, 1920	3 20†	70 00	25 00	2 15	1 50	2 50	76 30	5 00	4 00	4 00	5 00	3 65	5 00	2274	1 87	27
June, 1920	3 30†	70 00	25 00	2 15	1 50	3 00	76 30	4 47	4 00	3 75	5 00	3 65	4 67	None	1 73	27
Average	$3 10†	$70 50	$25 00	$2 10	$1 42	$2 53	$74 97	$4 83	$4 00	$3 92	$5 00	$3 65	$4 89	$0 2274	$1 83	$0 27
General average	.....	$46 50	.....	$1 33	$0 88	$1 42	$43 70	$3 14	$2 29	$2 21	$3 16	$2 73	$3 22	$0 1125	$1 15	$0 195
March, 1921	$3 10	$55 00	$22 70	$2 15	$1 25	$3 00	$63 30	$3 58	$2 15	$2 35	$3 63	$3 00	$3 78	$0 2274	$0 73	$0 38

† Delivered on job, instead of alongside dock as in previous years.

February Contracts Exceed Those of January

A considerable increase in the value of contracts let during February, 1921, particularly in the construction of miscellaneous building, is the outstanding feature in a comparison of contracts let during January and those let during February, as reported in *Engineering News-Record*. The actual increase in all contracts reported during February over the preceding month was 15½ per cent, though in contracts let for the construction of apartments, educational buildings, churches, hospitals, theaters hotels, bank and office buildings, lofts, and buildings of a similar nature, the increase was 82 per cent. The money value of all contracts let during February aggregated $62,906,821, whereas in January this figure was $54,408,367, as indicated in *Engineering News-Record*, Feb. 10, p. 279.

During February, 1920, there was a decrease of 15 per cent in the money value of contracts awarded as compared to the preceding month. The money value of contracts let during January, 1921, was 31 per cent of contracts let during January, 1920, whereas February contracts were 42 per cent of those let during January, 1920. The largest single item noted during February is an allotment of $5,000,000 for work undertaken by the Detroit Street Ry. Co.

Following is a tabulation of the money value of contracts awarded in February, 1920 and 1921:

Classification	February 1920	February 1921
1—Waterworks	$2,171,725	$927,307
2—Sewers	622,874	2,445,075
3—Bridges	2,137,393	885,529
4—Streets and roads	21,334,013	12,049,344
5—Railways	20,000	6,350,000
6—Excavation, dredging	786,943	305,740
7—Industrial works	63,262,290	4,737,850
8—Building	52,200,466	31,902,608
9—Federal government	2,282,373	1,544,927
10—Miscellaneous	3,466,519	1,728,441
Total	$148,284,596	$62,906,821

Hettrick, Code of Practice Author, Guilty of Conspiracy

John T. Hettrick, a New York City attorney, has been found guilty of conspiring to force plumbing contractors into his "code of practice" clearing house for bids in the plumbing industry. Together with William H. Chapman, William J. Doran, and Herbert Smith, Hettrick was found guilty Feb. 25, in the New York supreme court. All four defendants were sentenced to from six months to three years in the penitentiary.

The conviction of Hettrick and his co-defendants, two of whom were walking delegates for the plumbers union, and a third a member of the master plumbers' association, is the second conviction growing out of the recent investigation of the building situation made by the Lockwood joint legislative committee on housing. Attorneys for Hettrick and the other defendants have asked for a stay, pending application for an appeal.

Tax Exemption on New Homes Now a Fact in New York City

The Board of Estimate and Apportionment of New York City has approved the ordinance previously passed by the board of aldermen, exempting from taxation new homes and apartments for a period of ten years. The mayor has signed the ordinance making it effective at once. As noted in *Engineering News-Record*, Feb. 24, p. 362, the ordinance provides for an exemption of $10,000 for two-family houses and $1,000 a room for new apartments up to $5,000. To come within the ordinance, the buildings must have been constructed, or construction begun upon them, between April 1, 1920, and April 1, 1922.

Quotations Held No Indication of Market Conditions

That it is virtually useless to cite market quotations as indicative of real market conditions is the view held by E. H. Temple, Jr., construction manager, Aberthaw Construction Co., Boston, Mass. In the statement recently made, Mr. Temple asserts that dealers with heavy stocks on hand have given up all idea of securing old prices and are increasingly anxious to liquidate. He also believes that some contractors and fabricators who maintain shops which have expensive machinery and steady overhead costs are offering materials and service with contingencies and profits practically eliminated from price calculations.

Substantiating Mr. Temple's view of the present condition, he cites an operation in which his company recently engaged which called for incidental purchases of materials, dealers' quotations upon which ninety days ago were $13,000. Cash purchasing has since procured them for $9,635, a saving of 25 per cent. Though this amount is considered as insignificant in volume, its very insignificance makes the illustration widely applicable, asserts Mr. Temple.

As a result of the reduction in contractors' organizations to indispensable personnel, Mr. Temple finds that the efficiency of workmen has materially increased. In work now under way by the Aberthaw Construction Co., the making, erecting and stripping of forms show savings of 40 per cent over performance records in the past four or five years. Carpenter work as a whole shows savings of 30 per cent. However, those savings are noted in the operations of picked crews.

Cement Manufacturers Indicted

Alleged violation of the Sherman anti-trust law is the charge in an indictment handed down March 1 by the Federal grand jury in New York City against seventy-four corporations and forty individuals engaged in portland cement manufacture. The defendant companies represent 85 per cent of all production in the United States.

Analyses Made of Construction Companies' Incomes

One out of every three construction corporations in the United States operates at a loss according to analyses made of the latest income tax returns by the Associated General Contractors of America, and published in a special bulletin issued Feb. 26. The analyses further show that less is left for dividends in proportion to receipts, and that more is taken for federal taxes in proportion to income, than in any other industry. Construction is rated four times as hazardous as manufacturing and less than 20 per cent of construction corporations earn more than $5,000 net annual incomes. Eighty per cent of the total construction of the United States is carried on in the ten states of New York, New Jersey, Delaware, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Wisconsin and Michigan.

Steel Manufacturers Plan International Association

At a meeting in New York City last week, directors of the American Iron & Steel Institute, an organization which includes the leading steel companies in the United States and Canada, put into motion plans calling for the organization of an international association of steel manufacturers, the purpose of which will be the promotion of friendship and business co-operation in matters relating to foreign trade. According to Elbert H. Gary, who presided at the directors meeting, formal plans for such an international association will be presented at a meeting in October. Invitations will be sent to steel makers in all countries doing business with the United States, including the European nations, Japan, China, South Africa and South America.

Federal Agent to Ask Prison Terms in Housing Cases

Deputy Attorney General Samuel Berger has announced that he intends to ask that prison sentences be imposed on all persons convicted upon indictments found in connection with the Lockwood housing inquiry in New York City. His policy is a result of the conviction and sentence of Hettrick and others of conspiracy and coercion in the organization and operation of a code of practice in the plumbing industry. Approximately one hundred individuals and an equal number of corporations are under indictment as a result of the Lockwood inquiry. Fines only have been, so far, the penalties attached to the conviction of such defendants appearing in the Federal court.

Road and Miscellaneous Building Show Marked Activity

Receipt of bids and the award of contracts in road construction work, and an increase in the number and scale of miscellaneous buildings upon which construction has begun, are

features of the past week in the contracting field. As noted in *Engineering News-Record* of last week, p. 361, the Pennsylvania highway department received bids for the construction of 100 miles of highways. Highway departments in both Colorado and Wisconsin let contracts during the week aggregating a quarter of a million dollars in value, and other states, including Connecticut and Illinois, are soon to receive bids for the construction of many miles of permanent roads.

California received bids Feb. 21 on highways the total low bid of which was more than $1,250,000. Ohio received bids on 35 miles of roads Feb. 25 divided among thirteen projects that will cost close to $1,250,000.

In analyzing the Pennsylvania bids, it is found that the average of the low bids received for the entire 100 miles is well over $70,000 per mile, one project averaging $100,000 per mile. Whether contracts will be let on these bases remains to be seen. However, such figures cover heavy excavation in many cases. The total of the lowest bids on the entire 100 miles was $7,373,317.

An increase in the amount of building construction, including educational institutions, theaters, apartments, stores, lofts, office and bank buildings, churches, etc., is noticed in the list of contracts awarded published in the construction news section of this issue. In thirty-five contracts awarded, the total cost is $10,238,000. Most of the money is to be spent in school construction, though a number of large apartment houses are in the list.

Other construction includes a $5,000,000 addition to the West Penn Power Company's plant at Springdale, Penn., the contract for which has been awarded to Sanderson & Porter, New York City.

Monthly Prices of Construction Materials

UPS AND DOWNS OF THE MARKET

LABOR—General decreases in Boston and Minneapolis, with labor universally plentiful. The January report of the New York State Labor Commission shows reduction in wage rate of from 5 to 33 per cent, with average weekly earnings for the month $27.61, against $28.35 for December.

PIG IRON—We show a general decrease of from $2 to $7.

PIPE—Clay drain tile has been declining all winter in New York, and the present price of 3-in. is $50 per 1,000 lin.ft., as against $61 last report. In St. Louis 6-in. and 8-in. drain tile are down $5 and $10 respectively. We publish a list of Pittsburgh prices of sewer pipes this month for the first time. Sewer pipe down in New Orleans and Atlanta. Cast-iron pipe down $3 in San Francisco.

ROAD OILS AND ASPHALT—Road oils down 1 to 2 cents in New York and Chicago. Asphaltum down in New York, Chicago and St. Louis.

WOOD BLOCKS—Down in St. Louis, New York and Minneapolis. Advances in Boston and New Orleans.

SAND, GRAVEL, STONE AND LIME—No change in New York crushed-stone prices, which are for occasional orders of moderate quantities. Down in St. Louis and Montreal. Sand down 25c. per cu.yd. in New York, 10c. in New Orleans, and increased in Boston and Montreal. Gravel down in New Orleans, Los Angeles and Atlanta. Hydrated lime (finished) up $3 in Montreal, common lump down in Minneapolis and Atlanta.

CEMENT—We show decreases in 17 cities.

REINFORCING STEEL—This month we show Pittsburgh mill price of triangle mesh instead of price with freight allowed to New York, as heretofore. Our New York prices include delivery, warehouse prices being 10c. less. Metal lath down in Chicago. To stimulate business independent steel companies have cut prices on reinforcing bars. We quote $2.25@2.35, the latter figure being the Steel Corporation's mill price.

COMMON BRICK—New York delivered price unchanged, with wholesale price still $18, sales having gone as low as $15 however. No brick coming into New York, and stocks are being depleted. Down in Denver, Minneapolis, Detroit and Atlanta.

HOLLOW TILE—Down in New Orleans and Atlanta. Change expected in New York by March 15.

STRUCTURAL MATERIAL—The independents are cutting the Steel Corporation's price, and we quote a range of $2.15@$2.45 for both structural shapes and plates. Decrease of 25c. in San Francisco.

ROOFING MATERIALS—We show a general decline in price of roofing materials. Prepared roofings are about the same as last month, except in the case of slate surface roofing, which is now $2.80 per roll, against $3.50 last month.

STEEL SHEETS—We show a range of prices representing the independents' and the Steel Corporation's prices respectively, in Pittsburgh. Decrease in San Francisco and New York warehouses.

LUMBER—General decrease of $2 on rough Douglas fir in San Francisco. Southern pine down $2 in New York, which price is $1 to $4 below the quotations of the Lumbermen's Bureau. Other decreases in Boston, Denver and Atlanta.

LABOR RATES AND CONDITIONS THROUGHOUT THE COUNTRY

S means scarce; E, enough, P, plentiful

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor	Remarks
Atlanta	$0.90P	$0 70P	$1 00P	$0 30P		$1 00P	$0 25P	Atlanta—Labor plentiful, with construction very light
Baltimore	1@1.25	80P	.87½P	46@ 50P	$0 74P	1 00P	30@ 35P	Baltimore—Normal supply in all classes.
Boston	90S	90P	.90P	.60P	[illegible]	.90P	35P	Boston—Bricklayers and plasters leaving town. Other classes of labor plentiful
Cincinnati	1 25E	90E	1.00P	.70E	1 00S	1 00E	60E	Cincinnati—Considerable unemployment
Chicago	1 25	1 25	...			1.25	1 00	Chicago—Labor plentiful but independent.
Cleveland	1 00S	90S	1 00E	.57½E	80P	1 00E	57½E	Cleveland—All classes plentiful. New agreements May 1
Dallas	1.00P	1 00P	1 00E	.60E	1 00E	1 00E	50@ 75P	Dallas—All labor plentiful.
Denver	1.25E	1 16½E	1 16½@ 1.18¾E	75@81¼E		1 15½E	50@ 56¼	Denver—Approximately 25 per cent of building trades working. Master Builders' Association filed notice Feb. 17, with state industrial commission of intention to reduce wages of all building trades 20 per cent on March 17.
Detroit	1.25P	85@ 1 00P	1 10P	70E	1 10P	1 25E	50@ 60E	Detroit—Contracts to May 1. "Open shop" contractors have made 20 per cent cut in all classes. Unemployment increasing
Kansas City	1 12½	1 00	1 00	90	1 00	1 10	75	Kansas City—We received no reports this month.
Los Angeles	1 25E	1 00	1 00E	1 12½E	1 00P	1 00	50@ 75	Los Angeles—More men than jobs.
Minneapolis	1 00P	80P	80P	65P		80P	50P	Minneapolis—We show a 20 per cent reduction, effective Feb. 21. Labor organizations have not yet accepted new schedule
Montreal	90P	75P	60P	40P	50P	60P	35	Montreal—Much unemployment.
New Orleans	1 00E	1 00E	1 00E	65E	1 00E	1 00E	50E	New Orleans—Building trade stagnant, owing to high cost of labor and materials.
New York	1 25	1 12½	1 25	87½	1 12½	1 12½	.75@ 80	New York—Agreement of Nov. 20, 1919, was modified as shown effective May 1, 1920. Excavators, 75c.; Concrete workers, 81¼c.
Pittsburgh	1 50P	1 25P	1.12½P	1 00P	1 00P	1 25E	80P	Pittsburgh—Conditions normal.
St. Louis	1.25E	1 25E	1 25E	85P	1 00E	1 25P	52½@ 60P	St. Louis—Hoisting engineers receive $1 37½ on double hoist. Plaster hodcarriers receive 94¼c
San Francisco	1 25P	1 12½P	1 12½P	1 00P	1 12½P	1 12½P	81¼P	San Francisco—Labor plentiful
Seattle	1 12½	1 00	87½@1 00	87	1 00	1 00	62½@ 75	Seattle—Very little building. 12,000 to 15,000 out of work.

Price advances are indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$[illegible]	$44 60
Northern Basic	[illegible]	42 80
Southern Ohio No. 2	[illegible]	43 80
NEW YORK, tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	[illegible]	47 65
Southern No. 2 (silicon 2.25 to 2.75)	[illegible]	47 70
BIRMINGHAM		
No. 2 Foundry	*27.50*	41 00
PHILADELPHIA		
Eastern Pa.	*31.54**	45 65*
Virginia No. 2	*55.14**	45 25*
Basic	*29 00*†	43 00†
Grey Forge	*29.75**	42 50*
CHICAGO		
No. 2 Foundry Local	*28.00@29.00*	43 00
No. 2 Foundry Southern	[illegible]	46 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	*29.96*	43 65
Basic	*29.96*	42 90
Bessemer	*29.96*	43 40

*F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago Current	Chicago One Year Ago
Standard bessemer rails	$45 00	$45 00	$45 00	$45 00
Standard openhearth rails	47 00	47 00	47 00	47 00
Light rails, 8 to 10 lb.	2 45@3 00*	2 585*	2 45@3 00*	2 585*
Light rails, 12 to 14 lb.	2 41@2 95*	2 54*	2 41@2 95*	2 54*
Light rails, 25 to 45 lb.	2.32@2.85*	2 45*	2.32@2 85*	2 45*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8 Ft. 6 In.
Chicago	Plain	*$1 60*	*$1 85*
Chicago	Creosoted	*2 00*	*[illegible]*
San Francisco	Douglas Fir—Green	1 35	96
San Francisco	Douglas Fir—Creosoted	2 70	1 92

Prices per tie at mills in St. Louis district:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0 80	No. 1	$0 60
No. 2	90	No. 2	70
No. 3	1 00	No. 3	80
No. 4	1 25		
Texas white oak			1 05
Texas red oak (No. 4)	$0.80	No. 5	87

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pitt-burgh Current	Pitt-burgh One Year Ago	Chicago	St. Louis	San Fran-cisco
Standard spikes, ⅝-in. and larger	$3 65@3 90	$3 35	$3 40	$4 87½	$7 75
Track bolts	5 50@6 00	4 90	4 60	5 75	8 75
Standard section angle bars	2 75@3 75	2 75	2 75	4 05	5 00

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots to the Pittsburgh basing card of Mar. 21, 1919:

BUTT WELD

Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
¼ to 3	54 to 57½	41½ to 44	¼	15½ to 25½	4½ to 11½
			⅜	19½ to 29½	11 to 21
			½ and ¾	24 to 34½	8 to 18½

LAP WELD

2	47 to 50½	34½ to 38	2	20½ to 28	6 to 14
2½ to 6	50 to 53½	37½ to 41	2½ to 6	27½ to 30	9 to 17
7 to 12	47 to 50½	33½ to 37	7 to 12	19½ to 27½	6½ to 14½
13 and 14	37 to 41				
15	35 to 38½				

BUTT WELD, EXTRA STRONG, PLAIN ENDS

¼ to 1	52 to 55½	39½ to 43	¼ to 1½	24½ to 34½	9½ to 19½
2 to 3	53 to 56½	40½ to 44			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	45 to 48½	33½ to 37	2	21½ to 29½	8½ to 16½
2½ to 4	48 to 51½	36½ to 40	2½ to 4	23½ to 31½	11½ to 19½
4½ to 6	47 to 50½	35½ to 39	4½ to 6	22½ to 30½	10½ to 18½
7 to 8	43 to 46½	29½ to 33	7 to 8	14½ to 22½	2½ to 10½
9 to 12	38 to 41½	24½ to 28	9 to 12	9½ to 17½	5½ to +2½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
¼ to 3 in. butt welded	44	54@40%	45½%
2½ to 6 in. lap welded	39	50@40%	41½%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
¼ to 3 in. butt welded	28	40½@30%	30½%
2½ to 6 in. lap welded	24	37½@27½	27½%

Malleable fittings, Class B and C, from New York stock sell at +6% list prices. Cast iron, standard sizes, 15% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Month Ago	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$73 30	$73 30	$70 30	$69 10	$66 70	$92 65
6 in. and over	63 30	63 30	67 30	64 10	61 70	87 65

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	*50.00*	$35 00	$60 00	$50 00	.....	$55 00
4	*60.00*	51.00	70 00	70 00	$90 00	65 00
5	*90.00*	65.00	90 00	90.00	115.00	84 00
6	*115.00*	90 00	*120.00*	110 00	150 00	110 00
8	*185.00*	130 00	*185 00*	160.00	250.00	181 00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Current Delivered	Pittsburgh Delivered	St. Louis	Chicago	San Francisco	Dallas
3	$0 24	$0 132		$0 15	$0 14	
4	24	132		15	.175	$0 18
5	36	198		225	21	
6	36	198	$0 17	.225	.245	25
8	56	308	.25	.35	35	35
10	84	462	.35	.525	49	
12	1 08	594	45	625	63	80
15	1 61	792	68	90	1 05	
18	2 30	1 10	88	1 25	1 47	
20	2 76	1 32	1 20	1 50	1.96	
22	3 68	1 98		2 00		
24	4 14		1 56	2 25	2 52	2 40
27			2 75	4 50	3 50	
30			3 40	5 50	4 20	
33			4 35	6 75		
36			4 50	7 00		
	3	5	8	12	24	36
Boston	$0 21	$0 315	$0 49	$0 945	$3 15	$8 7125
Minneapolis			42	77	2 45	5 00
Denver		Quotations not available				
Seattle			40	80	2 88	
Kansas City		No price obtainable				
Los Angeles	11	165*	275	585	1.65	
New Orleans				561	15	
Cincinnati	136	23	.36	712	2 30	
Atlanta	[illegible]		[illegible]	45	[illegible]	
Montreal, delivered	50*	45*	70	1 35	4 50	
Detroit	148	2115	329	621	2 56	6 625
Birmingham		54	51	99	3 29	

4 in. 60c.; 20 in. 70c. per foot.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt (at terminal)	$0 08	$0 09
New York, 65% asphalt (at terminal)	[illegible]	09
New York, binder (at terminal)	08½	10
New York, flux (at terminal)	07½	
New York, refined asphalt	09	
St. Louis, 40% asphalt	11	06½
Chicago, 40-50% asphalt	06	07
Chicago, 60-70% asphalt	06½	0725
Chicago, 40-50% asphalt	10	07
Dallas, 60-70% asphalt	13	08
Dallas, 75-90% asphalt	15	10
San Francisco, binder, per [illegible]	15 00	2 25

ASPHALTUM—Price per ton in packages (350-lb. bbl. or 425-lb. drums, and in bulk in carload lots

	Package	Bulk
New York (Bayonne, N. J.)	$30.00	$21.00
Boston	No quotations	
Chicago	28 50	21 00
San Francisco	21 50	15 00
Dallas	35 00	27 00
Seattle	27 50	
Denver	....	50@ 70
Minneapolis	36 95	27 15
Kansas City	40 00	32 00
St. Louis	50@ 42	. .
Baltimore	40 00	
Los Angeles	23 75	15 00
Montreal	37 00	.
Atlanta	56 00	
Detroit	49 00	42 25
Cincinnati	36 00	27 00

PAVING STONE—

New York	5-in. granite	No quotations
Chicago	About 4x8x4 dressed	$3 40 sq.yd
	About 4x8x4 common	3 05 sq.yd
San Francisco	Basalt block 4x7x8	65 00 per M
Kansas City	Granite	3 65 sq.yd
Boston	5-in. granite	4 20 sq.yd
Atlanta	Granite	2 00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107.00 per M
Baltimore	Granite	2.25 sq.yd.
Montreal	Granite	6 50 sq.yd.
New Orleans	Granite	3 00 sq.yd
Cincinnati	Granite	3.25 sq.yd.
St. Louis	Granite	3.40 sq.yd.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft	.26	sq.ft.
	6x20-in. cross-walk	95	lin.ft.
Chicago	18 in. wide	70	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 70c. for 5x16 in., 80c. for 5x18 in.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York	3½	Ib	$. 5½
New York	4	Ib	3.52
Boston	3	Ib	3 45
Chicago	4	Ib	3 75@ 4 00
Chicago	3½	Ib	3 25@ 3 50
St. Louis	3½	Ib	3 05
St. Louis	4	Ib	3 50
Seattle	4	Ib	Off market
Kansas City	4	Ib	3 00
Minneapolis	3½	Ib	2 50
Atlanta	3½	Ib	2 30
New Orleans	3	Ib	2 99
New Orleans	3½	Ib	3 42
New Orleans	4	Ib	3 85
Dallas	4	Ib	3 90
Baltimore	3½	Ib	3 75
Montreal	4	Ib	4 90
Detroit	3½	Ib	3 40

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$3 00	$2 25	$3 00	$2 25	$1 25	$1 25
Denver	2 00	1 80	1 80	1 80	1.60	1 40
Chicago	2 75	2 00	2.75	2 00	2 75	2 00
Kansas City	3.25	3 25	3.75	3 75	1 25	1 25
St. Louis	1.65	1.78	1 70	1 82	1 70	1 68
Seattle	1.50	1.25	1 50	1 25	1 50	1 25
Dallas	1 75	3 50	1.75	3 50	1.75	2 25
Minneapolis	2.00	1.50	....	1.35	1 00	75
Cincinnati	2.00	....	2 00	....	1.30	1 30
San Francisco	2.50	1.50	2.50	1 50	1.65	1 50
Boston, per ton	2.65	2 00	2 65	2 00	2 00	2 00
New Orleans	3.00	2.55	....	2.40	1 25	1 35
Los Angeles	1.55	1 50	1 45	...	1 30	1 00
Atlanta, per ton	2.88	2.25	....	2.25	1.50	1 15
Detroit	1.85*	2.50	1 85*	2 00	2 50	1 85
Baltimore, per ton	1.40	1 40	1 60	1.60	70	65
Montreal, per ton	....	1.15	1.75	....	1 50	1.40

* Sand and gravel sells for $1 50 to $2 50

† Kaw River sand is $1.75 per yd.

CRUSHED STONE—Price for cargo or carload lots is as follows, per cu.yd.

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1 90@ 2 00	$1 85	$2 15	$2 00
Chicago	2 75	2 00	2 75	2 00
St. Louis	1 85	1 65	1 85	1 65
Dallas	2.25	2.90	2 25	2 90
San Francisco	2 50	1 50	2 50	1 50
Boston	3 00*(del)	3 00	3 00*(del)	3 00
Minneapolis	2 00†	1 50†	2.25†	1 60
Denver	....	3 75	....	3 75
Kansas City	2 35	2 25	2 35	2 35
Seattle (del.)	3 50	3 50	3 50	3 50
Atlanta	3 25*	3 10*	...	. .
Cincinnati	2 30	....	2 15	.
Los Angeles	1 70*	1 50	1 80*	1 50
Detroit	2.00	1.75	2 00*	1 75
Baltimore	1 75*	1 50	1.75*	1 50
Montreal	2.10*	1.75	2 40*	2 00

* Per ton. † Limestone; traprock, $1 60 and $1 80 per ton for 1½ and ¾-in

CRUSHED SLAG—Price of crushed slag per net ton in carload lots:

	1½-In.	¾-In.	Roofing	Sand
Lebanon or Bethlehem, Pa	$1 00	$1 00	$2 50	$0 90
Easton, Pa	1 20	1 20	3 00	1 10
Buffalo, N. Y.	1.25	1 00	2 00	1 00
East Canaan, Conn	1.25	1 35	4 00	1 10
Birmingham, Ala	1 25	1 25	2 05	1 00
Toledo, Ohio	1.50	1 50	2 35	.
Atlanta, Ga	2.58	2.25		

LIME—Warehouse prices:

	Hydrated, per Ton Finished	Hydrated, per Ton Common	Lump, per 200-Lb Barrel Finished	Lump, per 200-Lb Barrel Common
New York	$21 00	$20 00	$3 50* at plant	$3 30*
Kansas City	27 20	26.20	2 50	2 40
Chicago	20 00	.....	.	1 75
St. Louis	26 00	20 00	.	4 12½*
Boston	29 00	27 00	3 80	3 55
Dallas	.....	25 00	....	2 50†
Cincinnati	19 50	17 60	....	2 10
San Francisco	25 40	22 00	....	2 25
Minneapolis	27 00	22 00 (white)	2 00	1.70
Denver	.....	3 20 (bbl.)	1.00 (bu.)	...
Detroit	22 00	19 00	2 00†	1 80†
Seattle	27 00		3 25†	.....
Los Angeles	30 00	30 00	3 00*	3 00*
Baltimore	24 00 (East)			13 00‡
Montreal	28 00		15 00‡	....
Atlanta	.	18 00	.	1 80†
New Orleans	.	22 50	2 70	2.50

* 300-lb. barrels. † Per 180-lb. barrel. ‡ Per ton.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosedale)	$2 80	$1 50
Kansas City (Ft. Scott)	1 60	1 75
New Orleans	3 36	2 52
Atlanta (Magnolia)	11.00 ton	1 90
Cincinnati (Louisville)	2 75	2 25
Boston (Rosedale)	2.35	....

PORTLAND CEMENT—Current prices are for barrels in carload lots, *without* bags, to contractors:

	Current Without Bags	One Month Ago Without Bags	One Year Ago Without Bags
New York (del.)	$3 10	$3 10	$2 80
Jersey City (del.)	2 89	2.89	2 47
Boston	2 85	3 41	2 42
Chicago	2 17	2 37	2 00
Pittsburgh	2 15	2 42	2 05
Cleveland	2 43	2 73	2 32
Detroit	2.51	2 78	2 08
Indianapolis	2 61	2 61	2 27
Toledo	2 51	2 71	2 12
Milwaukee	2 59	2 59	2 11
Duluth	2 10	2 35	2.10
Peoria	2 53	2 63	2.12
Cedar Rapids	2 51	2 71	2 18
Davenport	2 47	2 67	2.14
St. Louis	3 30	3 45	2.20
San Francisco	3 09	3 09	2 63
New Orleans	4 00	4 20	2 36
Minneapolis (del.)	2 70	3 00	2 22
Denver	3 10	3 25	2 82
Kansas City	2 76	2 76	2 36
Seattle	3 10	3 10	2 78
Dallas	2 85	2 85	2 03
Atlanta	3 00	3 00	2 70
Cincinnati	3 32	3 32	3 00
Los Angeles	3 21	3 21	2 78
Baltimore (del.)	2.93	2.93	2.90
Detroit	2 33@ 2 41		
Montreal (including bags)	3.50	3 52	3 48

NOTE—Bag charge is generally 25c. each

TRIANGLE MESH—Price per 100 sq ft. in carload lots:

PLAIN 4-INCH by 4-INCH MESH

Style Number	Sectional Area per Ft.	Square Inches Width	Pittsburgh, Mill	New York, (Del'd)	Chicago	St Louis	Dallas	San Francisco
032	0 032		$1 03	$1 55	$0 98	$1 03	$1 11	$1 54
049	0 049		1 32	1 95	1 26	1 32	1 43	1 96
068	0 068		1 61	2 35	1 53	1 61	1 74	2 41
093	0 093		2 07	2 98	1 97	2 07	2 24	3 11
126	0 126		2 57	3 67	2 43	2 57	2 79	3 88
153	0 153		3 06	4 34	2 90	3 06	3 32	4 03
180	0 180		3 51	4 97	3 33	3 51	3 81	
245	0 245		4 64	6 52	4 40	4 64	5 03	
287	0 287		5 36	7 50	5 08	5 36	5 81	8 10
336	0 336		6 21	8 67	5 89	6 21	6 73	
395	0 395		7 20	10 03	6 83	7 20	7 81	
PAVING								
036P	0 036		$0 79	$1 23	$0 76	$0 79	$0 85	....
053P	0 053		1 12	1 68	1 06	1 12	1 21	....
072P	0 072		1 41	2 08	1 34	1 41	1 53	..
097P	0 097		1 82	1 76	1 73	1 82	1 97	
049R	0 049		1 12	2 08	1 06	1 12	1 21	
067R	0 067		1 49	2 64	1 34	1 49	1 53	
089R	0 089		1 82		1 73	1 82	1 97	

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in width in roll: 150-, 200- and 300-ft. lengths. Galvanized is about 10% higher

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted areas as follows

Gage	Weight	New York* Current Carloads	Chicago	St. Louis	San Francisco	Dallas
27	233	$29 20	$29 50	$32 00	$34 20	$32 75
26	250	31 00	31 00	33 00		34 50
25	300	32 75	32 50	35 00		36 75
24	340	33 05	33 10	37 00	42 70	39 25
22	450	35 50		40 00		43 30

*Delivered on job

BARS, CONCRETE REINFORCING—Current quotations per 100 lb

ROLLED FROM BILLETS

In	Pittsburgh, Mill	New York	Chicago	Dallas	San Francisco
		Warehouse, Uncut			
½ and larger..	$2.25@2 35	$3 63	$3 48	$3 87	$4 75@ $6 00
⅝.....	2.30@2 40	3 68	3.53	3 92	4 80 5 05
¾.....	2.35@2.45	3.73	3 58	3 97	4 95 5 10
⅞	2 50@2 60	3 88	3 63	4 12	5 00 5 25
1	2 75@2 85	4 13	4 18	4 57	5 05 5 50

Twisted bars cut to length take extra of 27½c per 100 lb

ROLLED FROM RAILS

	Chicago	St Louis	Dallas		Chicago	St Louis	Dallas
½ in and larger	$2 50	$2 50	$4 25	½	$2 90	$2 65	
⅝	2 55	[illegible]	4 30	⅝	2 90		
¾	2 65	[illegible]		¾			

BRICK—Contractors price per 1,000 in cargo or carload lots as follows

	Common Current	One Month Ago	One Year Ago	Paving 3-inch	Block 4-inch
New York (del.)	$22 70	$22 70	$25 00	$57 20*	$63 30*
New Orleans	25 50	25 50	22 50		
Chicago	15 00	15 00	14 00	37 00	
St. Louis, salmon....	15 00†	15 00	16 00		
Denver, salmon..	15 00	15 00	17 00		
Dallas	25 00	25 00	18 57	44 00	
San Francisco	18 00	18 00	15 00		44 38
Los Angeles	15 50	14 50	12 50		[illegible]
Boston (del.)	25 00	25 00	35 00	59 25*	66 25*
Minneapolis (del.)...	20@22	24 00	20 00	[illegible]	43 00
Kansas City.....	22 00	22 00	20 00		
Seattle	19 00	19 00	15 00	48 00	53 50
Cincinnati	21@22	22 00	19 00	45 00	
Montreal (del.).....	20 00	20 00	17 50		120 00
Detroit	18 00	20 00	21 00	46 00	52 00
Baltimore (del.).....	20@25	22 50	20 00	38 00‡	42 00†
Atlanta	17 00	15 00			
New Orleans	24 00				

* For paving block 3x8½x3 and 3x8½x4 respectively. †Hard brick $20 50 in St. Louis. ‡Vitrified f.o.b. point, Baltimore.

HOLLOW TILE—Price per block in carload lots for hollow building tile

	New York Current 60% Footage	One Year Ago	Chicago	St Louis	San Francisco	Perth Amboy N. J. Factory
4x12x12	$0 2444*	$0 1667	$0 12	$0 125	$0 145	
6x12x12	3259*	2223	18	165	21	
8x12x12	4345*		216	215	29	379
10x12x12			27	28		473
12x12x12			324	32		568

* Partition tile. Less 5% for cash, 15 day.

	4x12x12	8x12x12	12x12x12
Boston	$0 173	$0 38	$0 43
Minneapolis	121	2117	3314
Cincinnati	125	2	
Kansas City		No permanent market. Quotations withdrawn	
Denver			
Seattle	13	175	30
Los Angeles	11	192	23
New Orleans	[illegible]		[illegible]
Detroit	15	27	39
Montreal	25	31	38
Baltimore	16	27	45
Atlanta	[illegible]	[illegible]	

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	New York Current*	New York 1 Yr Ago	St Louis	Chicago	San Francisco
Beams, 3 to 15 in..	$2.15@$2.45	$3.58*	$3 97	$3 67½	$3 58	$4 85
Channels, 3 to 15 in	2 15@ 2 45	3 58*	3 97	3 67½	3 58	4 85
Angles, 3 to 6 in., ¼ in. thick	2 15@ 2 45	3 58*	3 97	3.67½	3 58	4.85
Tees, 3 in. and larger.	2 15@ 2 45	3 58*	4 02	3 72½	3 58	4 85
Plates	2 15@ 2 65	3.78*	4.17	3.87½	3.78	5 50

*Deliveries in Brooklyn, New York and Staten Island 15c per 100 lb extra

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York Current	New York One Yr Ago	Chicago	St. Louis	San Francisco	Dallas
		Warehouse					
¾ in and larger	$[illegible]	$[illegible]	$6 00	$5 08	$5 17½	$7 05	$6 85

CONE HEAD BOILER

½ in and larger	[illegible]	[illegible]	6 10	5 18	5 27½	7 15	6 85
⅝ and ¾	[illegible]	[illegible]	6 25	5 33	5 42	7 40	6 85
⅞ and 1	[illegible]	[illegible]	6 60	5 68		7 65	7 05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in taken an extra of 25c. Tank rivets 40 per cent off

NAILS—The following quotations are per keg from warehouse

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St Louis	Montreal
Wire	$3 25	$4 15	$6 00	$5 50	$4 20	$4 95
Cut		7 65	8 95	6 85	7 25	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points

	New York 1-Ply c.l	New York 2-Ply l.c.l.	New York 3-Ply c.l	Philadelphia 1-Ply c.l	Philadelphia 2-Ply l.c.l	Philadelphia 3-Ply c.l
No. 1 grade..	$2 15	$2.55	$3 00	$1 90	$2 30	$2 70
No. 2 grade..	2 05	2.45	2.95	1.85	2 20	2 60

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia

Shingles, red and green slate finish, cost $8.00 per square in carloads; $8.25 in smaller quantities, in Philadelphia

ROOFING MATERIALS—Prices per ton f.o.b. New York:

Tar felt (14 lb. per square of 100 sq. ft.) per roll	$2 80
Tar pitch (in 400-lb. bbl.) per ton	2 10
Asphalt pitch (in barrels) per ton	50 00
Asphalt felt (light) per ton	98 00
Asphalt felt (heavy) per ton	102 00

SHEETS—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill

Blue Annealed	Pittsburgh Large Mill lots	St Louis	Chicago	San Francisco	New York Current	New York One Yr Ago
No. 10	$3.20@$3.55	$4 77½	$4 68	$6 75	$5 68	$6 80
No. 12	[illegible] 3 60	4 82½	4 73	6 80	5 73	6 85
No. 14	3.40@ 3.65	4 87½	5 03	6 85	5 78	6 90
No. 16	[illegible] 3 75	4 97½	5 13	6 35	5 88	7 00
Black						
*No. 18 and 20	3.95@ 4 20	5 65	5 80	7 05	5 88	7 30
*No. 22 and 24	3.40@ 4 25	5 70	5 85	7 10	5 78	7 35
*No. 26	3.15@ 4 30	5 75	5 90	7 15	5 78	7 90
*No. 28	3.00@ 4 35	5 85	6 00	7 20	5 88	8 00
Galvanized						
No. 10	[illegible] 4 70	6 20	6 35		6 25	9 00
No. 12	[illegible] 4 80	6 30	6 45	[illegible]	6 35	9 10
No. 14	[illegible] 4 80	6 40	6 45	[illegible]	6 35	9 10
No. 18 and 20	[illegible] 5 10	6 60	6 75	[illegible]	6 65	9 40
No. 22 and 24	[illegible] 5 25	6 75	6 90	[illegible]	6 80	9 55
*No. 26	[illegible] 5 40	6 90	7 05	[illegible]	6 95	9 70
*No. 28	6.50@ 5 70	7 20	7 30	[illegible]	7 25	10.00

* For painted corrugated sheets add 30c. per 100 lb. for 5 to 28 gage, 25c. for 29 to 24 gage. For galvanized corrugated sheets add 1 lb., all gage

LINSEED OIL—These prices are per gallon

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl)	$[illegible]	$1 07	$[illegible]	$[illegible]
5 gal. [illegible]	26		90	[illegible]

WHITE AND RED LEAD—Base price per pound

	Red — Current — Dry	Red — Current — In Oil	Red — 1 Year Ago — Dry	Red — 1 Year Ago — In Oil	White — Current — Dry and In Oil	White — 1 Yr. Ago — Dry and In Oil
100-lb. kegs	13 00	14 50	14 50	16 00	13 00	14 50
25 and 50-lb. kegs	13 25	14 75	14 75	16 25	13.25	14 75
12½-lb. keg	13 50	15 00	15 00	16 50	13 50	15 00
5-lb. cans	16 00	17 50	16 50	18 00	16 00	16 50
1-lb. cans	18 00	19 50	17 50	19.00	18.00	17 50

500 lb. lots less 10¢, discount. 2000 lb. lots less 10 2½¢ discount

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots

	Lumber Prices in Yards at San Francisco — 6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$25 50	$26 00	$27 00	$29.00
3x6 and 8	26 50	27 00	28 00	30.00
4x4 6 and 8	27 00	28 00	29 00	30.50
3x10 and 12	27.00	28.00	29.00	31.00
3x14	27 50	28 50	29 50	31.50
4x10 and 12	27 00	28 00	29 00	31.00
4x14	28 00	29 00	30 00	32.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$26.50	$28.50	$29 50
6x14	28 00	30 00	30 50
8x10	26 50	28 50	29 50
8x14	28.00	30 00	30 50

New York, Chicago and St Louis

	Southern Pine — New York* — 20 Ft. and Under	Southern Pine — New York* — 22-24 Ft.	Southern Pine — Chicago — 20 Ft. and Under	Southern Pine — Chicago — 22-24 Ft.	Yellow Pine — St. Louis — 20 Ft. and Under	Yellow Pine — St. Louis — 22-24 Ft.
3x 4 to 8x6	$55 00	$57 00	$51.00	$52 00	$55 00	$57 00
3x10 to 10x10	49.00	50 00	53 00	54.00	57.00	5 00
3x12 to 12x12	55.00	56 00	55 00	56 00	59 00	61 00
3x14 to 14x14	60.00	61 00	60 00	61 00	62 00	64 00
3x16 to 16x16	67.00	68 00	65 00	66 00	69 00	71 00
3x18 to 18x18	79 00	80 00	69 00	70 00	74 00	76 00
4x20 to 20x20			72 00	73 00		

* For long leaf pine Short leaf pine up to 14 x 14 costs $15 per M. less

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In x 20-Ft. and Under — P	Fir	Hemlock	Spruce	12 x 12-In 20 Ft and Under — P	Fir
Boston	$48 00	$55 00	$56.00	$50.00	$56 00	$58 00
Kansas City	51 00	51 25	51.25	51.25	60 00	51.25
Seattle		35 00	.....	.....		35.00
New Orleans	38 00	...	.....	.....	42 00	.....
Baltimore	65 00				75 00	
Cincinnati	40 00	42 00	50 00	56 00	45 00	40 00
Montreal	78 00	78 00	68 00	78.00	79 00	100 00
Los Angeles†		47 00	46.00		...	49 00
Detroit	Quotations f o b mills only					
Denver		23 25		....		18 25
Minneapolis		44 00	40 00	....		44 00
Atlanta	25 50				40 00	
Dallas	45 00				55 00	

	1-In Rough, 10 In x 16 Ft. and Under — P.	Fir	Hemlock	2-In T and Gr 10 In x 16 Ft — P.	Fir
Boston	$45 00	$60 00	$45 00	$45 00	$60 00
Kansas City	102.00	106 50	106 50	113 00	112 75
Seattle		20.50			23 00
New Orleans	65 00			40 00	
Baltimore	45@ 47 50			45@ 50	
Cincinnati	34 00	47 50	43 00	35 00	64 00
Montreal	75 00	77 00	70 00	82 00	82 00
Los Angeles	.....	43 00	45.00		97 00
Detroit	35@ 40		43 00		
Denver	.....	27 25			29 25
Minneapolis		36 00	37 75		33 75
Atlanta	15 00			15 00	
Dallas		33 00		42 00	

* Montreal—Up to 32 ft., on which, $3.00 per M. increase up to 30 ft

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Boston	$0 41½	New Orleans	$0.51½
Buffalo	.29½	New York	.38
Chicago	.38	Pacific Coast (all rail)	1.66½†
Cincinnati	.33	Philadelphia	35
Cleveland	.24	St Louis	47½
Denver	1 35*	St. Paul	.69½
Kansas City	81½	Detroit	.33
		Baltimore	.33½

Note—Add 3% transportation tax. * Minimum carload, 40,000 lb.
†Minimum carload, 50,000 lb., structural steel only.

CONTRACTORS' SUPPLIES

STEEL SHEET PILING—The following price is base per 100 lb f o b Pittsburgh, with a comparison of a month and a year ago

Current	One Month Ago	One Year Ago
$3 00	$3 00	$2 55@ $3.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows: -

	New York
Hercules red strand, all constructions	15%
Patent flattened strand, special and cast steel	15%
Patent flattened strand, iron rope	List
Plow steel round strand rope	30%
Special steel round strand rope	25%
Cast steel round strand rope	17%
Iron strand and iron tiller	List
Galvanized iron rigging and guy rope	—17½%

San Francisco, Galvanized iron rigging and guy ropes—22½%
Bright plow, 25% off.
Chicago, +17½ on galvanized and on cast steel.
Western and California territory, 25% plow steel; 22½% galvanized iron rigging and guy rope.
Montana, Idaho and Arizona, 20% plow steel 27½% galvanized iron rigging and guy rope.

MANILA ROPE—For rope smaller than ⅜-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft., ½-in., 6 ½-in., 4½, ⅝-in., 3½, ¾-in., 2 ft 10 in., 1½-in., 2 ft. 4 in. Following is price per pound for ⅜-in and larger, in 1200-ft coils.

Boston	$0 22	Kansas City	$0 24
New York	.21	New Orleans	.21½
Chicago	.21	Los Angeles	.18½
Minneapolis	.21½	Seattle	.20
San Francisco	.19	St. Louis	.21
Atlanta	.26	Montreal	.31
Denver	20	Detroit	.21
Cincinnati	32	Baltimore	25
Dallas	29		

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb keg of black powder.

	Low Freezing 20%	Gelatin 40%	Gelatin 60%	Gelatin 80%	Black Powder
New York	.....	$0 33½	$0 36½	.....	$2 50
Boston	.225	2425	2825	$0 365	
Kansas City	2475	27	30	34	2 40
Seattle	1825	.2025	.2275	2950	2 60
Chicago	2225	.2425	.2675	.335	2 50
Minneapolis	.2222	2426	2682	.. ..	2 80
St. Louis	.245	.28	315	3575	2 50
Denver	2250	.2550	.29	3325	2 70
Dallas	.265*	275	.3025	.. ...	2 60
Los Angeles	22	27	37	.....	3 10
Atlanta	2525	2875†	.3225	.3650	2 60
Baltimore	2525	2875	3175	.36	2 10
Cincinnati	.2325	265	2925	.....	2 55
Montreal	.30	32	37	38	4 10
New Orleans	.255	275†	300†	.....	2 80

* 30 Per Cent † Low freezing

PILES—For spruce and plain pine poles, delivered New York, the prices are as follows:

Spruce 10-in. butts, 5-in. tops, length 20-30 ft	$11 50
Spruce 12-in. butts, 6-in. tops, length 30-40 ft	10 50
Pine 12-in. butts, 6-in. tops, length 41-50 ft	13 75
Pine 14-in. butts, 6-in. tops, length 51-60 ft	22 50
Pine 14-in. butts, 6-in. tops, length 61-71 ft	25 25
	Dallas
6-in. x 20-ft.	$4 60
6-in x 30-ft.	7 10
8-in x 30-ft.	8 45
8-in x 35-ft.	10 35

OLD MATERIAL—The prices following are per gross ton paid to dealers and producers in New York In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No 1 railroad wrought	$17 00	$17 50	$14 50
Stove plate	15.00	18.00	17 50
No 1 machinery cast	23 00	18 00	19 00
Machine shop turnings	8.50	7 50	6 00
Cast borings	9 00	10 00	10 00
Railroad malleable cast	13 00	15 00	14 00
Re-rolling rails	15 00	15.00	15 00
Relaying rails	45@ 47 50	32 50@ 37 50	35@ 40

SHIP SPIKES—Current prices per 100 lb.

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	.....	$9 20	$8 50	$8 55
⅝	.....	8.75	6.75	8 25
¾	.....	8.60	6.60	8 30

Pittsburgh base, $4 50 per 100 lb.

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E. J. MEHREN Editor

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Railway Engineering Convention

THIS number is largely devoted to the problems of the railroad engineer, for it appears just before the annual convention of the American Railway Engineering Association. That body will assemble in Chicago next week for the second time since the railways have been returned to private operation. The problems that loomed big a year ago are still big today. If anything, the railroads are even more in the public eye. They have an unusual measure of public support at the present time but they will have to fight hard to deserve it. There is insidious adverse propaganda, on top of the tremendous obstacles caused by inadequate revenue. The greater the difficulty and stress, however, the greater the demands upon those engaged in railroad service. More and more, engineering analysis and engineering methods must be applied to secure a satisfactory solution for the present bad situation. If the matter of terminal operation alone be mentioned there is sufficient warrant for the preceding remark to make extended explanation unnecessary.

An Engineer for the I. C. C.

FOUR vacancies exist at the present time in the Interstate Commerce Commission which would seem to make an excellent opportunity to promote the appointment of at least one engineer to the commission. The arguments in favor of having an engineer on a commission of this sort have been so often detailed that they will not be repeated here. In the case of the Interstate Commerce Commission, however, the recent broadening of its powers by the Transportation Act requires, more than ever, thorough familiarity with the mechanism of the railroad machine. An engineer, assuming of course that he have the proper qualifications, could render an invaluable service to the nation in the capacity of Interstate Commerce Commissioner. The purpose here, however, is not to argue the case but to urge upon engineers individually and upon engineering societies that they communicate to the new President their desire to see an engineer appointed to the commission. To do that is merely to follow the accepted procedure in trying to get before the chief executive the views of a large number of citizens.

Shrinkage and Subsidence

RAILWAY embankment quantities have generally exceeded the estimates and during subsequent years of operation additional material has been required to maintain the normal height and width of fills. These conditions are due to causes which have been grouped chiefly under two heads, first, shrinkage of the fill material and, second, subsidence of original ground under the weight of the fill and the weight and impact of traffic. The excess quantities represent expenditure for material and labor, but, as a rule, the records of such quantities and costs are very meager, owing in part to the fact that most of the work has been done in innumerable small jobs. When valuation of the railways was undertaken this excess material became of great importance to the railways in order that they might receive credit for great aggregate expenditures thus incurred for excessive earthwork. Extensive studies have been undertaken and information has been repeatedly published in *Engineering News-Record* giving the data disclosed. In this issue will be found the results of an extensive investigation of subsidence made by the carriers. These explorations have not only discovered enormous quantities of lost earthwork but have also shown that subsidence beneath embankments is almost universal. It is also shown that shrinkage and subsidence must be treated as separate in an engineering investigation. The results should be of as great value to engineers engaged in construction and maintenance as to valuation engineers.

The Price Situation

WHEN the price situation, as affecting construction costs, is discussed it is always apparent that many people can not divorce themselves from the belief that there can be no normal price level but that of 1913. True, practically everybody would like to get back to that level. We feel that at present levels the economic situation is "out of joint." But thinking will not bring it back to where it was in 1913. We know that after the Civil War it took twenty years to restore the old levels. No one can predict with certainty that that history will be repeated, but not merely historical precedent but present indications as well point to a slow deflation from now on. In many lines we have had large decreases and some people predict that the recent inclination of the downward curve will continue. Most authority, though, inclines to the belief that the slope will change to a flatter one. If that expectation be correct, it will be several years before large reductions can be realized in construction costs. In other words, if structures are urgently needed those who postpone them in the hope of being able to make large savings this fall or next spring are likely to be disappointed. Above all there seems no doubting the wisdom of going ahead quickly with any work that must be done this season.

Effect of Foreign Trade

WITH our inexperience, relatively at least, in export matters we do not as a people appreciate the bearing of export trade upon domestic prosperity. That is true despite the jolt which every individual received when the outbreak of the European war disarranged our export trade and brought with it a temporary unsettlement of our whole commercial structure. The farmers, whether they raise wheat or cotton, appreciate what Europe's failure to buy means to their individual

prosperity and they backed to a man the re-establishment of the War Finance Corporation. Most city people, however, remain indifferent to the export situation. Engineers and contractors, no less than every other class, are directly concerned, for the present depression in construction is due, in part at least, to the lack of purchasing by the farming communities, and that in turn is traceable to the slackness of export demand. The export of manufactured goods as well would keep our people busy and re-establish their purchasing power. For these reasons engineers and contractors should have a keep interest in the functioning of the War Finance Corporation and in the organization of the Foreign Trade Finance Corporation, the $100,000,000 private enterprise whose formation, with the backing of bankers all over the country, is now practically accomplished. Both have the function of making long term loans for the financing of exports and should be material factors in retaining—or re-gaining—much of the trade we developed during the war and of again supplying the European customers who temporarily, on account of the adverse rates of exchange, find it impossible to buy in this market.

Column Formulas Again

WHAT is said on column formulas on p. 431 of this issue reflects the personal convictions of a single engineer, but is likely to receive the approval of many, for the time-honored Rankine formula still has strong advocates. Their faith in it rests on the fact that tests over a sufficiently wide range usually indicate a dependence of carrying capacity on length according to some law represented by a line of reversed curvature. Granting this fact, the Rankine formula may very fairly be taken as the simplest expression of such a curve. Up to this point of the reasoning the question of column strength is one of fact rather than of interpretation or opinion; but beyond this point the matter becomes less simple. Testing-machine service and field service have to be correlated before test curves can be translated into formulas for working loads. The crucial question of this part of the problem, namely, whether the "exposure" of a column in actual service is directly parallel to its exposure to the attack of load in a testing machine, has had little discussion. Limitation of column length in structures depends on the same question.

Testing for Toughness

EVERY distinct experience in the service of steel structures furnishes a new reason for ranking toughness or ductility as the paramount quality of structural steel. There is a very general feeling among engineers, too, that steel is desirable or undesirable according to its toughness, more or less regardless of ordinary test-report figures or chemical analysis. Many engineers—chiefly the "old-fashioned" ones—would be willing to accept or reject steel on the basis of toughness alone. They do not do so, however, and cannot, because there is no accepted test for toughness. In fact, the quality itself is not clearly defined, and probably it is not even a single quality but a group of qualities, each depending on the particular kind of physical action involved. Cracking around a rivet-hole as the effect of punching, for instance, may depend on different qualities from those involved in making a bend. There is room for research in this field; it might ultimately develop a satisfactory test for toughness, and greatly simplify the whole matter of steel quality in the structural field. With the aid of satisfactory test methods and the knowledge derived from research, it will be possible to investigate important questions of the relation between structural strength and workmanship. In a recent accident, where the steel gave good account of itself, reamed rivet holes were involved, we are informed, and it is suggested that the reaming increased the toughness of the fabricated material. There is little or no knowledge in print on which to base a conclusion concerning this point, and until we are nearer agreement as to what toughness is and how it should be measured, the matter must rest largely on individual opinion.

Indictment of Cement Companies

LAST week a federal grand jury at New York returned indictments against seventy-four cement companies and some of their officers for violating the Sherman anti-trust law. It is alleged that the indicted companies and officials engaged in a conspiracy to fix prices, to divide territory, to withhold cement from the market and prevent it becoming a commodity of free and unrestricted sale, and to curtail the production of cement. The indictment is the outcome of the New York legislative inquiry into the building industry. In view of the prevalence among contractors and engineers of the belief that cement prices are fixed by arrangement among the companies and that the distribution is similarly controlled, it is desirable that the case come to early trial, to the end that the practices may be stopped, if unlawfully existing, or that the cement companies be exonerated. In August, 1919, action was begun against nineteen eastern cement companies, on substantially the same charges, in the U. S. District Court at Trenton, N. J. The defendants filed their answer but nothing has been done since. It was the government's "move" and the government has not acted, despite a "grand-stand play" by the attorney-general at the time to the effect that the suit was the first action of the government in an effort to reduce the "cost of living." The New York legislative hearings were unfair and carried no conviction to fair minded men—as was pointed out in this journal, Jan. 27, 1921, page 155. The effect of these actions, nevertheless—without proving anything—is to increase in the popular mind the already existing belief that there is collusion. Unfortunately, the legal mill grinds slowly. We shall probably have to wait long for a decision, which is bad both for the cement companies and their customers.

Should Engineering Corporations Be Licensed?

THERE is agitation in New York State to have repealed that section of the engineers' licensing law which permits the licensing of engineering corporations and partnerships. The protest against the offending section is sound, and should have general support. Engineering service, of its very nature, is of a personal character. It involves judgment which necessarily cannot inhere in an impersonal body, no matter how much previous experience may be found embodied in reports on its shelves. Each engineering problem is distinct and different. There may be elements that are so simple and so well standardized that they require a minimum of engineering experience to apply, but their combination into a

solution or the mere decision to apply them demands a training and balance that can only inhere in the individual. Moreover, the value of that judgment flows directly from the individual and can in no way be enhanced by corporate name or financial standing. The quality of the engineering service rendered by a corporation can not rise above the quality of its engineers. These engineers then, as individuals, should be made to stand out before the public and to carry openly the responsibility which, in fact, is theirs.

The principle of personal service in the professions is clearly recognized in law and in medicine. Neither law firm nor corporation of physicians as such may be admitted to the bar or practice medicine. The work of the engineer is no less of a personal character than theirs.

This action of the New York engineers, to secure repeal of the section, will do much to win over to licensing those who have had doubts as to its value. If licensing can in so conspicuous a way help to fix the professional status of the engineer, it will have a distinct achievement to which to point.

Now that the question has been raised, it would be well to pursue it in those other states that have in their licensing laws the anomalous provision of admitting corporations and partnerships to the practice of engineering.

A European-Asiatic Railway Problem

IN THE Bagdad Railway, described elsewhere, may be seen a striking example of the interlocking and conflicting interests of European countries in developing their foreign commerce and in supporting their colonial possessions. Its history illustrates also the effects of European international quarrels on the progress of an ambitious engineering undertaking.

Great Britain has long wanted a line from the Mediterranean to the Persian Gulf as part of an "overland route" to its Indian empire, to shorten or avoid the present long sea voyage. Germany has wanted a line from the Bosphorus through Asia Minor as a means of extending its political and commercial interests and becoming a rival of Great Britain in "the East." France also has had such a line under consideration. Russia has been afraid of the project as likely to interfere with its own plans of commercial and political expansion. Turkey, in whose territory the route lay, had no local interest in the railway for its own development, but was willing to use the scheme as a tool or weapon in dealing with the European powers.

After years of diplomatic negotiation and intrigue, Germany received a concession for the railway. Russia promptly exerted political pressure to secure a radical change in one end of the route and Great Britain exerted similar pressure to block the other end. But construction advanced steadily. Since the war, one part of the line has come under the control of France, the other under that of Great Britain. What arrangements will come out of these new complications of war and national rivalries can hardly be predicted.

The characteristic of the international features is that the railway is a strategic tool of a foreign power and not a means, except incidentally, of developing the country through which it passes. Any foreign investment necessarily may involve international complications, but the difficulties are immeasurably increased when the investment is purely a military tool.

Machines in Snow Removal Work

IN CLEARING New York City's streets of the 12½-in. depth of snow deposited by the storm of Feb. 19-20, the Department of Street Cleaning demonstrated the effectiveness of mechanical equipment, an innovation this year. It is true that conditions of temperature, snow density and labor supply—all important factors—were more favorable this year than last, when traffic was paralyzed for several weeks. Nevertheless, credit for keeping the streets open is chargeable, not so much to luck as to advance planning and the use of machinery in place of the slow hand methods of former years.

The outstanding feature of this year's method of attack, as described on p. 415, was the use of tractors, wide-blade plows and motor trucks. Snow-plowing, with 10-ft. blades, was done in three ways—with pull-plows hauled by 2-ton tractors of the "tank" type and with push-plows mounted on the front ends of the heavier 4-ton caterpillar tractors and the 5-ton motor trucks. This work was successful in clearing traffic lanes by pushing the snow toward the gutters or, in the case of a broad thoroughfare like 5th Ave., toward the center of the street. The piled snow was then disposed of by the department's new fleet of more than 300 motor trucks, in addition to the vehicles of the snow-removal contractors.

A few attempts at mechanical loading were made, but the bulk of the loading was by hand-shoveling. In this feature the department has a field for study and experiment. The inclined elevating conveyor has possibilities of usefulness in cases where piled snow has not frozen into a solid mass. Its effectiveness depends in large measure on the skillfulness with which the operator of the motor truck being loaded backs his machine underneath the discharge end of the conveyor and follows its advance. With the movement of the two machines—truck and loader—not synchronized, much of the snow is spilled outside the truck body.

We believe, as stated editorially in our issue of Feb. 19, 1920, p. 355, that the small revolving-type of steam shovel would be an effective tool for loading piled snow. Its action is positive and it would stand up to its work under conditions of frozen masses where the elevating conveyor would have difficulty in functioning In the metropolitan district during the winter there are many idle shovels which the street cleaning department could rent with profit to itself and to the contractors.

One more feature of this year's program is worth noting: The best tractors and trucks must be maintained properly and facilities provided for minor repairs. The city was not organized with an adequate mechanical staff to keep its machines tuned up, and if another storm had followed the first, many of the tractors and trucks might have been laid up, due merely to lack of proper mechanical supervision. For mechanically operated vehicles, like the highways over which they operate, adequate maintenance must be provided. Especially was this need urgent in New York's case where the bulk of the truck and tractor drivers were comparatively "green" operators.

All in all, however, the handling of this season's snow work marks a distinct advance. Many improvements will probably be developed as a result of the lessons of this year's storm, but the encouraging feature is the clear conception of the work as an engineering job and the employment of mechanical tools in place of the slow hand methods of the past.

Reconstruction of Upper Deck on Eads Bridge Approach

Corroded Steel and Timber Roadway Floor Replaced with Concrete Without Interrupting Railway or Highway Traffic

By E. C. Albrecht
Assistant Engineer, Terminal Railroad Association of St. Louis

CORROSION of steel framing of the upper roadway deck of the western approach to the Eads Bridge over the Mississippi River at St. Louis, Mo., has necessitated the reconstruction of part of the roadway. The work had to be done without interrupting traffic either on the roadway or on the railway tracks below; both the design and the methods of execution were largely determined by this requirement.

The corrosion was caused by smoke and gases from locomotives on the railway tracks of the lower deck.

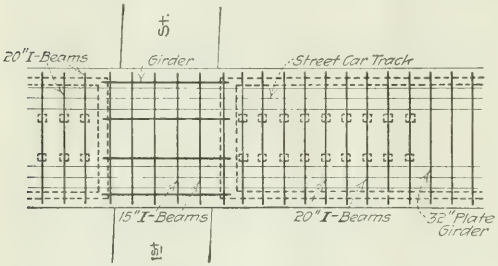


FIG. 1. STEEL FRAMING OF OLD UPPER DECK: EADS BRIDGE APPROACH

Reinforced concrete has been used in the new work in order to eliminate all exposed steel, the concrete being protected against the blast of the engines by cast-iron plates. This work, which will be completed in 1921, extends the full length of the approach, 693 ft. The bridge is operated by the Terminal Railroad Association of St. Louis and the work is being done by company force.

Typical construction of the old deck, as built during 1900-1903, is shown in Figs. 1 and 2. Two solid 30-in. walls of stone masonry extend down to bed rock and between them is an earth fill to the level of the railway tracks on the lower deck of the bridge. The upper deck, for highway traffic, was carried by transverse 20-in. 65-lb. I-beams spaced from 7 ft. 7 in. to 9 ft. 1½ in. c. to c., these being supported on the side walls and on timber posts resting on brick piers carried down to rock. On the I-beams were timber stringers, dapped in such a way as to give a 4-in. crown to the roadway. A deck of 3½-in. yellow pine planking was spiked to the stringers and made watertight with a layer of 2-ply tarred roofing paper, upon which was the 3½-in. creosoted wood block paving.

Near the east end of the approach, plate girders were used, spanning the entire width between side walls. These girders, spaced 8 ft. 3 in. c. to c., consisted each of a web plate $\frac{7}{16}$ x 28½ in., four flange angles 5 x 3½ x ½ in., and two 10½-in. cover plates ⅜- and ½-in. thick. In this part of the structure the railway tracks are laid on an earth fill upon brick arches which are 30 in. thick at the crown and rest on stone piers 7½ ft. thick extending to bed rock. Across two streets and an alley, the upper deck was carried by four longitudinal girders, those on the outside resting on the side walls of the bridge and those on the inside being supported by steel columns. Across these girders were 15-in. 80-lb. I-beams to carry the timber deck. The lower or railway deck is carried over each of these streets by four plate girders resting directly on the walls at the street lines.

All the brick and stone masonry in the walls, piers and arches is part of the original Eads Bridge, built in 1872. Careful inspection in 1917 showed that this work was in very good condition. Only well burned bricks (exceptionally hard in those days) were used, and the stone was mostly limestone from quarries at Grafton, Ill. All brick and stonework was laid in cement mortar, but the available records do not indicate the quality of the cement used.

Condition of Approach

The upper deck, described above, was built in the period 1900 to 1903, but by 1917 the condition of this steelwork was such that its renewal would have been necessary had it not been decided to rebuild the entire deck in concrete. Although the corrosion was general on all of the exposed steel it was particularly severe on the flanges and webs of the beams directly over the railway tracks, due to the severe blast from the locomotives. That this blast is of unusual intensity is evident from the comparatively short life of the structure, 17 to 20 years and can be attributed directly to two causes: (1) the engines are working hard on the heavy grade, and (2) the clearance from top of rail to underside of girders is as low as 16 ft. in some places, so that the smoke and cinders are blown forcibly against the steel.

Another cause which, in the writer's opinion, contributed largely to the rapid deterioration of this steelwork was the large amount of dirt and soot which clung to the webs and flanges of these beams, and which in combination with moisture led to a chemical reaction that quickly attacked the steel. The moisture was due mainly to steam condensing on the steel. No doubt a certain amount of water leaked through the deck, but this was a very small factor. Under the circumstances it was impossible to keep this steel clean and well-painted. Reconstruction was contemplated shortly before the war, but had to be abandoned at that time.

Reinforced concrete throughout was adopted for the new deck, as shown in the drawings. Fig. 3 is a typical section. The lower level is divided lengthwise into two corridors by a 36-in. wall of concrete, having openings at varying intervals to provide access from one side of the bridge to the other. The 10¾-in. upper roadway slab is reinforced with ¾-in. square rods spaced 6 in. c. to c. and the 5½-in. sidewalk slab with ⅝-in. square rods 5½ in. c. to c. Floor beams supporting the slab have a clear span of 20½ ft. and are cantilevered 33 in. beyond the face of the masonry bridge walls to receive the sidewalks. These beams are 28 in. thick and 33 in. deep below the slab, their spacing (as for the old steel beams) varying from 7 ft. 7 in. to 9 ft. 1½ in. c. to c. Each beam is reinforced with eight 1-in. square rods, and four-prong ½-in. square stirrups spaced 12 in. c. to c. throughout. To protect the concrete from the engine

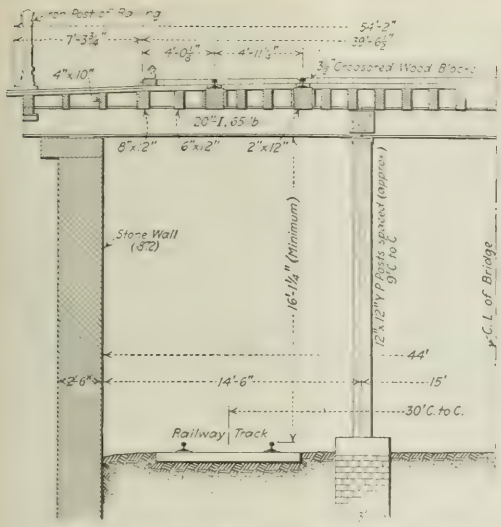


FIG. 2. TYPICAL SECTION OF OLD UPPER DECK CONSTRUCTION

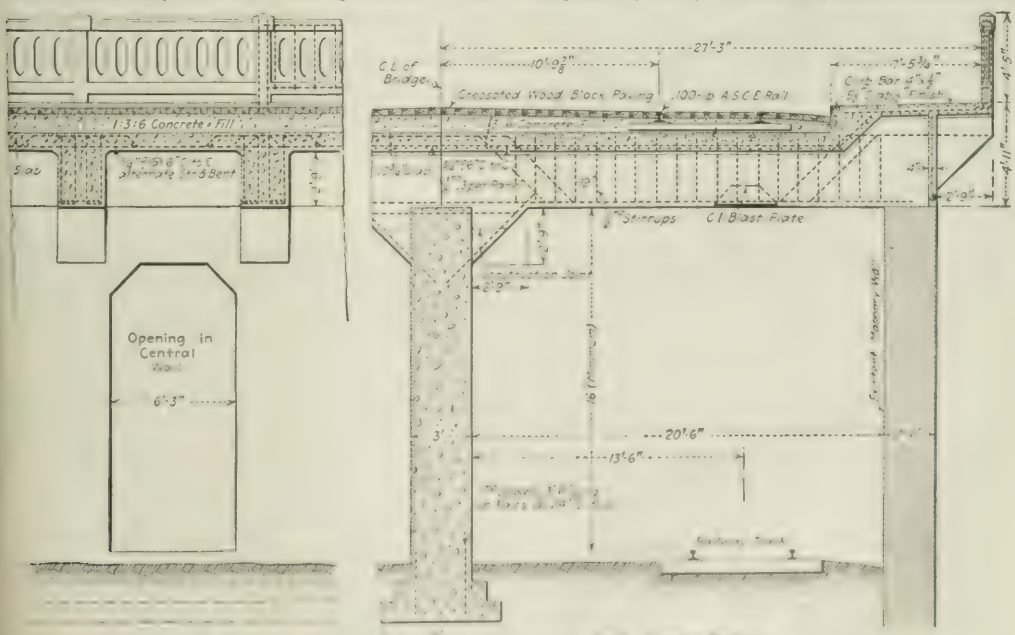
blast a 1-in. cast iron blast plate 28 x 36-in. is provided in the bottom of each beam, lugs on the castings being embedded in the concrete.

Street car tracks are located at the sides of the roadway, the center being open to vehicular traffic, so that the crown had to be formed in two separate parabolic curves. With the customary type of crown there would have been a difference in elevation of 2 in. for the two rails in each track, which could not be permitted. It was decided, therefore, to place both rails at the same elevation, with a flat space between them. From the curb to the nearest rail, the roadway is given a rise of 3½ in., and from the other rail to the center the roadway rises 2½ in., making a total of 6 in. from curb to center line of roadway. Each rise was worked out as a separate parabola, and the resulting crown is found to be satisfactory. A concrete fill on the slab is shaped to the desired crown. The roadway is paved with 3½-in. creosoted wood blocks, laid in a heavy coat of hot pitch spread over the concrete, no sand cushion being employed. The sidewalks are finished with ½-in. of 1:1 cement mortar. An ornamental concrete fence is provided on each side.

At street crossings the deck is supported on three heavy reinforced concrete girders as shown in Fig. 5. The two side girders have a clear span of 46 ft. and are 30 x 100 in. in section. The reinforcement consists of 1¼-in. square rods and ½-in. two-prong stirrups, aranged in pairs and spaced at varying distances. The center girder has a clear span of 43½ ft. and is 36 x 107 in. in section, with similar reinforcement. Cast-iron scuppers are placed at the streets to drain off the storm water. Expansion joints in both the roadway slab and the center wall are provided at intervals of approximately 50 ft.

Construction Methods

As it was necessary to keep both the upper and lower deck open to traffic during the reconstruction, it was decided not to remove any of the old decking until the 36-in. longitudinal central wall was completed. Work was started in June, 1919, the wall being poured in lifts about 4 ft. high and in sections about 50 ft. long. A mixer was placed between the tracks and a short distance ahead of the section under construction. All concrete was placed by hand, the laborers pushing wheelbarrows



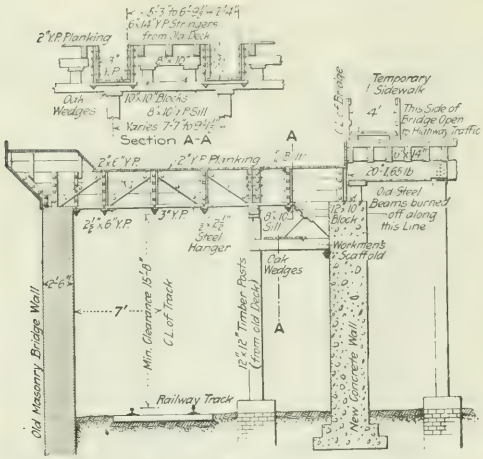


FIG. 4. FORM DETAILS FOR CONCRETE UPPER DECK

up an incline to the full height of the forms. The heavy center girders across the streets and alley were also poured in conjunction with the wall. Each girder was poured in one continuous operation, requiring 22 hours. There was no interference with railway traffic, the cars for handling material being operated between trains. The wall and center girders were completed Oct. 20, 1919, and work was then suspended until the next spring.

Operations were resumed May 16, 1920, the north half of the upper deck being started. A derrick mounted on a flat car on this deck is used to tear up the old flooring and moves east as the work progresses. Highway traffic is confined to the south half of the bridge opposite the section torn out. At the west end of the work was placed a 54-ft. concreting tower with chutes suspended from cables and capable of reaching to a distance of 175 ft. This plant was mounted on trucks and moved east as each section was completed. Fig. 6 shows the derrick and concreting plant.

In the first place, a section of the old decking, two panels or about 18 ft. in length, is torn out, the material being dropped into cars on the railway track below. Everything is removed except the steel I-beams. Heavy wooden blocks are placed under these beams on the center wall and wedges driven so as to take a firm bearing. The beams are then burned off with an acetylene torch, and lowered into the cars. The timber posts are then cut off to the proper elevation and beams 8 x 10 in. are placed upon them to support the forms. The beam forms are hoisted from cars on the railway deck and placed over the posts by the derrick. As these forms are delivered complete and each is handled as a single unit. The derrick then moves on for another length of 18 ft. and the above operations are repeated.

The beam forms, Fig. 4, are of an unusually heavy type, because of the great weight to be carried and their long span of 14½ ft., this span being necessary because the railway track had to be kept open to traffic. After the forms are completed and the reinforcing steel is placed for a length of approximately 175 ft., the wrecking of the old deck is stopped and concreting is begun. The beams and roadway floor slab are poured first, with all construction joints made at the center of the floor spans. The street car track is then laid, and the fill concrete and sidewalk slab are poured as the second operation.

During the construction of the north half of the deck, all traffic passes over the south half, directly opposite the section torn out, a watchman being stationed at each end of the section. Both street cars and other vehicles have to move in single file in one direction at a time. A temporary board walk fenced in on both sides, is provided for pedestrians in the center of the roadway, alongside the section torn out. Two temporary street car crossovers were installed at the east end of the work in order to reduce the length of single track over which the cars have to operate in both directions. Traffic has been maintained satisfactorily, and although at times the congestion becomes rather heavy, there have been no serious delays.

All work is being done by the forces of the Terminal Railroad Association under the direction of B. B. Betts,

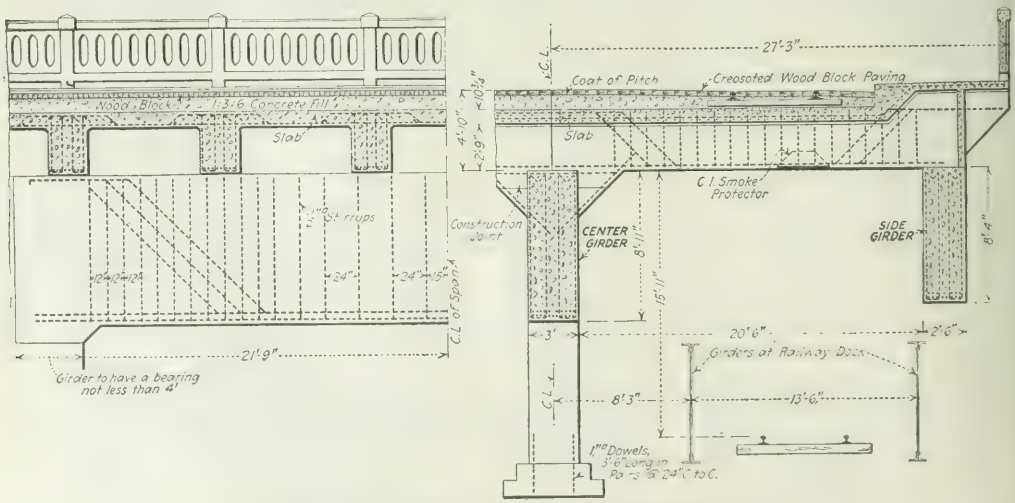


FIG. 5. CONSTRUCTION OF STREET SPANS, EADS BRIDGE

CONSTRUCTION PLANT FOR REBUILDING DECK OF BRIDGE APPROACH

superintendent of construction. The new deck was designed by the writer under the direction of H. J. Pfeifer, chief engineer. A 50-ton street car, placed in any position, with an allowance of 25 per cent for impact, was the assumed live loading for the roadway, while the sidewalks were designed to carry a superimposed load of 100 lb. per square foot. The estimated cost of the work is $160,000. By December, 1920, the north half of the structure had been completed and operations are now suspended until the spring of 1921.

Some Things to Be Learned About Concrete

The Committee on Research of the American Concrete Institute in its report to the recent convention gives the following subjects that need study in the field of concrete:

1. Proper methods of measuring quantities going into a batch of concrete.
2. Collection and correlation of data to show quantity of set concrete which can be made from given amounts of different aggregates.
3. Establishment of a standard screen scale for concrete aggregates and limits of variation in sizes of different classes of aggregates.
4. A standard field method for determining consistency of concrete.
5. A standard field test for strength of concrete.
6. Tests to ascertain the efficiency of various types of mixers in making concrete.
7. The allowable variations in sizings of aggregates.
8. An index of quality of aggregates as determining their value in concrete.
9. An abrasion test for gravel.
10. The production of plant-mixed aggregate.
11. A method of evaluating various forms of mechanical anchorage of reinforcing bars in reinforced-concrete beams and slabs.
12. The value of clay tile built in with concrete beams in adding to the shearing resistance of the beam.
13. Relative values of rectangular and T-shaped or I-shaped reinforced-concrete beams in resistance to shear.
14. A method of evaluating bent-up bars as shear reinforcement for concrete beams.
15. A study of corrosion in reinforcement in contact with salt water or salt air.
16. Bond stresses in two-way reinforcing, as in footings.
17. Adjustment of steel stresses due to plasticity of concrete.
18. Test of chuted concrete.
19. Central mixing plants.

Mechanical Equipment Speeds Snow Removal

Fall of 12½ Inches in New York City Attacked With Caterpillar Tractors, Blade Graders and Motor Trucks

EXTENSIVE use of mechanical equipment, in contrast to the hand-labor methods of previous years, a plentiful supply of emergency labor and advance planning by the Department of Street Cleaning, resulted in the speedy opening up to traffic of New York City's streets, following a severe storm which deposited 12½ in. of snow in 23 hours, beginning on the night of Saturday, Feb. 19. The storm called into service for the first time the "tank" type tractors, blade graders, push plows and motor trucks for which (including a number of garages) $4,000,000 had been authorized last summer. While this year's storm did not approach in severity or in the density of the snow the one which caused a tie-up of traffic for weeks last winter, it was of a character to demonstrate the effectiveness of the city's new methods of snow removal.

PLOWING STREET WITH MOTOR TRUCK

According to the records of the U. S. Weather Bureau at New York, the storm began at 11:25 p.m. Feb. 19, and lasted until 10:05 p.m., Feb. 20. The amount of snow which fell during the 22 hrs. 40 min. was 12½ in., the density being 0.21, or 13 lb. per cubic foot.

There are scheduled for snow removal in the Boroughs of Manhattan, the Bronx, and Brooklyn 951 miles of streets or a surface area of 33,000,000 sq.yd. Snow removal in the other two boroughs of the city, Richmond and Queens, does not come under the jurisdiction of the Department of Street Cleaning. The storm of Feb. 19, therefore, presented to the department the problem of disposing of about 11,500,000 cu.yd. of snow. The work was handled by a force of about 20,000 men, of which 4,000 are the regular employees of the department, 13,000 emergency laborers, and 3,000 hired by the snow-removal contractors. The methods of removal involved carting to river dumps and disposal into the city's sewerage system.

For purposes of administration, the city is divided into districts and the work handled from street cleaning headquarters through district superintendents. For the contract removal of snow agreements are entered into generally during the previous summer. Emergency labor is secured by a campaign of advertising and publicity in the daily press and the moving picture theatres, in addition to a system of registration of available men who are called out, by precincts, through the co-operation of the Police Department. This year, in contrast to last, the supply of labor for snow work was plentiful, due to the general slowing up of industrial activities. In fact, when the first call for men was made the hourly rate of pay was 65 cents, but as the work progressed and the number of applicants for jobs increased the rate was reduced to 50 cents an hour. The regular department employees received $5.60 a day (for drivers) and $5.21 a day (for sweepers). The contract work is let on a unit price basis and varies in different parts of the city, depending on the length of haul, but a rough average price for this year's work is about 52 cents per cubic yard. The emergency workers reported at the department's 103 stations in various sections of the city where men seeking work were assigned to duty and given badges, tickets and tools.

MECHANICAL LOADER FILLING MOTOR TRUCK

CLEARING STREET WITH TRACTOR AND BLADE GRADER

The use of mechanical equipment was the outstanding feature of this winter's snow removal work. Following the authorization of an appropriation of $4,127,000, the Department of Street Cleaning, acting in accordance with recommendations of a committee on snow removal consisting of engineers and department heads in the municipal service, purchased the following machines:

MECHANICAL EQUIPMENT

212 5-ton, 6-cu.yd. White motor trucks (of which 75 have interchangeable bodies for the substitution of flushing equipment).
100, 2-ton, 3-cu.yd. Mack motor trucks.
100 Cleveland tractors, each weighing 2 tons.
500 Holt caterpillar tractors, each weighing 4 tons.
150 Climax blade graders.
300 Champion push plows.
1 Friedman snow loader.

In addition a Barber-Greene mechanical loader, equipped with a special conveyor frame and belt, was used experimentally for transferring piled snow to motor trucks; funds for buying one of these loaders have been authorized. The storm also brought forth the usual claims for snow-melting devices.

The storage of the department's mechanical equipment presented a problem, inasmuch as a number of garages, provided for in the appropriation previously referred to, had not been made ready. The "tank" type tractors were assigned to various Fire Department stations, while a large number of the motor trucks were housed by taking over the East 24th St. Pier, a structure 725 ft. long, building a ramp to the second story, and utilizing it as a garage. Where possible, motor trucks were stored at Street Cleaning Department stations.

Until this year, the department had practically no mechanical equipment and it was, therefore, necessary during the summer time to train the regular drivers as chauffeurs. A school was established for this purpose. Instruction was given also to Fire Department employees, to whom was assigned the duty of operating the caterpillar tractors.

A schedule for tractor and truck operation during snow storms was prepared last summer. On a large-scale map of the city, routes—in most cases about 3 miles long—were laid out for every machine and marked in different colors so that when the storm signal was given, each driver of a tractor or truck had already received his orders and needed no further instructions. As a supplement to the map there were distributed to each driver printed directions specifying in detail the route that he should follow with his machine as soon as the alarm sounded. With the giving of the storm signal, therefore, much of the machinery of snow removal is put into operation automatically.

The plan of attack mapped out involved the use of all available mechanical equipment during the early period of a storm for operating push plows or blade graders, in order to open up paths for traffic by shoving the snow either toward the curbs or into the center of the street, depending on its width and location. The 5-ton trucks were equipped with push plows having 10-ft. blades, while the Cleveland tractors hauled blade graders, also provided with 10-ft. blades. The Holt

tractors were equipped with 10-ft. push plows. The tractors and their pull-plows are always operated in pairs, one following behind the other. The small tractors are equipped, however, to carry an 8-ft. push plow, but the plans provide for the use of this equipment only after traffic lanes have been opened up, the push-plows on the small tractors being designed for shoving snow to manholes, not clearing traffic lanes.

The small tractors operate at a speed of from 1 to 3½ miles per hour and are equipped with a 20-hp. engine. They are rated to pull 1,284 lb. at the 3½-mile speed. The length of tractive contact on each side is 50 in., and the width 8 in. The machines are standard equipment except for the addition of a cab for the protection of the driver, as shown in the accompanying photograph. The 5-ton trucks are used for plowing until the storm is well in hand; then the plows are detached and the trucks are employed for hauling snow from loading points to dumps.

DEPARTMENT'S NEW TRUCKS OFFER LOW LIFT FOR SHOVELERS

Mechanical Loading Tried

The motor trucks, it will be noted from one of the pictures, have a low body designed especially to minimize the lift (about 5 ft.) in hand-loading with shovels. While the bulk of the snow carried by trucks was loaded by hand, mechanical loaders were given an experimental try-out. The Barber-Greene machine, shown in one of the photographs, consisted of an inclined conveyor equipped with a special cleated belt and carried on caterpillar tracks. This machine was backed into the snow piles, a motor truck following along underneath the discharge end of the conveyor. During a period of four hours, this device loaded about fifteen trucks per hour, each truck carrying about 5 cu.yd. One operator is required to run the machine and another to break down the snow at the charging end so that the belt may be properly fed. The motor truck operators during this test were new at the work and did not always spot and back up their machines to best advantage. With more experience in co-ordinating the work of the loader and the receiving truck, it is believed by Street Cleaning Department officials that a much higher rate of loading than that actually recorded can be realized. Sometimes a 5-yd. truck was loaded in less than 2 min. A further increase in effectiveness can be secured by using side-boards on the low bodies of the trucks, thus increasing their yardage and reducing the lost time in backing up and pulling out at the beginning and end of each loading.

For recording the yardage of snow removed by the contractors each vehicle is measured and its capacity computed. It is placarded with a number and the driver is issued a card in triplicate, which is punched both at the loading point and the dump. Punches with different shaped dies are employed and are changed about by inspectors at frequent intervals to prevent possible collusion between drivers and foremen. At the end of each day's work these cards are turned in to Street Cleaning Department headquarters where the clerical force examines and checks them and makes the necessary extensions to compute the yardage and amounts due the contractors.

During the recent storm, both a night and day shift were worked and although it was close to midnight when the orders for snow removal work were issued, practically all of the mechanical equipment was manned and in operation within a few hours. No serious interruptions to the movement of the traffic on New York City's streets resulted, in spite of the fact that more than one foot of snow fell in less than a 24-hour period.

The work was done under the direction of J. P. Leo, Commissioner, Department of Street Cleaning, with a snow removal staff headed by A. A. Taylor, general superintendent, J. J. Condon, superintendent and H. Hart, assistant superintendent, snow removal division, and E. C. Goodwin, examining engineer.

Rods vs. Expanded Metal for Slabs

Tests on two slabs, 10 ft. square and 5 in. thick, made by F. A. Simmons, Assistant Professor of Civil Engineering of Carnegie Institute of Technology, give some data on the relative behavior of rod and expanded metal reinforcement for a slab supported on four sides. One slab was reinforced with ½-in. round rods, 6 in. c. to c. in each direction, which gives an area of 0.392 sq.in. per foot of width in each direction and a gross weight per square foot of 2.672 lb. The other was reinforced with expanded metal laid in one direction and weighing 1.40 lb. per square foot or 0.384 sq.in. per foot of width.

In the rod-reinforced slab the first cracks were observed when the load per square foot on the slab was 661 lb. At this point a deflection at the center was observed of 0.19 in. In the expanded-metal slab, the first cracks were observed at 713 lb., when the center deflection was 1.05 in. and as the previous readings indicated rapidly increasing deflections it was decided not to continue the loading to complete failure. In the other slab the total load obtained was 1,153 lb. per square foot. The last deflection taken on the next to the last load gave 1.09 in.

The concrete tested from 2,600 to 3,060 lb. per square inch in compression, in cylinders poured from the same batches as the slabs.

Plant and Equipment for Lining The Selkirk Tunnel

Pneumatic Concrete Placers Mounted on Cars Being Used to Line Five-Mile Canadian Pacific Ry. Tunnel Through Selkirk Mountains

By the Staff of Sydney E. Junkins Co., Ltd.
Vancouver, B. C., and Winnepeg, Man.

Work is now under way in the lining with concrete of the five-mile double-track tunnel of the Canadian Pacific Ry. under the Selkirk Mountains near Rogers Pass. This pass gave the name to the tunnel in its construction period but it is now known as the Connaught Tunnel. The operations will involve some 20,000 lin.ft. under main line traffic conditions, so the construction plant and equipment have presented somewhat exceptional problems. To them may be added an altitude at the tunnel of 4,000 ft. above sea level, an average snowfall during the winter of 40 ft. and a distance of 220 and 420 miles to the nearest cities where materials, equipment and labor can be obtained.

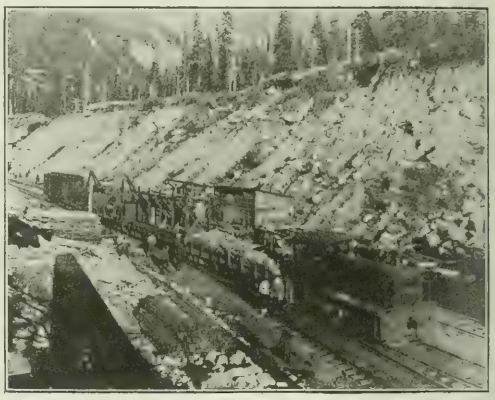
The principal requirements for the plant are as follows: (1) Storage and handling of material outside the tunnel. (2) Transportation of men and material into and out of the tunnel. (3) Lighting. (4) Mixing and placing concrete.

MATERIAL STORAGE, OFFICE, POWER HOUSE AND CAMP AT WEST PORTAL, CONNAUGHT TUNNEL

The plant itself had to be laid out with special consideration to safety, non-interference with railway operation, non-interference with signal and other circuits, fire hazard, reasonable and economic speed in performance and special weather conditions in the mountains. Practically every variety of layout was considered to take care of the above conditions.

It was decided to construct a central electric generating station which should supply power sufficient for brilliant lighting of the working zones within the tunnel and for the operation of a plant mounted on cars, consisting of air compressor with its operating motor and auxiliary apparatus, storage space for the materials for the aggregate, and motor operated mechanical premixing and air-placing concrete apparatus. A transmission line to the working zones, transformers, low tension lines to the lights and motors, and a gasoline locomotive for hauling this plant and the supply cars were the necessary adjuncts of the plan.

The heart of this scheme is the electric power plant which is located near the west portal of the tunnel at Glacier station. On account of the topography it was not feasible to place the power plant at main line level, and it was therefore located on an embankment south of the railroad. A high line with a switchback permits the delivery of coal in carload lots, while water is made available both from a gravity camp supply and from the Illecillewaet River, which flows by the power house.



WORK TRAIN WITH 27-TON GASOLINE LOCOMOTIVE, ROCK SCALING AND DERRICK CARS

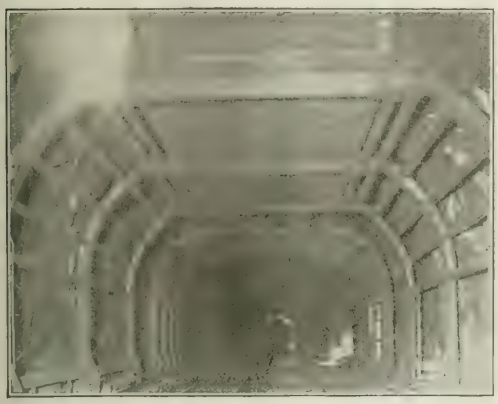
The power house is a frame structure on concrete foundations, and is divided into the usual engine and boiler rooms. An overhead coal trestle permits the delivery of coal direct to the firing floor, while storage space for 1,000 tons for winter operation is also provided, the last to reduce the cost of keeping the high line open during the heavy winter snows.

In the interests of economy three old locomotive boilers were fitted up and installed with forced draft blowers, separate stacks and breeching. Steam is turned from each boiler into a common header and thence led to two direct connected, simple, horizontal, non-condensing engine generating units each of 150 kw. nominal capacity. These units are connected through a simple three-panel switchboard and can be run separately or in parallel. Separate circuits are provided for light and power.

During the driving of the tunnel pioneer tunnels about 7 x 8 ft. in cross section were driven from each end parallel to and about 50 ft. from the main tunnel for a considerable part of its length, the west pioneer tunnel being some 9,000 ft. long. Crosscuts from the pioneer to the main tunnel were driven at about 1,500 ft. intervals and the pioneer tunnels were used for the passage of men and materials and the removal of spoil from the main headings. These pioneer tunnels were a considerable factor in the extraordinarily rapid progress during tunnel construction.

The pioneer tunnel, so far as it reached, provided an ideal space for the stringing of the high tension transmission line, eliminating all possible interference with traffic in the main tunnel for nearly two miles and by the use of bare wire making material savings over the cost of lead covered cables.

Two three-phase circuits are led from the power house at 2,200 volts a.c. on a wooden pole line above ground for a distance of some 2,200 ft. to the entrance of this west pioneer tunnel; thence through the pioneer tunnel about 9,000 ft. to the last or sixth crosscut between the pioneer and main tunnel. From the sixth crosscut the transmission line is carried in lead covered cables in the main tunnel about 3,600 ft. to the trans-



PIONEER FORM IN FOREGROUND AND CONCRETING FORMS BEHIND

former bays, whence the lower voltage current at 110 volts for light and 550 volts for power is distributed approximately 2,000 ft. in each direction throughout the present working zones. The low tension distribution system is provided with outlets about every 100 ft., to which the power and the light apparatus can be readily attached as needed.

Immediately after the passage of trains, particularly when operating against the 1 per cent grade in the tunnel, smoke conditions make work extremely difficult. Most careful consideration was given to a variety of schemes for illuminating the working sections under smoke conditions and at the same time for not over illuminating the work after the smoke had cleared. Numerous laboratory experiments were made. Flood lights of 500 watt capacity each were finally decided upon. These lights are portable and adjustable as to diffusion of beam, and have been found to work out in practice exceedingly well, permitting illumination to be varied immediately to meet any particular set of conditions obtaining in the tunnel at any time. They also have largely cut the time lost due to smoke and show a large saving in labor costs.

Two 75-ton pit flat cars were coupled together to carry the concrete mixing and placing apparatus. On one car is located a 1,290 ft. motor driven compressor, while on the other car are located a mechanical concrete mixer of 22 cu.yd. per hour capacity and a pneumatic placing apparatus of the same capacity manufactured by the Ransome Concrete Machinery Co. Storage bins for sand and gravel are provided on each car with a belt conveyor to carry material from one car to the other. Cement storage is located convenient to the mixer, and water tanks are provided. All storage is calculated on a basis of blowing a complete form without coming out of the tunnel to recharge. Sand and gravel are delivered to the mixer skip by gravity and the mixed concrete drops by gravity into the air placer. Necessary pipe and flexible hose connections to the forms are also installed.

In operation the cars are spotted near the form to be blown, are jacked up in order to take the weight from the springs and electrical power connection is made to the nearest outlet on the power distribution line. No difficulty has been experienced with vibration or rocking, although the compressor motor has a capacity of 200 hp. at 514 r.p.m.

A 27-ton gasoline locomotive is used. Its duties are varied and include the handling of the mixer cars in and out of the tunnel, the handling of rock scaling and derrick cars, material cars, switching of cars in the yard and to the high line, switching of material cars to the storage sheds, running of lunch cars into the tunnel in order to save working time otherwise consumed by the men going out for lunch, and in general the many miscellaneous switching uses continually arising on work of this kind. The machine is rated to handle 210 tons on a 1 per cent grade and is operated by one man.

An electric locomotive would have imposed excessive costs and a steam locomotive would have aggravated

ROCK SCALING CAR AND WORKMEN SCALING TUNNEL WALLS WITH ELECTRIC DRILLS

smoke conditions in the tunnel. The effect of the exhaust gases from the gasoline locomotive was carefully considered but found to be negligible.

On account of the usual overbreak in building the tunnel a considerable amount of false formwork has been found necessary. Space back of the false forms is now packed with cordwood lagging. A search is being made for other material which may be found cheaper to put in place. A large amount of overhead work is involved in fastening the false forms to the roof, in packing the lagging, in placing reinforcing and in scaling rock. Six rugged movable platforms on wheels have been built of light steel frame and timber for this overhead work. They clear traffic and hold considerable amounts of construction material as well as the workmen. Each of these platforms handles the advance work for one main form.

The main forms are six Blaw-Knox collapsible steel forms, each providing 20 ft. of finished tunnel lining at one placement. These also clear all traffic. Each form is on wheels, and after the concrete is blown and set the top plates are collapsed and the form rolled forward to its new position.

Because of excessive snowfall all material has to be carefully housed. A 5,000-cu.yd. gravel bunker is installed, the gravel being dumped by gravity from cars on the high line. Gravel is handled into the mixer car by bucket conveyor. Steam apparatus is provided to prevent the gravel from freezing. Sheds for cement, reinforcing steel, lagging and lumber storage are located conveniently for delivery direct from cars.

A small motor-driven machine shop and a blacksmith shop are placed in buildings adjoining the power house for the repair and maintenance of the equipment.

The proper and comfortable accommodation for 200 men in the heart of the mountains has been an important and difficult question. A complete camp complying with Government regulations has been gradually built up, consisting of sleeping quarters, subdivided into units of four men each, bathhouse and laundry, separate small houses for married men, community dining room, kitchen, store houses and roothouse, a total of about 60 buildings. All quarters are electrically lighted and provided with water. Heat is furnished by stoves. A drainage system and a septic tank have been installed.

The work has been done under the direction of the Canadian Pacific Railway Engineering Department, Western Lines, W. A. James assistant chief engineer, Frank Lee, engineer maintenance-of-way, and H. Rindal, district engineer. Mr. James represented the railway company on the ground as engineer of construction in charge of the driving of the tunnel.

The Sydney E. Junkins Co., Ltd., of Winnipeg and Vancouver, is doing the construction work.

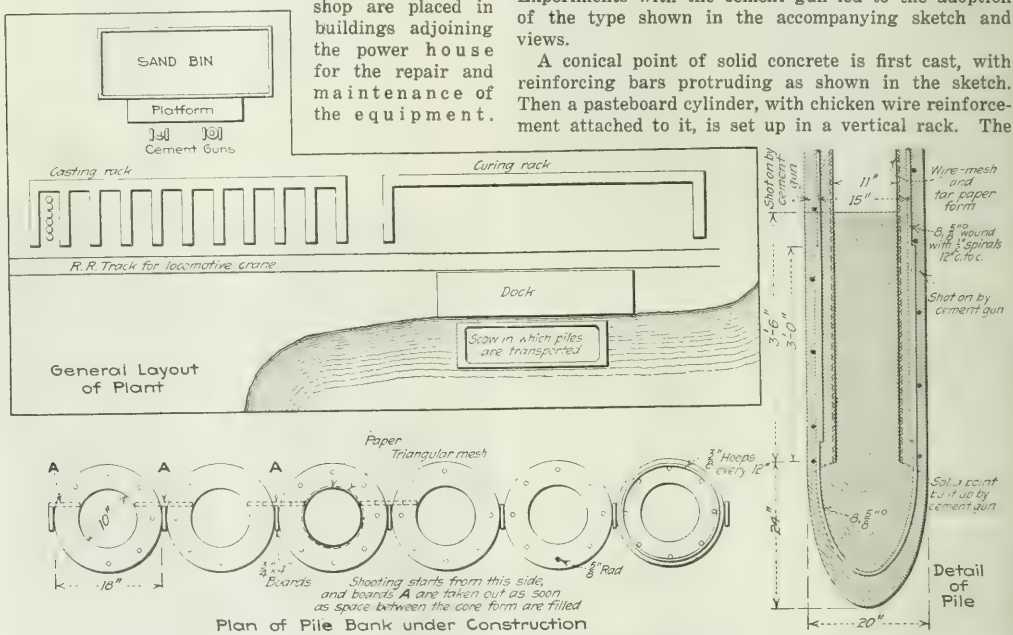
Long Concrete Piles Built Up With Cement Gun

Bullet Nose Point First Formed and Hollow Shaft Joined to It by Shooting Concrete on Paper Form

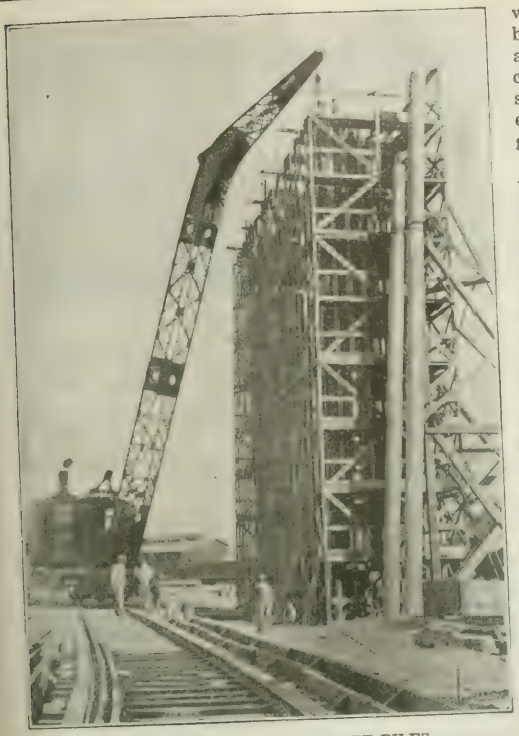
FOR sea-water work in Los Angeles Harbor the city of Los Angeles is now building about 1,200 reinforced-concrete piles from 42 to 60 ft. long of hollow cylindrical section and 18 to 20 in. outside diameter by building up the shell with concrete shot on by a cement gun. Deterioration is so rapid in the southern Pacific waters that some more compact concrete than can generally be made by ordinary process was desired. Experiments with the cement gun led to the adoption of the type shown in the accompanying sketch and views.

A conical point of solid concrete is first cast, with reinforcing bars protruding as shown in the sketch. Then a pasteboard cylinder, with chicken wire reinforcement attached to it, is set up in a vertical rack. The 4 or 4½-in. granite annular ring is then applied to the outer surface of the pasteboard, the rack being of such a nature that the workmen can use the nozzle all around the pile. The piles are then left in the rack to cure for about two weeks, after which they are taken from their vertical position and stored inclined vertically. By constructing, curing and storing the piles in a vertical position, it was reasoned (1) that bending stresses and the attendant cracks would be avoided and the resultant light, hollow pile would have adequate strength, while (2) the dense concrete which it was claimed would be secured with the cement gun would give a surface more impervious to sea-water than would piles cast in the usual manner. Under conditions of maximum loading the piles are expected to carry a load of about 20 tons each.

The piles are built up in a so-called shooting-frame, a wooden scaffold-like structure made up of a series of eight floors about 6 ft. apart and divided in plan into ten bays. Each bay has a clear opening for its full



DETAILS OF PILE AND CONSTRUCTION PLANT FOR CEMENT-GUN PILES AT LOS ANGELES



CASTING RACK FOR CONCRETE PILES

height on the front of the structure along which a railroad track runs. The bracing and anchorages are provided at the back. The bays are made large enough to accommodate six piles each, this number being made up at a time.

The noses which are made first are about 5 ft. 6 in. total height, the upper 3 ft. 6 in. being a cylindrical stem 10 or 11 in. in diameter, depending upon the length of the completed pile, and the lower 2 ft. in height being a bullet-shape or tapering nose with its upper diameter from 18 to 20 in. There are eight $\frac{5}{8}$-in. round rods in the base which project about 3 ft. above the collar in order to provide for a lap of full length steel. When the bases have set sufficiently they are placed six in a row in the blowing rack, and the tar paper collars 10 or 11 in. in diameter placed around the stem of the base then wrapped with triangular mesh, then the full length vertical rods placed on a 15-in. diameter circle around the pile. When wrapped the piles are ready for blowing.

The paper cylinders or cores are made on a collapsing mandrel on which there is first wrapped a strip of building paper of a quality which weighs 35 lb. to the 500-sq.ft. roll. This strip of paper is placed lengthwise on the mandrel and a light wire is wound around it on a 4-in. pitch. Over this is then wound a strip of building paper 6 in. wide with a 3-in. pitch which gives a spiral winding with several thicknesses of paper at all points and makes the paper cylinder stiff enough so that it readily holds its strength when the mandrel is collapsed and removed. While this strip of paper is being wound, a trough of fish glue which is kept hot beneath the lathe is kept in contact with the winding surface in such a way that the paper strip is rigidly glued in place. After being taken from the mandrel, the paper cylinders which are about 12 ft. long are allowed to dry and are then covered with wire mesh. The mandrel is made with a slight flare at one end and contraction at the opposite end so that the successive paper sections will fit together in bell and spigot fashion.

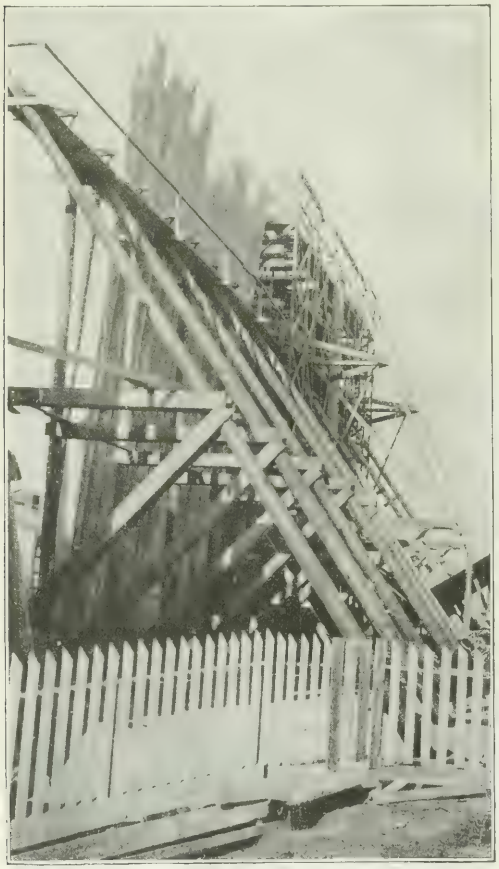
Piles under 50 ft. have an outside diameter of 18 in. with 4-in. walls leaving a 10-in. hollow core; those above 50 ft. are 20 in. outside diameter with $4\frac{1}{2}$-in. walls and 11-in. core. In all piles the vertical reinforcement consists of eight $\frac{5}{8}$-in. vertical rods encircled by a heavy wire-mesh cylinder. This latter supplants the earlier design of $\frac{3}{8}$-in. spiral hooping on 12-in. rise, which proved inadequate in construction.

The operation of building up the piles is begun by setting six noses in a bay and placing a section of the paper core on the shaft of each nose. The noses are

FIRST PILE NOSES IN PLACE

set in a row and spaced so there is 8 in. between the paper cores of adjoining piles, thus allowing room to enclose each core with a 4-in. wall. A board partition is set up in the space between adjoining cores to provide a backing against which to throw concrete. This partition is put on in sections of about the same height as the paper cores and is removed just before the final work on each section. At the middle of each partition and at right angles thereto, a single thin strip of wood is placed to prevent the piles from bonding.

The man operating the cement gun nozzle begins at the bottom and works upward from floor to floor. One section is finished at a time by going entirely around the cluster of six piles before moving to the section above. After the piles have been allowed to stand for 11 to 15 days, they are picked up, one at a time, by the locomotive crane and placed in the adjoining curing rack, still in a vertical position. Here they are left for another 30 days. A scow with a rack built upon it, similar to the curing rack, is used for conveying the piles from the yard to the point where they are driven,



CURING RACK WITH PILES IN PLACE

about 2,000 ft. away. Thus the pile is always kept in a vertical position, or nearly so, and is not subject to the cross bending strains incidental to the ordinary method of handling piles that have to be raised from the horizontal position in which they are cast.

The capacity of the plant is at present six piles per day, these six piles consisting of two 60 ft., one 56 ft., one 53 ft., one 49 ft. and one 42 ft. The operating time is 5½ days per week, therefore, the weekly capacity should be 33 piles; however, on account of delays such as bad weather and other causes their average production is 25 piles per week. There are two cement guns each with a nozzleman and two men in his crew, with three men on the plant. There are 1,626.5 sq.ft. of

SOLID NOSES FOR THE PILES

surface and approximately 350 cu.ft. in the piling in one set-up and one nozzleman will shoot the six piles in 16 hr., or two working days.

The guns work under 35 lb. air pressure with nozzles specially designed to permit the passage of ½-in. rock maximum, the big percentage of the material, however, being ⅜-in. and under. The mixture is 1:1½:2½, the 2½ being composed of this last mentioned coarse pea-gravel.

The material in which the piles are being driven consists chiefly of silt and detritus, and there is a penetration of from 18 to 30 ft. By means of two 2-in. water jets, the piles are jetted down about two-thirds of the required distance, a hammer being used for driving them the remaining distance. The driving so far has been quite satisfactory and the piles are standing up under the battering and the load. Should it be desired ever to fill them and make them solid it should be an easy matter to do.

The design of these piles and the method of construction were both worked out by J. W. Ludlow, assistant harbor engineer under John A. Griffin, city engineer of Los Angeles. Mr. Ludlow was assisted by V. R. Sterling and F. W. Wadleigh.

Photographing Road Plans

By Neil F. Hathway
Highway Engineer, Montcoal, W. Va.

CARRYING a large roll of road plans while staking out or inspecting road construction is quite often a great inconvenience. The blue prints soon become soiled and torn and one set will hardly last through a season. To get the plans into pocket form the engineer often extracts from the roll the sheets that he expects to need that day and folds them into a convenient size. In the course of a few weeks the plans are creased, dirty and so disarranged that considerable time is often lost in finding the sheet desired.

To do away with the inconvenience of a large roll of blue prints for field use I photographed the tracings with a 3A kodak. For this purpose a sheet was tacked against the outside of the office building to give a white background and the tracing fastened to this. Although, due to inexperience, I failed to take full advantage of the size of the film, the photographic prints were so clear that practically all details were plain to the naked eye. With the aid of a small reading glass the print is as easily read as the full-sized blue print (22 in. x 36 in.).

These prints can be placed in the field note book. The cost was much less than the cost of blue prints.

The Bagdad Railway—An International Problem

Uncompleted 2,000-Mile Line Across Asia Minor To Form an "Overland Route" to India—Heavy Tunnelling—Fortified Stations

A PROMINENT side issue of the World War was the German attempt to open a route between Central Europe and Asia, with the unfinished Bagdad Railway as a link across Asia Minor. This project was thoroughly defeated. With the international changes and complications following the war this railway line has become of special importance and it is evident that it will eventually play a part in the development of the Far East by European enterprise. Little information has been available concerning the progress of the line. Articles describing the work have appeared in *The Engineer*, London, by Major Derwent G. Heslop, Royal Engineers, who during the war was the British officer in control of the Bagdad, the Hedjaz and the Damascus railways. The railway and its connections are shown on the accompanying map. The following is an abstract of Major Heslop's account:

TUNNEL SECTIONS ON THE BAGDAD RAILWAY

BUILDING STONE VIADUCT OVER THE GIAOUR DERE

British projects for a railway between the Mediterranean Sea and the Persian Gulf, giving a short "overland route" to India, date back to 1831 and include several alternate locations through the Tigris and Euphrates valleys. In 1888, the Sultan granted to a German company a concession for a line from Angora to Mosul and Bagdad, but owing to objections from the Russian government the route was changed to run from Konia to Mosul, although this new location, based upon political considerations, involved heavy work in crossing the Taurus and Amanus mountains which border upon the Mediterranean. In 1895 a further concession was granted for an extension south to Basra and thence to a port on the Gulf, but on protest of the British government this was modified to exclude Germany from the harbor at Koweit and from the oil fields in the Delta of the Euphrates. At present the southern part of the line is held by the British and the northern part is under control of the French; Turkey has the connection to Constantinople and Greece, in part at least, has control of the Smyrna connection. It will be seen by the map that there is a gap of about 200 miles between the two sections and that the extension to the Gulf remains to be built, the Bagdad terminal being served by steamers and barges on the Tigris.

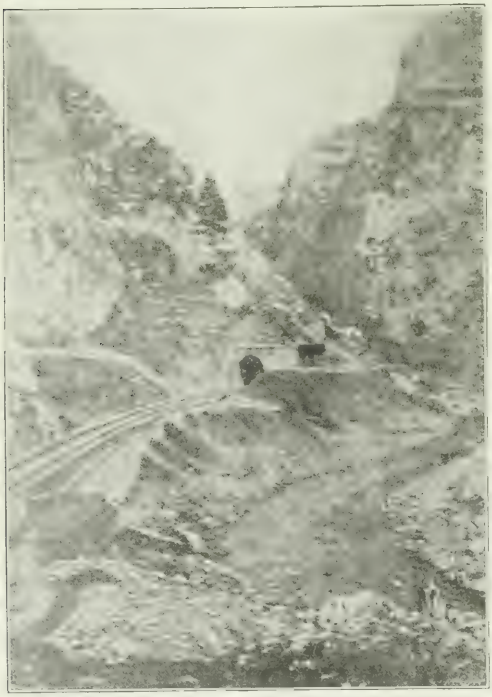
Only the narrow strait of the Bosphorus separates the European railway system terminating at Constantinople from the Asiatic line starting near Scutari and extending to Konia, reached also by a line from Smyrna. From Konia to Boulgourlu, 124 miles, the Bagdad railway traverses a plateau at an average elevation of 3,280 ft., but in the next 80 miles to Dorlak it crosses the Taurus range, reaching a summit elevation of 4,840 ft. near Ouloukichla. It then crosses a coastal plain at 72 ft. elevation for 87 miles to Mamoure, where it begins the 34-mile crossing of the Amanus range, reaching an elevation of 2,430 ft. in the Airan tunnel and descending to Islahie, whence it extends 92 miles through rolling country to Muslimie. For 265 miles the line then runs through easy country, crossing the Euphrates, and extending to Nissibin, the present end of the northern section.

From Bagdad the line was built 116 miles north to Tekrit, but before the war no work had been done on the next 143-mile stretch to Mosul. In 1918, the British-Indian army in its campaign against the Turks extended the line some 50 miles north to Baiji, using rails made in India and operating the Bagdad-Baiji section with rolling stock from the Indian railways. During 1919-1920 a further extension was made to within 40 miles of Mosul, but it is reported that this part of the line has been cut by the insurgents. Between Mosul and Nissibin, 125 miles, some grading has been done, but there is a gap of over 200 miles to be filled to complete the rail connection between the two seas. Four branch lines aggregate 88 miles: Yenidji to Mersina, 27 miles; Toprak Kale to Alexandretta, 37 miles; Muslimie to Aleppo, connecting with Syrian lines, 9 miles, and Derbissie to Mardine, 15 miles.

Long maximum grades of 2.5 per cent occur in the

mountains, the grade being reduced to 2.3 per cent on curves of 1,300 (the minimum) to 2,600 ft. radius. Transitions or easements are used on all curves up to 4,900 ft. radius. The gage is 4 ft. 8½ in., as on the connecting lines. Flange rails of 75½ lb. per yard, in lengths of 39 ft. 3 in., are carried on 115-lb. steel ties of trough section, there being 16 ties to a rail, or 18 on the heavy grades. Six-bolt, 33-in. splice bars have short bottom webs between the joint ties, which are spaced 21½ in. c. to c. Tapered tie-plates have hooked lugs to hold the outer flange of the rail, the inner side being secured by clips and nuts on T-head bolts.

Much damage has been done to rails and ties by operating construction trains over unballasted track on soft roadbed. Many cuts were not excavated to full section and there is trouble from material sliding and



THE CHAKIT RIVER GORGE

falling. Maintenance work at many points has been neglected greatly, but on the whole the line is in fair condition.

Manual interlocking signals are provided at stations, with steel semaphores on lattice steel posts, the home signals being 328 to 656 ft. from the station and the distant signals 1,640 to 2,300 ft. beyond. Where no stations have been built there are passing sidings at intervals of about 12½ miles.

Stations and other buildings are of stone masonry, those east of the Euphrates being fortified against the attacks of wandering bands of Bedouins. Water, obtained mainly from wells, is pumped by hand or power to steel tanks on steel towers. To facilitate spotting the engines at water columns, the tender has a slot the full length of one side of the top, instead of hav-

THE BAGDAD RAILWAY AND ITS CONNECTIONS

ing a manhole. Between Konia and Nissibin there are repair shops at eight points and engine houses at fourteen points. The latter are of the American segmental type, but with only a single approach track over the turntable.

A telegraph line extends the entire distance, iron poles being used west of the Euphrates as timber is scarce and poles would be stolen. The Arabs cut the wire guys, steal the insulator cups and like to show their marksmanship by shooting the white porcelain line insulators. Cables have been laid through the tunnels by the British engineers to eliminate the difficulties of maintaining the wire line across the mountains on account of wind and snowstorms.

Twelve tunnels 120 to 12,444 ft. long, aggregating 7.3 miles, occur in a distance of 8.4 miles on the Taurus section, the longest opening between tunnels being 570 ft. Originally a single tunnel 6.8 miles long was proposed, with only one curve. To expedite construction, however, a location was adopted following the wild gorge of the Chakit River, thus giving a number of tunnels and consequently a greater number of headings. Concrete arch bridges over the lateral ravines were built in advance of the tunnels, materials being handled over a 13-ft. highway built across the mountains for twelve miles, having zig-zags on the sides of the gorges and numerous small tunnels and temporary bridges. From this road materials were lowered to the railway works on rack-rail inclines.

Bottom headings 6 x 5¾ ft. were driven at an average rate of 328 ft. per month in the limestone rock. These were enlarged later for a portable railway, which served to handle traffic temporarily between the standard gage sections, supplementing the motor truck traffic on the temporary highway. The description indicates the use of light air drills held by the men, and some American rock drills were abandoned on account of the time consumed in taking them down and replacing them at each blast. Holes 39 to 60 in. deep were fired by hand in rounds of 20 to 25 holes. Compressed air was used to blow out the gases, but the men could not resume work for about twenty minutes after the blast. Power for all the tunnels was supplied from one plant, a second plant being built as a reserve. The miners were mainly Croats, Italians, Austrians and Greeks, with Russian prisoners for unskilled labor.

These tunnels were completed for standard-gage operation in October, 1918, a month before the armistice. They are of horseshoe section, generally with

12 to 14-in. concrete lining for the arch alone, or for the arch and sides, and having a drain at one side. In loose rock a heavier lining and concave invert were used, with a central drain of masonry on the invert. Notwithstanding the great difficulties of the survey work and the fact that nearly all the tunnels were on curves the lines and levels are reported to have been carried very accurately.

In the Amanus range there are fourteen tunnels 220 to 16,086 ft. long, aggregating 30,196 ft., in a distance of twenty miles. Six years were required in building the Bagtche tunnel, 3.1 miles, as it was driven only from the ends, the great depth of 2,000 ft. below the surface making intermediate shafts impracticable. At one point a stratum of porphyry was encountered and reduced progress to 4 in. per day, but fortunately it proved to be only about 6½ ft. thick. Outside of the two mountain ranges there are twenty-seven tunnels but these aggregate only 9,384 ft.

Of the steel bridges, the largest is that over the Euphrates at Jerablus, having ten through truss spans of 262 ft. It was completed during the war, taking the place of a timber structure, but it is said to have been partly destroyed in 1920 by the Turkish insurgents under Kemal Pasha. The Seihun bridge near Adana has four through spans of 177 ft. and one of 295 ft. The Djihan bridge has four through spans of 164 ft. These two bridges were completed in 1912 and all three have stone piers on pile foundations surrounded by cofferdams. A steel viaduct of the American type crosses the Here Dere gorge, with three deck spans of 243 ft. on two steel towers 50 ft. wide and one masonry pier. At one end is a girder span of 44 ft. and at the other end a truss span of 132 ft. The rails are about 280 ft. above the stream.

A notable stone arch structure is the Giaour Dere viaduct, 705 ft. long and 227 ft. high. The central portion has three 98-ft. arches, with spandrel arches over the piers, and is flanked on each side by four arch spans of 20 to 40 ft. The timber centering was supported on steel I-beams built into the masonry. Material was handled by a cableway. Concrete arch bridges with main spans of 98 ft., carrying spandrel arches, were used in crossing the gorges between tunnels on the Taurus section.

Connections and Operation

The Bagdad Railway from Konia to Bagdad will be about 1,065 miles long. Adding the 500 miles to Scutari and 500 miles to Koweit, the total length will be about 2,100 miles, or 2,000 miles from Smyrna. About 700 miles have yet to be built. Its equipment comprises approximately 90 locomotives, 90 passenger cars, and 1,520 four-wheel box, gondola and flat cars, mainly of 15 tons capacity. Since the armistice, the railway company, now under French control, has been operating some sections of the line, and where the country is under cultivation there is likely to be considerable local traffic. Apart from its political and military purposes, however, Major Heslop considers that the prospects of the railway are very discouraging, owing to the heavy grades, the long stretches of unproductive country, the poor harbor conditions at some of the Mediterranean ports, and the time required to close the 200-mile gap and build the southern extension.

The Aleppo branch of the Bagdad Railway connects with a French line to Damascus, 260 miles, having branches to the ports of Tripoli and Beyrout. From Damascus there is the meter-gage Hedjaz Railway to Medina (800 miles) and Mecca (1,000 miles) built by the Turkish government for military purposes and to carry the immense Mohammedan pilgrim traffic to Mecca. From this line there is a 104-mile branch to the port of Haifa. During the war, the British forces advancing from Egypt built a standard-gage line from the Egyptian Railways at Kantara, on the Suez canal, north to Haifa, 255 miles. This has connections with Acre, Jerusalem and Jaffa. Thus a standard-gage route from Constantinople to Egypt requires only a 108-mile link through rather rough country between Damascus (or Rayak) and Haifa.

Management—The main offices and the headquarters of the operating and maintenance departments of the Bagdad Railway are at Aleppo, but the construction department has its offices at Constantinople. Since the armistice the head or director has been Mr. Schwender, a Swiss lawyer; the chief engineer of construction, Mr. Mavrogodato, is a Greek, and the chief engineer of maintenance, Mr. Wolf, is a Swiss. The assistant engineers are of various nationalities, but were mainly Germans and Swiss under the original management. From Konia to Nissibin the line is under four district engineers, who have American track velocipedes for inspection trips. They go over their districts twice a month and report twice a year on every bridge and tunnel. Employees under the heads of departments include Europeans of nearly every nation, but the laborers and workmen are largely Arabs, Turks, Armenians and Kurds.

After the armistice in November, 1918, the British government took possession of the Bagdad Railway and carried on some construction work. In October, 1919, the French were given occupation of the country, and the line was turned over to them, but at the time Major Heslop wrote it was not known whether the French Government would provide funds to carry on the work.

Qualities of Sand-Lime Brick

Sand-lime brick, according to Circular 109 of the U. S. Bureau of Standards, is a building brick made of sand and lime. It was first produced in the United States in 1901. By the action of steam under pressure the lime is caused to combine with some of the sand, forming a hydrated calcium silicate. This material acts as a bonding agent to hold the rest of the sand together. Most sand-lime bricks will compare favorably with "first common" clay bricks. They are characterized by their straight edges, parallel faces, and nearly white color. Their continued use in northern climates has established their durability under weather conditions, but sand-lime brick is not a refractory material. The industry maintains a national association with which the Bureau co-operates in conducting research work on the subject. Bureau of Standards Technologic Paper 85 contains detailed descriptions of the method of manufacture and of several factories. A good sand-lime brick for general purposes should have an absorption of not over 20 per cent, an average compressive strength of not less than 2,000 lb. per square inch, and an average modulus of rupture of not less than 450 lb. per square inch.

Enlarged Waterloo Station, London and Southwestern Ry.

Largest Passenger Station in England—Steam Main Line and Electric Suburban Trains—Steel and Glass Trainshed Roof—Station Facilities

WITH THE ENLARGEMENT and reconstruction of the Waterloo Station of the London & Southwestern Ry. at London it becomes the largest passenger terminal station in England. With the improvements now approaching completion it will have twenty-one platform tracks for a daily traffic of about 1,200 main-line and suburban trains. Electric operation by the third-rail system is used for the suburban service, which represents about 80 per cent of the total traffic of the station. A curved layout and an eight-track approach are notable points in the station plan, while the trainshed roof is of a type little known in this country.

FIG. 1. PLATFORMS AND END OF TRAINSHED

The Waterloo Station, with only three platforms, was built originally in 1848, but extensions were commenced in 1860 and were followed by successive enlargements and alterations to meet the requirements of increasing traffic. By 1900 these piecemeal changes had resulted in such an awkward arrangement that a project was started for the comprehensive improvement and reconstruction of the entire station as a unit. Preparation of the plans and of a construction program which would avoid undue interference with traffic consumed some time. Progress was slow under the difficult conditions and then the work was interrupted by the World War. But it is now expected to have the improvements completed by the end of 1921. A general plan of the station is shown in Fig. 3.

With the purchase of nearly ten acres of land for enlargements the railway company was under the legal responsibility of providing accommodation for residents and institutions displaced. A housing project for 2,000 persons has been carried out, and new churches and schools have had to be built at other locations.

Topographic conditions locate the main entrance at the northwest corner, on York Road, but an additional approach has now been made from Westminster Bridge Road, at the south end. The station floor is above the street level and is carried on brick arches. But since these did not provide sufficient headroom for the new driveway it was necessary to replace some of the arches by a girder framing supported on columns and piers. In some cases the new foundations had to be carried down nearly 30 ft. through peat and gravel to the firm London clay. The ground slopes down from the west side, so that at the northeast corner a bridge extends from the enclosed entrance yard to a neighboring station on the Southeastern & Chatham Ry., as shown. Formerly there was a curved junction track connecting the two railways. It was rarely used but served for transferring special cars. The new improvements have necessitated the removal of this track. A third street approach is provided at the northeast corner by an inclined roadway having a grade of 4 per cent.

Track Plan and Approach—In general the track layout is fan shaped, with most of the tracks on curves ranging from 660 ft. radius for tracks Nos. 12 and 13 to 3,300 ft. for No. 2. The tracks are in pairs, between high platforms, those of each pair being spaced 11 ft. 8½ in. c. to c. They are arranged practically in three groups, two of the groups being separated by a line of offices and the others separated by a broad platform with the distinctively English feature of a carriageway parallel and level with the platform. At the end of this platform are two short tracks for loading and unloading automobiles and carriages. On the west side of the station is a group of tracks for cars and trains held in reserve, together with a small coaling station and a turntable. No special tracks are provided for mail cars.

Third-rail electric suburban trains are handled mainly on tracks Nos. 1 to 4 and 16 to 21. Electric equipment is applied also to Nos. 6 and 7, which tracks can be used either for suburban or main-line traffic. Track construction is of the British type, with bull-headed rails of 90 to 100 lb. per yard carried in cast-iron chairs on wood ties in stone ballast. As the station is at the end of a descending grade, each track is fitted with a pair of hydraulic buffers designed to stop with-

FIG. 2. CARRIAGE EXIT FROM TRAINSHED OF WATERLOO STATION

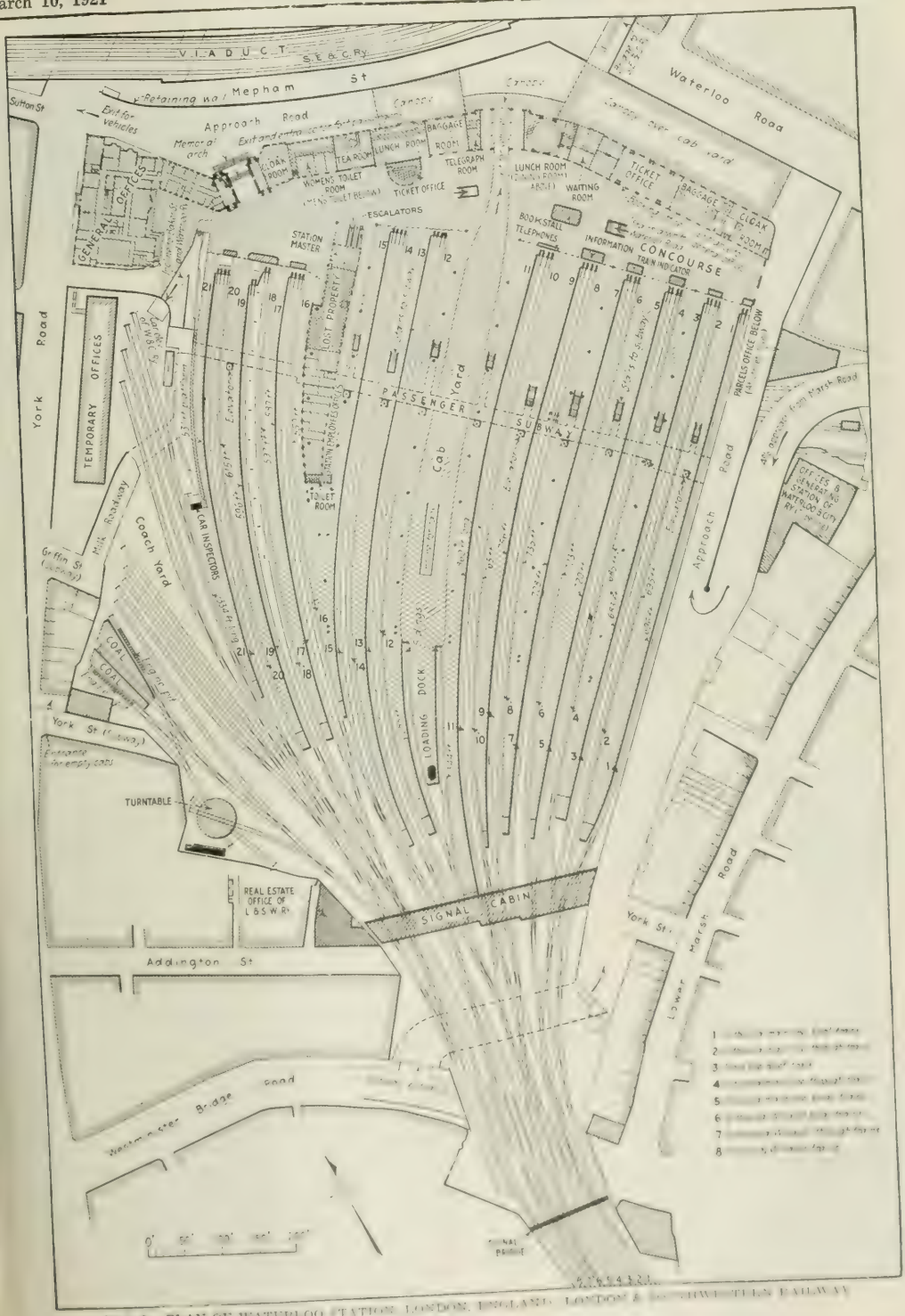


FIG. 3. PLAN OF WATERLOO STATION, LONDON, ENGLAND, LONDON & SOUTHWESTERN RAILWAY

out injury a 400-ton train moving at 10 m.p.h. These buffers are used extensively at English railway terminals.

An eight-track approach is one of the special features from an operating point of view, as with such a liberal proportion of approach tracks to station tracks there is avoided the bottle-neck condition which hampers or throttles movements at many large stations. Five of the approach tracks are for main-line service, one of these being a relief track serving inbound and outbound traffic during the morning and evening rush hours respectively. The other tracks are for the Windsor division, two being for through and local outbound trains and the third for all inbound trains. Only a few slip

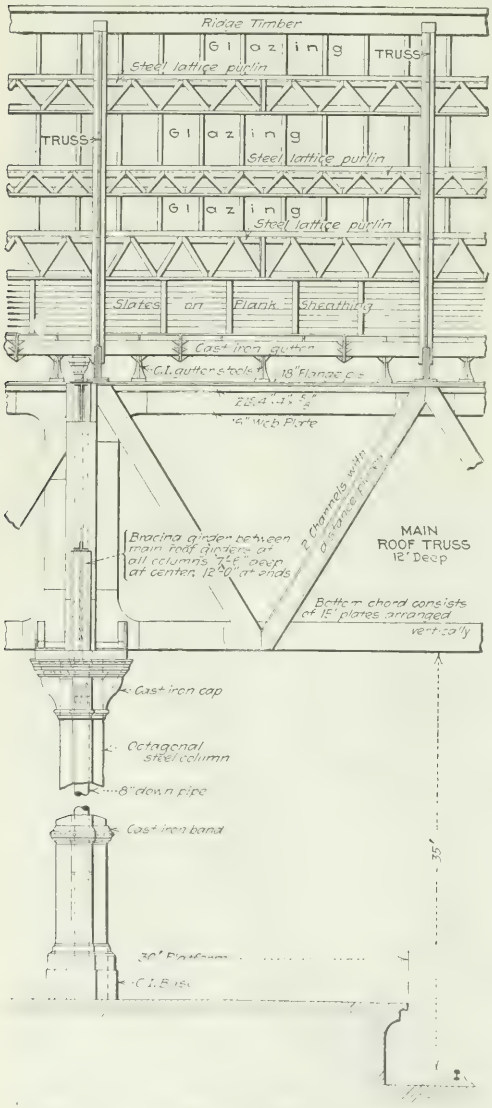


FIG. 4. TRAINSHED OF WATERLOO STATION, LONDON & SOUTHWESTERN RY.

FIG. 5. COVERED PORTION OF CAB ENTRANCE

switches are used, although the tracks are thoroughly interconnected. The approach is a long masonry viaduct with arch spans, streets being crossed by steel girder bridges.

Platforms and Baggage Handling—Platforms having average and maximum widths of 25 and 40 ft. extend between the pairs of tracks, these platforms being level with the floors of the cars. The longest platforms are Nos. 11 and 13, 860 ft. and 838 ft. respectively, the lengths reducing gradually to 695 ft. for No. 1 and 531 ft. for No. 21. They are of reinforced concrete on steel framing, with asphalt surface and 4-in. stone coping. Asphalt is used also for the broad concourse across the inner ends of the platforms. Fig. 1 shows the outer ends of the platforms, with signal equipment and the glass screen across the end of the trainshed.

A passenger subway across the main part of the station has stairways to the platforms and gives access also to stations on two of the underground rapid-transit "tube" lines. The concourse has stairways to the lower street level and has also ramps and escalators connecting with the underground rapid-transit stations.

The interior longitudinal driveway mentioned above enables incoming passengers from trains on two tracks to go directly to cabs or carriages, these tracks being used principally for important main-line trains. Access to the driveway is by means of an incline from a subway at the street level at the south end of the station, all vehicles passing out through an archway to the yard and street at the north front of the station, Fig. 2. Cabs land outgoing passengers at two covered portions of the station yard, one in front of the baggage room and the other in front of the main ticket office, as shown in Fig. 5.

It may be explained that railway passengers in England usually bring their trunks and heavy baggage with them, the baggage being transferred to and from the trains by hand trucks. For the parcel traffic, which corresponds somewhat to our express business but is handled by the railways, there is a large room under the east side of the station, with a subway extending across the station (under the passenger subway) and having elevators to the train platforms.

Station Facilities and Headhouse—A long three- and four-story building along the north end of the station forms the headhouse, with station facilities on the first floor, along the outer side of the concourse. In the accommodation for passengers there is marked contrast with American practice. From the plan, Fig. 3, it will be noted especially that no spacious waiting room or main hall is provided, as in American stations, but that there are two groups of small rooms with separate accommodation for first-class and third-class passengers. The reason is that in England the sta-

tion serves mainly as a passage to and from the trains, and is not regarded by the public or the railway officials as a general meeting and resting place. In this respect English stations seem uninviting and inhospitable to American travelers.

A handsome stone front forms the street side of the building, the interior construction being of steel and brick. At the northwest corner are located the general offices of the railway. A memorial arch in honor of the railway company's employees who lost their lives in the World War is erected over the main entrance and exit for foot passengers.

Trainshed—A steel-frame roof covered mainly with glass forms the trainshed, ample provision for ventilation being made in the roofing. Columns are located on the platforms in the main part of the building, including tracks 1 to 16, but for the remainder of the west side of the station the columns are in the spaces between the tracks, with a headroom of about 25 ft. above the rails. In the former part there is a clear headroom of 35 ft. above rail level, giving about 22 ft. above the smokestacks of the locomotives. It is reported that the purpose of this lofty trainshed is to permit of a possible future double-deck construction.

Roof construction for the trainshed, Fig. 4 and 6, is of a so-called "ridge-and-furrow" type which is little known in this country but is used extensively in England for roofs of large area. Lines of parallel chord trusses of 80 to 130 ft. span extend across the station at intervals of 60 ft. and upon these rest 60-ft. triangular trusses 15 ft. high, which are spaced 15 ft. c. to c. Across the latter trusses are laid latticed purlins, brackets which carry plank walks or gangways. Advantages claimed for this type of roof are ample light, economical structural design and good facilities for cleaning and repair.

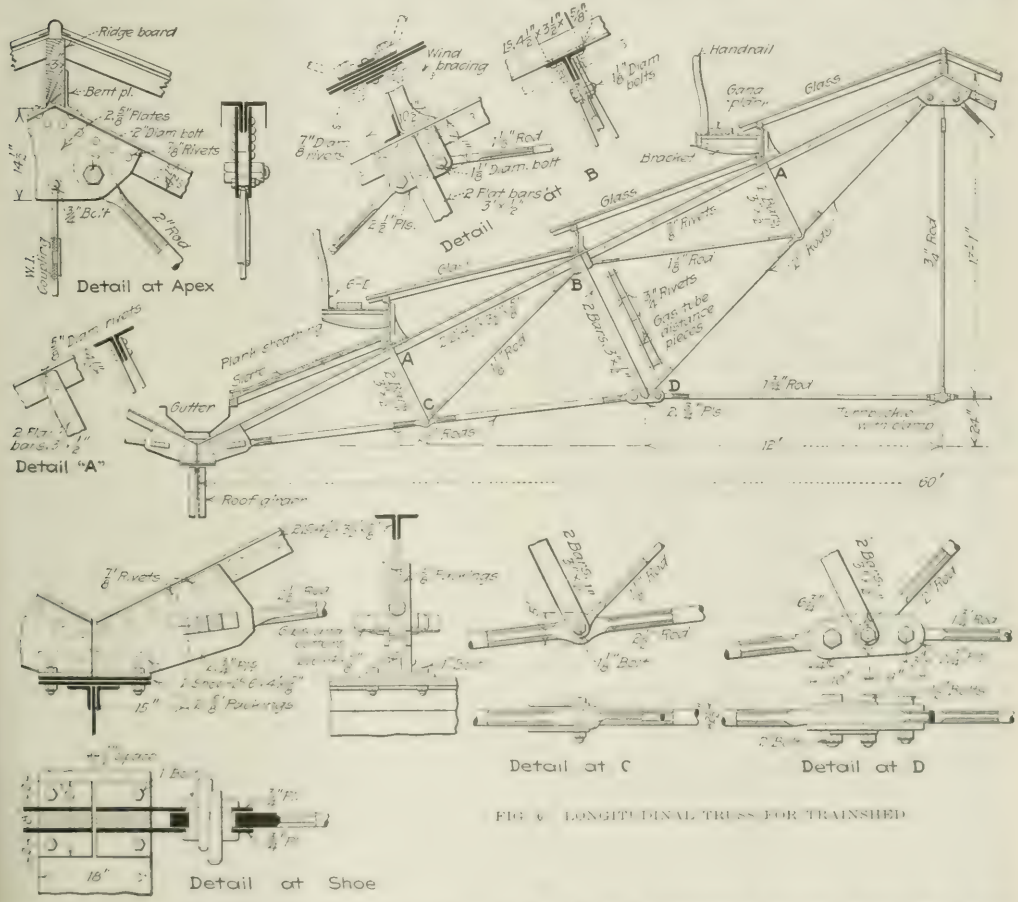


FIG. 6. LONGITUDINAL TRUSS FOR TRAINSHED

The triangular truss design, with its key and bolt connections, Fig. 6, is of interest to structural engineers in this country. The ends of the tie rod are secured to the connection plates by grooved gibs and a pair of taper keys or cotters driven in opposite directions. At the middle is a turnbuckle around which is a clamp bent to form ears for the attachment of the bolt of the vertical rod. Each strut is composed of a pair of flat bars with spacing sleeves between them and rivets through the sleeves, the upper ends of the bars being riveted to the top chord and the lower ends having a pin or bolt joint with the rod members.

Steel is used for the top chords, struts and connection plates. Rods and bolts are of wrought iron, turned bolts in drilled holes being used for the connections. The wind bracing between the trusses consists of 1¼-in. rods with ⅞-in. bolts.

Rolled plate glass constitutes almost the entire covering, slate on plank sheathing being used only for the lowest panel of each ridge, adjacent to the cast-iron gutter which forms the bottom of the "furrow." The glazing is arranged in steps, as shown, with ventilator openings between them. Notwithstanding the great area of roof, there is said to be little trouble from breakage of glass due to expansion or vibration movement in the steel framing. A glass screen closes the end of the trainshed to within about 15 ft. above the rails, Fig. 1.

TRAFFIC AT WATERLOO STATION IN 24 HOURS, 1921

	Loaded Trains	Empty Trains
Main line, inbound	73	37
Main line, outbound	68	41
Suburban, inbound	454	25
Suburban, outbound	452	27
Total	1,047	130
Total loaded and empty trains	1,177	
Maximum inbound in rush hour, 9-10 a.m.	40	....
Maximum outbound in rush hour, 5-6 p.m.	41	1
Per cent of suburban trains (electric)	80.6	38.4

Traffic Conditions—Regular traffic of this station for a 24-hour period averages 1,177 trains, of which 130 are empty. In addition there are numerous engine and switching movements. A signal cabin just beyond the station extends across the entire width of the tracks, and beyond this again is a signal bridge spanning the tracks. Signals are erected also at the ends of the platforms, Fig. 1. Suburban trains operated by electricity constitute over 80 per cent of the traffic. These conditions are shown by the accompanying table.

Engineers—The general scheme of reconstruction was planned under the direction of the late J. W. Jacomb-Hood, chief engineer. It is being carried out by A. W. Szlumper, the present chief engineer of the London & Southwestern Ry., with R. D. Hawes as assistant engineer in charge of construction.

Relative Merits of Hudson River Bridge and Tunnels

For Freight and Passenger Service Between New York City and New Jersey—Cost Analysis

CRITICISM of the "automatic-electric" system proposed in the report of the New York, New Jersey Port & Harbor Development Commission, as its ultimate solution for primary distribution and collection of Manhattan freight, is contained in a statement by Gustav Lindenthal, issued Feb. 25, 1921, comparing this system to the double-deck freight and passenger bridge that Mr. Lindenthal has proposed be built across the Hudson River connecting New York City with New Jersey. Mr. Lindenthal's proposal, together with a detailed outline of the traffic capacities of such a bridge, were presented at the annual meeting of the American Society of Mechanical Engineers, Dec. 9, 1920 (see *Engineering News-Record*, Dec. 23, 1920, p. 1246). The principal criticism of the commission's plan, embodied in his current statement, is that it fails to provide for passenger traffic and the handling of heavy bulk materials and low-grade tonnage including coal. An abstract of Mr. Lindenthal's statement follows:

Following the report of the commission the impression has been created that a bridge across the Hudson River in connection with a marginal elevated railroad on the west side of Manhattan would be uneconomical. In a comparative analysis it should be considered that the commission's plan provides for freight only; does not provide for coal and other bulk freight; it is of local benefit to lower Manhattan only; its economy is not inherent in the type of construction but in system of operation; it does not provide rail connection with steamship piers on Manhattan; as a system it is untried on a large scale; its great cost is not justified by probable benefits. On the other hand, the bridge plan would be cheaper than tunnel operation on basis of similar service, and its capacity for freight would be much greater than the automatic-electric system. It would provide not only for bringing heavy and bulk freight in standard cars into New York City, but also for carrying 300,000,000 suburban passengers and 30,000,000 vehicles across the river annually. A large union station for the long distance trains of all railroads from both states centering in New York would also be provided.

The commission's report deals only with freight transportation and estimates the cost of the first half of the underground automatic electric system at $201,190,000. On the same basis of comparison and taking the commission's estimates, so far as they are applicable, the bridge and marginal elevated railroad plan would cost only $175,000,000, or $26,000,000 less than the tunnel plan. On this estimate the portion of the bridge and elevated structure which would serve the automatic-electric freight operation has been liberally estimated at $45,000,000. The problem of passenger transportation cannot be solved comprehensively and economically by detaching it from the problem of freight transportation.

The automatic-electric system would carry principally food and general merchandise, which must be transferred to small cars. Coal, heavy structural material, machinery and similar bulk freight would mostly have to be transported to Manhattan as heretofore by expensive lighterage or car floats subject to delays and tie-ups that have caused hardship. The bridge plan is not limited to any kind or portion of freight. Particularly it can handle coal promptly to storage bins on the entire length of Manhattan Island. It will be able to accommodate the transportation of all kinds of freight at the rate of 60,000,000 tons per annum, looking to the future, whereas the capacity of the tunnel system proposed by the commission is limited, under best assumptions, to 15,000,000 tons per annum, which capacity may be reached in a few years. The bridge plan would also provide for direct carload interchange between New Jersey railroads and those on the other side of the river.

It can be shown that not only a part but all freight (if necessary, also coal and other bulk freight) can be transported in motor trucks from the proposed large railroad receiving and classification yard in the Jersey Meadows over the bridge to any part of Manhattan for store delivery from the Battery to Spuyten Duyvil, or across the East River bridges (or vice versa), *and with only two handlings* (one for loading, another for unloading), *cheaper and speedier than through the proposed tunnel system*, which has a limit of 50,000 tons *per day*, as indicated in the report. As against this the roadway alone over the bridge with fourteen lanes of vehicle travel will have a capacity of *10,000 tons per hour* without interfering with fast vehicles for passenger traffic. All this makes possible a volume and elasticity of operation absent in the proposed tunnel system.

For a Standard Form of Contract

Following the suggestion made before the American Water Works Association last year by G. W. Buchholz of the General Contractors' Association, the American Water Works Association has appointed a committee to co-operate with the General Contractors' Association in an attempt to draw up a standard form of engineering contract. The chairman of the Water Works Association committee is J. Waldo Smith, of New York

A Review of Column Formulas for Bridge Design

An Argument for Returning to the Rankine Formula—Plotted Tests to Failure Establish Its Correctness —Other Formulas Wasteful Because Approximate

By an Engineer of Bridges

SOME tests on small-sized wooden compression members recently published by the Bureau of Standards give a new illustration of a fact that has been demonstrated time and again in the past, namely, that the strength of struts is correctly portrayed by a formula of the Rankine type. In spite of modern preferences for other formulas, in the design of steel columns particularly, every series of tests forcibly directs our attention to the older formula. If this gives truer proportioning of compression members than, for instance, the straight-line formula, it seems an inescapable conclusion that the latter will produce sometimes weaker columns and sometimes less efficient columns—wasteful of metal—and therefore must result in unscientific designing. Would it not be wiser to return to the use of the Rankine formula?

Doubtless the method by which Professor Rankine derived his formula is known to all structural engineers; it will not be restated here. Tests to verify a column formula may be made either with round (theoretically hinged) ends or flat (fixed) ends, since the two conditions bear a definite mathematical relation to each other. The points of inflection of the bent column with fixed ends are (in strict theory) at the quarter points of the column, and therefore the middle half length will form in effect a column whose ends are of a freedom comparable to that at a hinged end. Then the constant in the formula must be four times as large for hinged ends as for fixed ends; since its value for fixed ends in tests of wrought-iron columns has been found to be 1/36,000 its hinged-end value is 1/9,000. The same values apply to steel, as its modulus of elasticity is the same. Thus we have the following formulas:

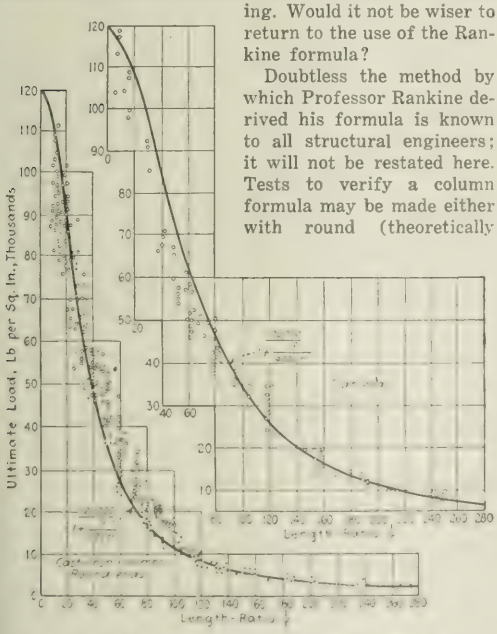


FIG. 1 CAST-IRON COLUMNS, ROUND END AND FLAT END
(Tests by Tetmajer and Hodgkinson)

$$p = \frac{S}{1 + \frac{l}{36{,}000\, r^2}} \text{ for fixed ends}$$

$$p = \frac{S}{1 + \frac{l}{9{,}000\, r^2}} \text{ for hinged ends}$$

Experiments by Tetmajer, Hodgkinson and others on cast-iron specimen columns, summarized in the two plots in Fig. 1, supplied remarkable confirmation of this formula. Half a century later the recent Bureau of Standards test on spruce struts for airplane work, Fig. 2, give equally gratifying confirmation. Clearly, Rankine with his theory outlined the true law of flexural failure of columns. It is to be expected that full-sized tests, involving the effect of imperfections of manufacture and variation of material, will give less uniform results, but this should not disturb our conception of the fundamental law of column failure.

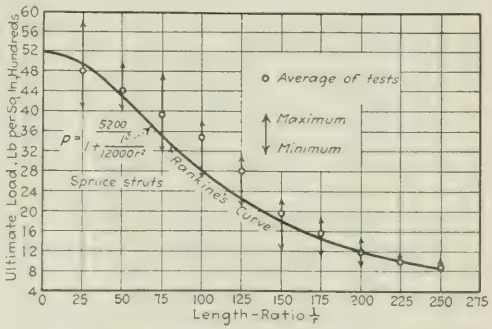


FIG. 2. SQUARE-END SPRUCE STRUTS (BUREAU OF STANDARDS)

Later the straight-line formula for column strength was proposed, and in bridge design the formula 16,000 — 70 l/r came into use, as approximating the Rankine hinged-end formula in its results (the formula for fixed ends had by this time fallen into disuse, on the view that all bridge compression members are in a state of flexure requiring the use of the hinged-end formula). It developed that the straight-line formula allowed higher stresses to be used in the usual range of column length, or for values of l/r between 50 and 180; on the other hand, for higher values than 180 it would produce very much heavier columns. The writer has always believed that it is this fact which led to the limitation of column length in specifications. The general claim is that "longer columns would be unsafe," yet it will be seen on comparing the straight-line formula with test results or with the Rankine formula that under the former long columns are *ultra-safe*. It is also worth notice that for lengths over 230 the straight-line formula allows no stress whatever; in other words, it makes such columns impossible regard-

less of arbitrary length limitations, although we know that such columns do have some strength, however small.

What do tests on full-sized columns show? As already remarked, the unavoidable variations in material and manufacture would be expected to produce less consistent results. Yet all full-sized tests uphold the Rankine formula, as will be seen.

Fig. 3 shows tests of 5-in. steel tubing at Watertown Arsenal in 1908. Both flat and clamped ends are included; evidently there is no practical difference between the two. Comparing the plotted points with the Rankine formula curve also drawn, it is seen that the longer columns made a slightly better showing than those of shorter lengths, which again throws doubt on any arbitrary limitation of column length. Even though compression members in actual bridges are usually

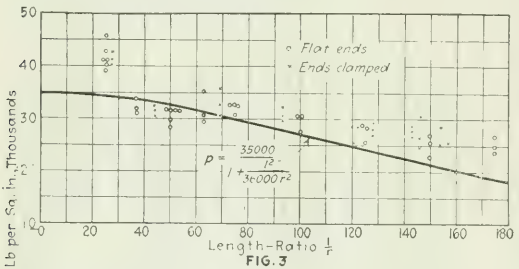


FIG. 3

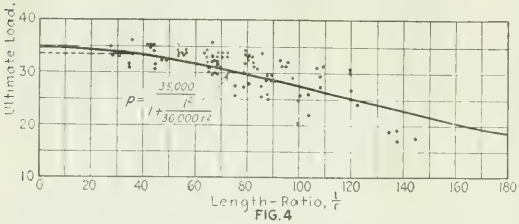


FIG. 4

FIG. 3. TESTS OF 5-INCH STEEL TUBES
(Flat and clamped ends shown to be equivalent. Tests made at Watertown Aresenal, 1908)

FIG. 4. BUILT WROUGHT-IRON COLUMNS, PIN ENDS
(Single and double channel, box and I-sections. Watertown Arsenal, 1881-84)

short we should nevertheless recognize the existing strength of long columns and should not condemn structures in which such long columns are found. In one steel trestle, for example, there is a long column, too long to fit the straight-line formula, which was trussed by light rods after the structure had been in existence some time to give it an appearance of strength; the trussing is of little value in making the column stronger, and in place of giving the structure an appearance of strength it really serves to call attention to the column and make it appear weak. The column is of ample strength for its purpose, and should be credited with its actual capacity.

Further evidence that long columns have a very definite strength is furnished by tests on iron compression members of various sections made at Watertown between 1881 and 1884, as plotted in Fig. 4; and in the tests of Christie, Bouscaren and others plotted in Fig. 5. The behavior of steel is quite the same, as shown by some Watertown tests of 1909, recorded in Fig. 6. While the latter tests were made with pin ends, there is every evidence in the results that the pins, under load, did not act as hinges but fixed the ends; compare Fig. 7. The constant 1/36000 applies to all the tests just referred to. Other data of the same kind are given by test of Phoenix and Z-bar sections, Fig. 8.

We now come to the tests made under direction of the committee on steel columns of the American Society of Civil Engineers, probably the most complete and systematic of any yet made. While the subject is not directly to the point here the writer cannot refrain from mentioning the clear-cut demonstration furnished by these tests that heavy material, which has received less work in rolling in the mill and is therefore softer, is quite apt to weaken a column; no one who has to do with design of structures should fail to keep this demonstration carefully in mind.

The A. S. C. E. tests have been plotted in the left-hand

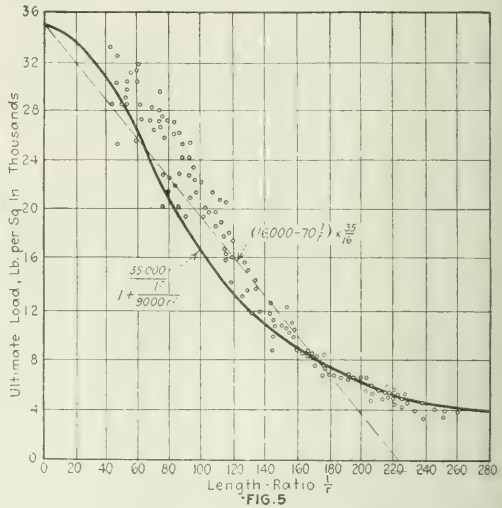


FIG. 5

FIG. 5. BUILT AND ROLLED WROUGHT-IRON COLUMNS, ROUND ENDS
(Tests by Hodgkinson, Tetmajer, Bouscaren and Christie)

part of Fig. 9 to represent fixed-end conditions. To record them on a hinged-end basis the value of half the test length has been used for plotting in the right-hand part of the diagram, in which the confirmation of the Rankine formula is more clearly evident.

All the preceding data, in the writer's opinion, establish the Rankine column formula as representing truly the strength of iron and steel compression members, and as the formula which should be used in bridge design. It remains to consider the question of fixed *versus* hinged ends.

In the early days of modern designing it was customary to use both the fixed-end and the hinged-end formula, according to what was considered to be the end condition of the particular column; in fact, formulas applying to a column with one fixed and one hinged end were sometimes used for a member which the designer believed to be in a corresponding physical condition. However, when the danger of secondary stresses arising from the distortion of a structure came to be more clearly recognized the fixed-end formula lost favor; it was concluded that these secondary stresses would be better allowed for if columns were proportioned by the hinged-end formula.

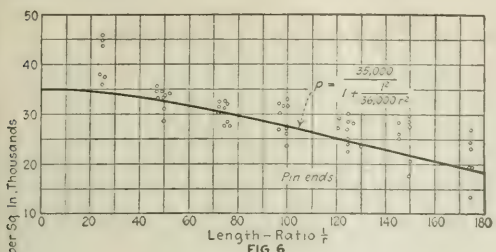


FIG. 6

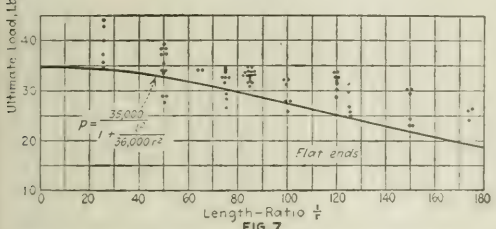


FIG. 7

FIGS. 6 AND 7. STEEL COLUMNS, PIN AND FLAT ENDS (Built and rolled I-sections, channels and tubes. Watertown Arsenal, 1909. No difference between pin-end and flat-end tests)

Free ends of columns do not exist in structures, however. It seems that more attention is being given to this fact in recent years than to the undeniable existence of secondary stresses affecting columns. At any rate the conservative practice of using the hinged-end formula is being abandoned, it would appear, for numerous proposals are being made that tend toward producing lighter columns. Undoubtedly there is a desire at present to reduce the cost of construction, but it would be an engineering mistake to reason on the assumption that a column formula that will sanction the lightest columns will be the quickest to find acceptance.

The straight-line formula, already light as compared with the Rankine formula, was made still lighter by the A. S. C. E. column committee, which proposed a uniform column load of 12,000 lb. per sq.in. up to a length of 80, thence reducing at the rate of 100 l/r. Quickly following this proposal came that of the American Railway Engineering Association, 15,000 — 50 l/r, with a maximum of 12,500, and this may be succeeded by a still lighter one, 15,000 — 40 l/r. Then for the sake of novelty, perhaps, the formula 12,500 — $\frac{1}{4}$ l^2/r^2 was introduced; and this has again been outdone, and again lighter columns authorized, by the formula 13,000 — $\frac{1}{4}$ l^2/r^2. The whole crop of formulas is empirical and arbitrary. Apparently the race is to the swift. Whither are we drifting?

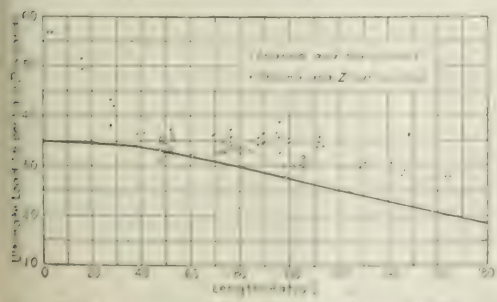


FIG. 8. WROUGHT-IRON FLAT-END COLUMNS (Channel, box, phoenix and Z-bar sections, with [illegible] high results)

As a conservative and well digested hinged-end formula, probably that in use by one of our large railroad systems is adapted to the requirements of practice more nearly than any yet proposed. This, with 16,000 as a basal unit stress, becomes

$$p = \frac{16{,}000}{1 + \frac{l^2}{13{,}500\ r^2}}$$

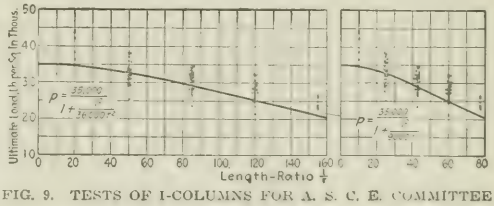


FIG. 9. TESTS OF I-COLUMNS FOR A. S. C. E. COMMITTEE

A plot of this formula together with a number of others is given in Fig. 10, and a condensed list of allowable stresses follows here:

WORKING STRESSES FOR COLUMNS
(In thousand-pound units)

Formula $p = \dfrac{16}{1 + \dfrac{l^2}{13{,}500\ r^2}}$

	P		P	l/r	P
40	14.3	86	10.3	135	6.8
42	14.1	88	10.2	140	6.5
44	14.0	90	10.0	145	6.2
46	13.8	92	9.8	150	6.0
48	13.7	94	9.7	155	5.8
50	13.5	96	9.5	160	5.5
52	13.3	98	9.3	165	5.3
54	13.2	100	9.2	170	5.1
56	13.0	102	9.0	175	4.9
58	12.8	104	8.9	180	4.7
60	12.6	106	8.7	185	4.5
62	12.4	108	8.6	190	4.3
64	12.3	110	8.4	195	4.2
66	12.1	112	8.3	200	4.1
68	11.9	114	8.1	205	3.9
70	11.7	116	8.0	210	3.7
72	11.6	118	7.9	215	3.6
74	11.4	120	7.7	220	3.5
76	11.2	122	7.6	225	3.4
78	11.0	124	7.5	230	3.2
80	10.9	126	7.3	235	3.1
82	10.7	128	7.2	240	3.0
84	10.5	130	7.1	245	2.9

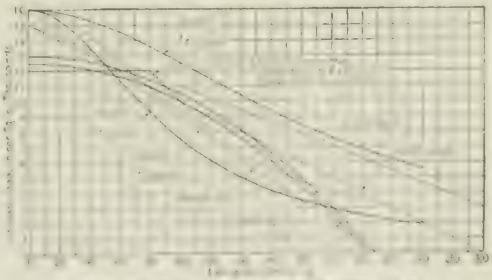


FIG. 10. VARIOUS COLUMN FORMULAS

It should be remembered that in the case of short columns the allowable stress is limited by the details of design. These details should be proportioned, of course, with regard for their ratio of length to thickness. In good engineering practice the ratio $l/d = 12$ has usually controlled the detailing, and, as this corresponds to $l/r = 40$, the tabular stress for this ratio is the highest allowable loading on any column. The column stress heretofore is not subject to physical variations.

Subsidence of Earth Fills as a Factor in Valuation

Railway Investigations Indicate Both Firm and Soft Ground Settle Appreciably Under Embankments and Thus Increase Earthwork Quantities

SUBSIDENCE of the ground under railway embankments, due to the load placed upon it, as an important and almost universal factor affecting the quantity of material required both for construction and maintenance of the embankments is shown convincingly by extended investigations which have been made during the past few years by a number of railways in connection with their valuation work. These investigations have been reported to the Engineering Committee of the Railroad Presidents' Conference Committee on federal valuation, but heretofore have not been published. Graphic illustrations of conditions discovered are afforded by the accompanying diagrams selected from the reports. The subject is considered as entirely separate from the question of shrinkage dealt with in another report of the Presidents' Conference Committee (see *Engineering News-Record,* Aug. 26, 1920, p. 418). An abstract of the subsidence investigations as reported to the carriers' engineering committee follows:

Subsidence of swampy ground and resultant loss of fill is a common experience and needs no proof. Abnormal conditions of subsidence and loss at sink holes are also well known. But the point of the matter is that these and other investigations indicate subsidence as practically universal in both firm and soft ground under railway embankments, and consequently are an important factor in estimating earthwork quantities. If this is not fully recognized in valuation work the railways will not receive proper credit for actual cost of the existing works.

Subsidence and Shrinkage

It is evident that subsidence must result in increasing the amount of fill material beyond that estimated for a fill of given height above the original surface of the ground. The extent of subsidence varies with the character of the soil and subsoil but is appreciable even on apparently firm ground, while in soft ground the volume of fill beneath the original surface may equal that above it, thus practically doubling the quantity of the original estimate. Part of this excess may be applied as the fill is built, the original borrow pits or other source of material sometimes proving insufficient to meet requirements. The application of the remainder of the excess may be spread over a term of years, as subsidence continues and additional material is added from time to time to bring the surface of the fill up to grade.

Subsidence as an important factor in the problem of earthwork shrinkage was discussed in an article on "Shrinkage of Loosely Filled Earthwork in Embankments" in *Engineering News-Record,* June 24, 1920, p. 1256. It was shown also that the matter has a wider bearing than its relation to shrinkage, reference being made to a report of the American Railway Engineering Association which stated that investigations on several hundred miles of line indicated that subsidence exists under practically all embankments and should be considered when revaluation surveys are being made.

As to the importance of subsidence in relation to valuation, it will be seen that this behavior of the ground has caused railways to place and pay for a much greater quantity of fill material than that required above the normal or original level of the ground. For instance the report of one Eastern carrier shows that investigation on 85 miles of fill developed 7,287,675 cu.yd. of excess material due to subsidence. Allowing 10 per cent for shrinkage in the distribution of grading this would represent approximately 8,016,443 cu.yd. of material excavated and paid for. Common excavation on this road may be estimated as worth in ledger value, say 35c. or more per cu.yd., so that the excess discovered represents a cut of at least $2,805,755. According to the report the cost of the tests which disclosed this material was only 0.215c. per cubic yard, or in other words $1 of ledger value was produced at a cost of 0.6140.

On another Eastern carrier borings in one fill across a swamp developed the existence of 250,000 cu.yd. of filling material below the normal ground line; similar work elsewhere disclosed about 700,000 cu.yd. of excess or subsurface material, the cost of exploration being only 0.3c. per cubic yard. In 38 tests on one road the depth of subsidence of fills 3½ to 10 ft. high on soft and stiff mud was from 1.2 to 8.5 ft. The aggregate original depth below base of rail for the fills at the points tested was 220.8 ft., but the total subsidence was 164.7 ft. as determined by wash borings and 170.5 ft. by sounding with an iron rod. In other words, the depth of fill below base of rail was increased approximately 75 per cent.

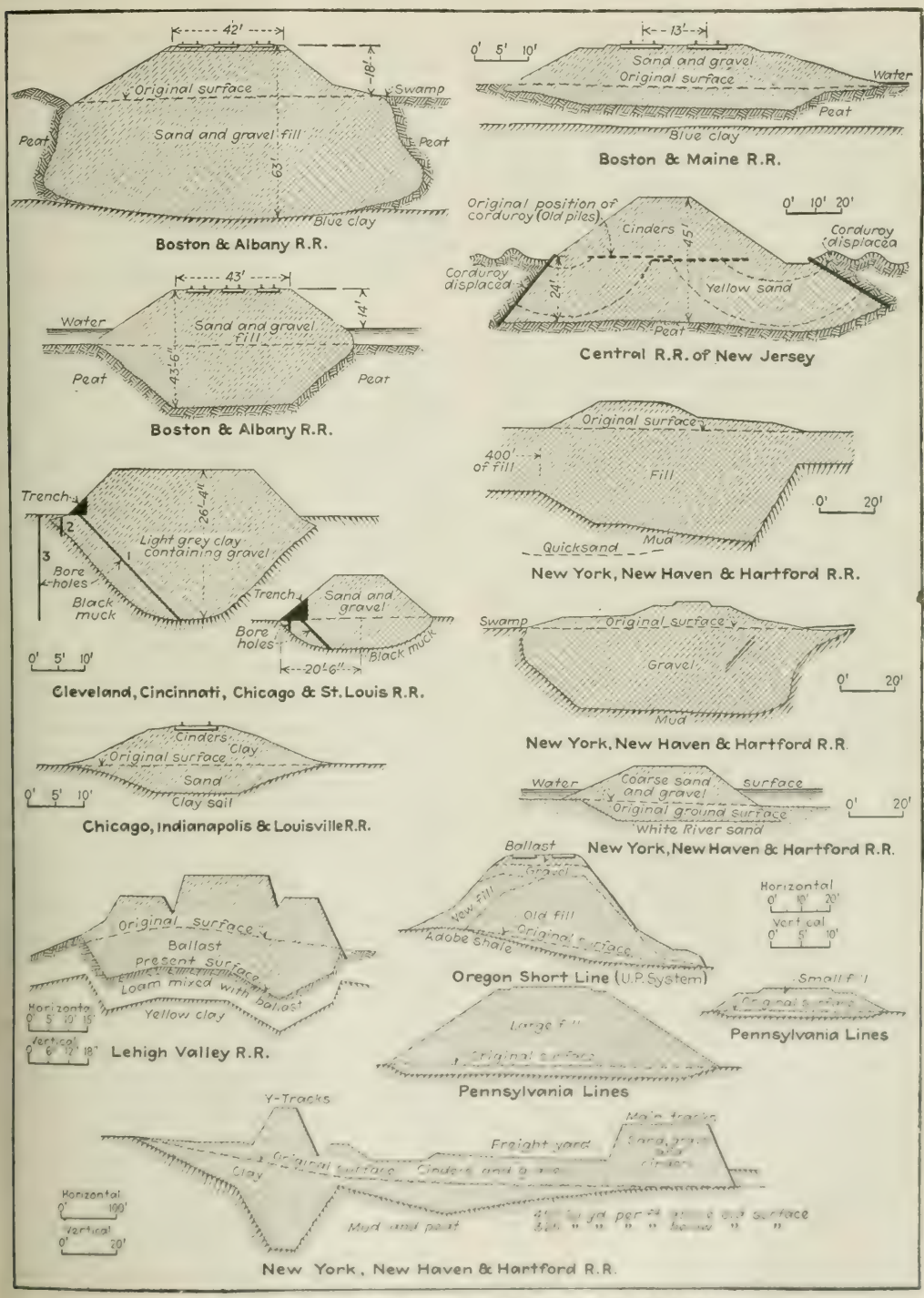
Subsidence at points where there was no fill, the ballast being laid directly upon the soil, was discovered by borings on double track and four-track sections of another carrier. Where the soil was 0.8 ft. of loam over yellow clay both loam and clay had settled to form a depression or channel. In the yellow clay the area above the original surface was 67.50 sq.ft., while the area below that surface was 67.0 sq.ft. In red clay and loose shale the areas above and below the original ground line were 65 and 31 sq.ft. respectively. Tests of fills on mud, peat and marshy ground on another carrier showed that the subsidence or material below the original ground line was from 79 to 432 per cent of the material above that line.

Subsidence Practically Universal

Subsidence was also found at unexpected points on many lines. In the case of two lines investigations were made where in general a shallow sandy loam is underlaid with gravel and clay subsoil and without tests it would not appear that there was any subsidence. The tests showed, however, that it had occurred on almost the entire length of both lines, the maximum depth being 3 ft. with an average of 0.5 ft. for one line and 0.9 ft. for the other. The height of fills did not exceed 12 ft. On 103 miles of fill the tests disclosed 409,246 cu.yd. of subsidence material.

A strong statement in regard to subsidence as a common or almost universal occurrence is made in the report of one investigation as follows:

"Recent investigation of embankments has developed



TYPICAL EXAMPLES OF SUBSIDENCE UNDER RAILWAY FILLS

subsidence quantities of sufficient extent on lines where there was no reason to expect that subsidence would be found to warrant the suggestion that there should be made arbitrary allowances for subsidence per mile of all embankment, dependent on limited tests over similar areas."

The investigation here mentioned was made on two valuation sections, selected at random, aggregating 218.2 miles of road with 150.5 miles of embankment. Excluding 1.9 miles not investigated and 0.4 mile of known sinkhole, there were 148.2 miles of embankment on apparently firm ground, but subsidence of such ground had occurred under 49.8 miles, or 33.6 per cent of the total 148.2 miles. The total subsidence found was equal to 10.7 per cent of the quantities of all embankment investigated, as determined from the cross-sections taken by the Interstate Commerce Commission, and 23.9 per cent of all embankment quantities under which subsidence was found. The average cost of investigation was only 0.46c. per cubic yard of subsidence discovered. In general the top soil was loam on a clay subsoil.

Failure to discover subsidence by tests at certain points is reported by one Eastern and one Western carrier. In the former case isolated tests in two states were made at three gravel fills 2 to 4 ft. high and one 20 ft. high, all on clay soil. Trenches were cut in the fills and the report states that the original surface was readily distinguishable. In conducting the valuation work tests with iron bars were made wherever there was any question as to subsidence. A summary of the results is given in the table.

On one Western carrier no subsidence was found on lines except that through the lagoons in the northwest where the subsidence varied from 40 to 87 per cent of the embankment material. A curious condition was found on this road, however, in the raising of ground level along the fills, thus apparently reducing the height and volume of the fill. On one stretch of 200 miles the measured quantities above the present ground line were 22 per cent less than the record quantities.

In another case material from a 30-ft. embankment sloughed off and raised the adjacent ground so as to cover up 22 per cent of the quantity placed in the fill. The slight subsidence directly under the bank evidently squeezed out material on either side, thus raising what still appeared to be the normal ground surface. In the case of other roads, however, the settlement is confined mainly to the space directly under the base of the fill.

Special conditions met with in building embankments have been mentioned above. However, another striking example is reported in the building of an important cutoff line in the East. The trouble here however, was something more than subsidence. The old line was on a bench cut in the mountain slope on the east side of and 15 to 20 ft. above a swamp at the head of a creek, but the new location was on a fill 40 ft. nearer the swamp and 6 ft. above it. The swamp is 4,700 ft. long and 300 to 400 ft. wide, with black muck soil covered with trees and brush, this growth and the rocky slopes indicating no great depth of muck. The embankment was estimated at 30,000 cu.yd. above the surface, but this was increased to 90,000 cu.yd. to allow for subsidence.

Filling was commenced in June, but at the end of two months all material had disappeared, the surface of the swamp rising in some places 6 ft. above the subgrade level. A new location was then adopted, excavating the old roadbed for two tracks and placing the other tracks on a fill alongside the swamp. Frequent slides occurred without warning and sometimes the bank and construction track would disappear during the night. Six sink holes were encountered, requiring from 7,128 to 101,172 cu.yd. each or a total of 216,820 cu.yd. At the largest hole, 86,000 cu.yd. were dumped in the length of the contractor's train before the fill began to show above the surface. Dumping caused the surface of the swamp to rise and fall in waves for a distance of 200 ft., indicating that probably the 40 ft. of muck was floating on an underground lake.

SUBSIDENCE IN 148 MILES OF EMBANKMENTS ON FIRM GROUND OF AN EASTERN CARRIER

Ave. Height of Fill to Subgrade, Ft.	Volume of Fill (I. C. C. Quantities) Total Investigated, Cu.Yd.	Volume of Fill (I. C. C. Quantities) Where Subsidence Was Found, Cu.Yd.	Subsidence Quantity, Cu.Yd.	Per Cent Increase of Fill Due to Subsidence: Of Quantity Investigated	Per Cent Increase of Fill Due to Subsidence: Of Quantity Where Subsidence Was Found
Up to 10 ft.	3,766,303	1,422,510	409,740	10.9	28.8
10 to 20 ft.	2,302,754	1,155,805	239,128	10.4	20.7
20 ft. and over	672,320	443,096	74,666	11.1	16.9
Total.....	6,741,377	3,021,411	723,534	10.7	23.9

A two-track fill was completed in September of the following year, with 356,467 cu.yd., but in the next year a 300-ft. length disappeared and had to be made good with an additional 54,360 cu.yd. of material, while a year later it was necessary to drive piles and place stringers for 140 ft. To carry the embankment along the side of this swamp required the placing of 497,834 cu.yd., instead of the 90,000 cu.yd. provided at first as a liberal estimate.

Don't Write It—Say It

"DON'T *write* it—*say* it" is the advice the recent engineering publicity conference of the American Association of Engineers got from Alexander Black, editor of the Newspaper Feature Service of New York City. Further he stated:

The whole trend of good writing is toward colloquial simplicity. As ranting has disappeared from the stage, fine phrases are disappearing from good writing. Some people not only sound *written*—they sound as though they were singing it. In speech they will tell you where they live. In writing they don't live—they reside. They don't *begin*, they *commence*. They never "had a talk." They "held a conversation." In other words, they "take their pen in hand" and the reader gets the ink on him. The average person doesn't write a personal letter as if he were saying something to a friend. He writes a *letter*, and it sounds like a letter. Some men make even an after-dinner speech the same way. They don't *talk*. They *speech*.

My experience with writers on science, on practical things, is not so much that they are too complicated as to their subjects as that they are too complicated as to their English. Simply imagine yourself *saying* it to the policeman and you will be able to keep your feet on the earth. If I can read a thing aloud and it doesn't sound *written*, I know I am on my way. In the average case quick writing will sound more written than writing that has been worked down to clean terms. It isn't a matter of long words or short words. Some long words are very common—commoner than they ought to be. Some beautiful short words are quite unfamiliar. In speaking to the big audience, words it will accept, used in a way it will accept, are the great consideration. The right word is developed by a feeling for *saying* it. To get this feeling one must practice saying it. There are many mistaken theories as to what "the public" will not understand. Most of the disappointments come not from failure to understand, but because the public's natural human interests have not been sufficiently considered and successfully reached.

Methods of Investigating Subsidence Under Railway Fills

WASH and auger borings, core drills, sounding rods, test pits and trenches are included in the methods employed by the railways for investigating subsidence of original ground surface beneath embankments, the investigations being carried out extensively in connection with railway valuation, as described in the preceding article. The following particulars as to apparatus, methods and costs have been compiled from a number of reports submitted by individual railways to the Railroad Presidents' Conference Committee on federal valuation.

Wash Borings

On the Boston & Maine R.R. and the Boston & Albany R.R. test borings were made by a contractor who had the necessary equipment, which he used in tests on foundation work. The apparatus consisted of a 2-in. pipe casing driven by a drop hammer and having within it a 1-in. jet pipe which could be raised and lowered by a rope and pulley. A force pump with 2-in. suction and 1-in. discharge supplied the jet, water being taken from a tub and returned to it by piping. A pair of tall A-frames of 1½-in. pipe carried a cross-piece with rope and pulley for raising the hammer and the jet pipe and for drawing the casing, which could be driven to a depth of 100 ft. When this casing had been driven to the desired depth, the material within it was washed out by the jet, changes in material being indicated by the appearance of the flow. As a check, the jet pipe was raised and dry samples were taken of the material in the pipe.

Borings were made at intervals of not over 1,000 ft., on alternative sides of the track, being made usually on the shoulders of fills in order to avoid interference with traffic. To establish the bottom of the fill at any station, four borings were made, one in each shoulder, and one in each slope. Valuable information was obtained by bore holes in yards, where the depth of filling material was unknown. To test the accuracy of the records of these borings, pits were dug at adjacent points after sinking 42-in. steel cylinders. These test pits showed that the bottom of the fill as recorded by the borings was within about an inch of the bottom as discovered in the pits. The cost of the apparatus and three men was $20 per day in 1915 and 1916 and the borings averaged 50 ft. per day.

In work on the Central Railroad of New Jersey the boring outfit was set up on the shoulder of the fill and the casing was driven to about the elevation of the original ground surface. After taking a wash sample at this point the driving was continued, samples being taken frequently until the bottom of the filling material was determined. Dry samples were taken in the casing by attaching to the ¾-in. jet pipe a slotted rod used in making soundings, as noted below. The wash borings cost 43c. per lineal foot.

A wash boring outfit used by the valuation department of the New York, New Haven & Hartford R.R., shown in Fig. 1, consists of a pipe tripod carrying a head from which is hung a pulley for operating the drop hammer and pulling up the casing. The hammer is an 8-in. cube with a recess for a 4 x 5-in. cylindrical white oak block with grain vertical. A driving head consisting of a short piece of 2-in. pipe with a steel cap is coupled to the 2-in. casing, which is made in 4½-ft. lengths. Within the casing is driven a ¾-in. jet pipe with lateral outlets and a chisel point. A 1-in. steel rod with pointed end may be fitted to the hammer for driving inside the casing.

For a party of five men, including the engineer, the average cost per week was $106, as shown in the accompanying table. The total cost for equipment, wages and expenses during the entire period, 1915-1918, but exclusive of transportation and 15 per cent overhead, was $15,008, giving an average of 55.4c. per foot of hole bored and 0.20c. per cubic yard of subsidence disclosed.

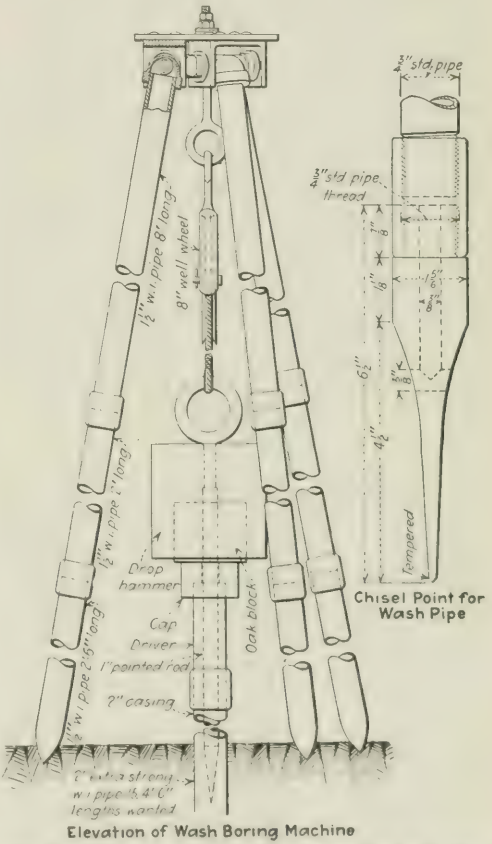


FIG. 1. WASH BORING APPARATUS, N. Y., N. H. & H. R.R.

WEEKLY COST OF TEST BORINGS, N. Y., N. H. & H. R.R.

Men	Wage	Expense
1 Foreman	$18	$9
1 Foreman	18	6
1 General helper	15	4
1 Helper	14	4
1 Helper	14	4
Total	$79	$27

Core Drills and Augers

A combined drilling and wash boring outfit has been used by the New York Central R.R., the machine having a core drill driven by a 7-hp. gasoline engine and served by a 4 x 5-in. force pump. The drill had a 1½- and

2¾-in. bit, the casing pipe being 2 and 3½ in., respectively. In loose material the casing was driven and the core washed out, the drill being used when rock was encountered. This outfit had the particular advantage that wash borings could be continued after boulders were encountered. Dry samples can be taken in the casing by means of a special bit or sampler on the end of the rod, but frequent dry sampling increases the cost of the work considerably. This machine can make borings to a depth of several hundred feet.

With a foreman and two helpers the cost of boring (in 1915) was from 70c. to $1.25 per foot under ordinary conditions. On one fill across a swamp the cost of wash borings and core borings was 28c. and $1.30 per foot respectively, exclusive of interest and renewals.

Test borings on the Cleveland, Cincinnati, Chicago & St. Louis Ry. were made with a 2-in. auger having a stem of ¾-in. pipe which could be extended to a length of 40 ft. This auger worked in a casing of 2-in. pipe in 4-ft. lengths. The tools included a maul, two Stilson wrenches and two track jacks for pulling the casing. Pits were made in the toe of the slope and borings were driven from the bottom of the pit until they encountered the natural soil. Augers and post hole diggers have been used by the Chicago, Indianapolis & Louisville R.R. and other roads.

Sounding Rods

Tests of subsurface conditions by sounding with a rod were made on the Boston & Maine R.R. and under favorable conditions the depth of filling material could be determined in this way to a depth of five or six feet. The rod was a 12-ft. length of ½-in. gas pipe with a pointed end and was worked down by one or two men until it reached some resisting material, but it did not appear practicable to make such sounding to a greater depth than 6 ft. in swampy ground. The cost was much less than for wash boring. A solid steel sounding rod used by the New York, New Haven & Hartford R.R. is shown in Fig. 2.

A slotted rod was used by the Central Railroad of New Jersey, with successful results in fills not more than 15 ft. high. The rod was made up of 5-ft. lengths of 1-in. pipe, the lower end of the first section having a ¾-in. slot 8 in. long. After the rod had been churned as far as possible by hand it was driven with a sledge. It was pulled up frequently for taking samples of the material in the slot. To reduce the cost of the investigation, the rod was used at the toes and near the bottom of slopes, wash borings being made on the shoulder at points where the subsidence was deepest. The rod tests cost 7½c. per lineal foot as against 43c. for wash borings, the cost of subsurface material discovered being only 0.11c. per cubic yard.

Dry borings with rods have been made on the Philadelphia & Reading R.R. at a cost of 15c. per foot and 0.02c. per cubic yard of subsurface material disclosed. The boring rod was of ¾-in. pipe in 5-ft. lengths, the first length having a solid end tapering to ⅜-in. diameter in a distance of 6 in. Another length had a slot 6 in. high for cutting and taking samples, leaving a little more than half the section of the pipe. Three Stilson wrenches and 2½ ft. of ¾-in. chain with a ring at one end completed the equipment.

A lining bar was used to start the hole and then the point with one extension piece attached was forced down

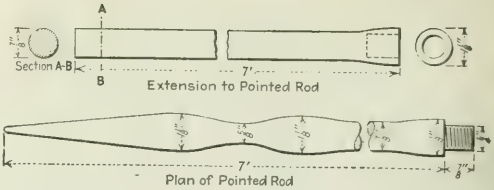


FIG. 2. ROD FOR SOUNDINGS IN SOFT EARTH

by driving or by turning it with the wrenches, three men being required in the latter case. When the point reached a sufficient depth it was withdrawn and the cutter or sampler was inserted, being driven down if necessary. To take a sample the pipe was raised by wrapping the chain around it, the bar being inserted in the ring and used either as a lever or for direct lifting. Three men were all that could work to advantage when forcing down the pipe with wrenches.

Test trenches were cut in the slopes of fills on the Bessemer & Lake Erie R.R. to determine the bottom of the filling material, the trench being made on one side only and extending from the toe nearly to the ends of the ties. Levels were taken over the fill before and after excavating the trench. Tests made in firm ground showed subsidence even where the original surface beyond the toe of the slopes showed no indications of settlement. Pits and trenches at the toes and in the slopes have been used on many roads in exploring for subsurface fill material. Steel cylinders for test pits on the Boston & Maine R.R. have been noted above.

On the New York Central R.R. a party for subsidence tests comprised an assistant engineer in charge, with a foreman and three men from the Carpenter Department, these men being allowed 50c. per day ~~extra~~ for board. Besides a boarding car with sleeping and cooking accommodation there was a flat car for the equipment, the principal items being the drilling tools, handcar, speeder, pipe casings, augers for drilling to a depth of 60 ft. and through timber if necessary, post hole diggers and shovels for digging test pits at toe of slope.

Locations for tests were selected by the valuation engineer, where it was thought that more than 2,000 cu.yd. of subsurface material would be found, the assistant engineer determining where and how often borings should be made at each place. Observations were taken usually at 200-ft. intervals. The observations of this latter party were plotted on sheets of cross-section paper, with their readings marked. The assistant engineer plotted his notes and computed his yardage in the field, making affidavit as to the accuracy of his notes. After the work was completed on a valuation section, the notes and computations for subsurface material on the entire section were bound together, an affidavit was made, and attached to the final report.

Exploration which disclosed 700,000 cu.yd. of subsurface material cost $2,540 (in 1915) including the salary and expenses of the engineer, or an average of 20.5c. per lineal foot of hole and only 0.3c. per cubic yard of material. Beside holes, 367 test pits were dug.

For tests at minor locations and small soft spots a laborer was added to the party, being equipped with a speeder and tools for light drilling. He sounded all the small soft spots. It was considered that the most economical method of exploring small soft spots would be to have an engineer in charge of two men with a rough drilling outfit go over the line on a motor car.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Elastic Action of Foundation Soil

Sir—Referring to E. G. Haines' communication, p. 89, Jan. 13,1921, I wish to here acknowledge my indebtedness to him for his very original and to me fruitful discussion of J. C. Meem's paper of 1907. I had long observed the lack of correspondence of the actual behavior of earth cuts with that which one would logically deduce from the then prevailing theories of earth pressures; Mr. Haines' discussion set me thinking along what I consider right lines. Since 1907 I have closely observed many miles of earth cuts, tunnels, etc., along the Catskill aqueduct and New York subways, and my observations confirm those of Mr. Haines and Mr. Moulton, both of whom deserve the highest credit. However, my article in Engineering News-Record of Dec. 20, 1920, p. 1268, gave precise data and observations on the properties of earth in foundations, a field other than that covered by Mr. Haines and Mr. Moulton's observations.

Referring to Mr. Meem's letter, p. 185, Jan. 27, the writer has the unpleasant task of the disciple who differs from his old master, for he has learned much from him and leaned long upon him for advice and guidance. Mr. Meem in the fourth paragraph of his letter attributes the rebound to the elasticity of the pile itself rather than to the soil beneath the pile. A little examination of the rebound curves (Fig. 2A, Dec. 20, 1920, p. 1268) will show this to be an untenable assumption, as the pile then would not resettle under reapplications of the same test load. Rebounds of $\frac{3}{8}$ in. have been observed for piles 10 ft. long where the elasticity of the pile itself would account for only $\frac{1}{20}$ inch.

Mr. Meem also states that the inference should not be drawn that the non-maintenance of a percentage of the test load will cause the pile to settle and that the excess test is the real prevention of settlement under the bearing load. I beg to differ; thousands of tests made in the course of our work show this to be erroneous. For example, in tests made for the Bureau of Buildings of Manhattan, New York City, a 14-in. steel pile shell $\frac{3}{16}$ in. thick was sunk 9 ft. in the ground and 2 ft. below water level and filled with 1:2:4 concrete; material at base of pile 95 per cent sand and 5 per cent clay, 95 per cent of the sand passing through No. 100 sieve. Under 50 tons load applied with hydraulic jacks the pile settled about 10 in., upon release of pressure the pile rebounded $\frac{3}{8}$ in., upon reapplication of the load the pile further settled about $1\frac{1}{2}$ in., upon release of the load it again rebounded $\frac{3}{8}$ in., and upon reapplication of the load again settled further about $1\frac{1}{2}$ in. The pile then was retested to 50 tons and wedged with steel beams as per "pretest method"; a rebound of only $\frac{1}{16}$ in. was observed; upon reapplication of the load up to 50 tons a settlement of slightly more than $\frac{1}{16}$ in. occurred, giving a net settlement of $\frac{1}{160}$ inch.

The firm with which I am connected is installing a foundation for an 18-story building at Gold and Frankfort Sts., New York City. Here daily in the course of the work several tests of 20-in. cylinders to 80 tons are made. If anyone doubts the reality of the elastic properties of earth, rebound and the necessity of preventing rebound, and the inadequacy of the excess test alone to prevent settlement, he is welcome to visit this work.

I hope that no one will refuse to look through the telescope to see the moons of Jupiter. When Galileo announced his discovery of the moons a savant denied their reality, as an extended research through the old masters failed to find any mention of them, and upon Galileo's invitation to look at them through his telescope refused. Shortly after, the savant died upon which Galileo remarked that he hoped the soul of the departed upon his ascent to heaven would pass close enough to Jupiter to see his moons.

New York, Feb. 24. LAZARUS WHITE,
Spencer, White & Prentis, Inc., Engineers and Contractors.

Shall the Engineer Arm Be Recognized in Army Promotions?

Sir—The editorial in your issue of March 3, p. 365, upon the need for recognizing the services of Cols. Mason M. Patrick and Edgar Jadwin of the Corps of Engineers, U. S. A., by placing them on the list of permanent brigadier generals soon to be reported to the Senate for confirmation, and by so doing recognizing the engineers of this country for their work in France, has been read with pleasure. I regret that this movement was not undertaken one year ago.

Going to France in August, 1917, and starting my army work by organizing the engineer depots and supply directly under General Patrick, I came to know him about as well as any other officer entering the army from civil life. At that time he was chief engineer, Line of Communications, and all the pioneer work of the tremendous construction program of the A. E. F. was under his charge. Another wonderful piece of work, seemingly forgotten by everybody, was that while doing difficult service as an engineer he was also commanding general, Line of Communications, during the trying winter of 1917. In that capacity he laid the foundation of what was later known as the Services of Supply, and this work, while a side issue in his service, was of inestimable value to the A. E. F.

About May, 1918, he was promoted to be major general and chief of the Air Service and thereafter for a year I knew little of his work except that the Air Service soon seemed to find its feet or, rather, wings. In 1919, as member of the U. S. Liquidation Commission of the War Department, I again came in close touch with him in liquidating the complicated affairs of the Air Service and if my admiration could have been increased it would have been by his work in these matters. In all the conferences on the many matters pertaining to the liquidation of the Air Service never, by word or deed, did he try to "pass the buck" or to explain to the commission that certain matters were the work of his predecessors or in any way attempt to dodge any criticism. I was the only commissioner that knew he was in no way responsible for the early condition of affairs.

Brigadier-General Jadwin carried to a successful completion the largest program of construction work ever undertaken in the world under the direction of one head. I served under him as chief of the Railway and Dock Construction, D. C. and F., and was in daily, almost hourly, contact with him. I have never known a man, in army or civil life, who so well understood the fundamentals of administration, who could so inspire confidence and enthusiasm among those working under him, and who could see and forestall trouble as could General Jadwin.

At the time of the armistice he had 150,000 men working under him at top speed and he never knew the word "impossible" which was dropped, by his example, from the Engineers' vocabulary.

That the service record of these two men should be overlooked in the naming of permanent brigadier generals is unjust and a reflection on the work of American engineers. I propose to urge my friends who served with me in France to bring all the pressure possible to bear so that this injustice may be corrected. J. H. GRAHAM,

New York, Formerly Colonel, Corps of
March 7. Engineers, A. E. F.

Salary of Secretary, Am. Soc. C. E.

At the meeting Jan. 20 of the Board of Direction of the American Society of Civil Engineers the salary of the secretary for the year 1921 was fixed at $10,000.

HINTS FOR THE CONTRACTOR

Save Cost of Bunker by Storing Materials in Surge Chamber

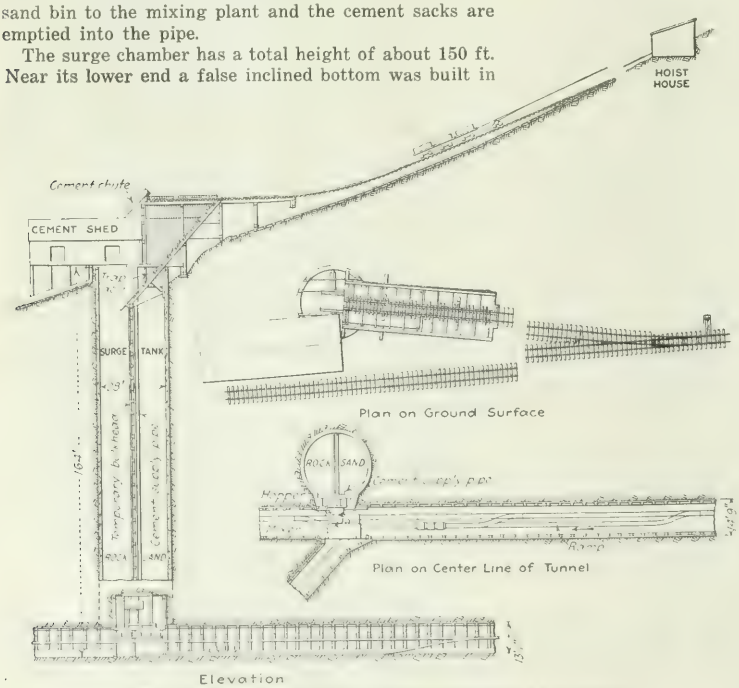
IN PREPARING to place the concrete lining in the tunnel which will serve the penstock of the Caribou hydro-electric development, in California, it was decided that the delay and expense of building a sand-and-gravel bunker could be avoided by using the surge chamber as a temporary storage bin for the materials and locating the mixing plant near its bottom, above tunnel level. The surge chamber is excavated in the hillside above the tunnel and close to its south end where the tunnel meets the construction railroad over which materials are delivered. The general arrangement, as shown in the accompanying drawing, has worked out successfully according to W. D. Shannon, superintendent of construction for Stone & Webster, Inc., the contractor on the project.

Sand and crushed rock are hauled on standard-gage cars up an incline to a switch above the tipple. The cars are then lowered to the tipple and emptied down a very steep chute which has a trap door arrangement by means of which the sand can be discharged into one side of the surge chamber and the rock into the other side, the chamber being divided into halves by a partition built on a diameter.

The cement is hauled up on the same track and chuted into a shed which can store about 2,000 bbl. From this shed a 12-in. steel pipe goes down through the sand bin to the mixing plant and the cement sacks are emptied into the pipe.

The surge chamber has a total height of about 150 ft. Near its lower end a false inclined bottom was built in each side of the partition and trap doors were put in through which the aggregate could be delivered to the mixer below.

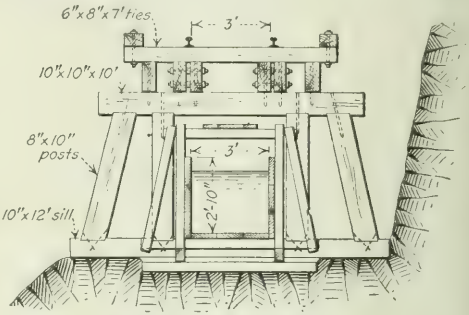
The mixer discharge is above the arch of the tunnel so that materials and concrete are delivered entirely by gravity.



ARRANGEMENT FOR USING SURGE CHAMBER AS BUNKER

Construction Railroad Built Over Flume to Save Excavation

ON THE Caribou project in northern California, a narrow-gage construction railroad was built over a wooden flume at a considerable saving in the cost of construction. The flume, which carries the water for a hydro-electric power house is located in a bench cut and sills for the railroad trestle were slipped under the flume and plumb posts were set just outside the side walls, as shown in the accompanying sketch. This plan provided a roadbed without the expensive excavation that would have been necessary otherwise, and it was made possible for the work to be done in such a way that there was no interference with the usual flow of water in the flume. On the contrary, the water in the flume was used as a means of delivering the timbers which were cut in a sawmill near the head of the flume. An inclined rack in the flume box was so constructed that it could be moved along as the work progressed. It served to stop the timbers at the desired point.



(BOSTON & MAINE R.R.)
SECTION OF TRESTLE AND FLUME

NEWS OF THE WEEK

New York, March 10, 1921

Muscle Shoals Dam Appropriation Is Killed

The fight on the matter of continuing work on the Wilson dam at Muscle Shoals was continued into the closing hours of Congress. The $10,000,000 intended for the continuation of the work during the coming fiscal year finally was eliminated from the Sundry Civil bill when it seemed that the controversy was about to cause the failure of that entire $400,000,000 supply bill.

The question precipitated the most acrimonious controversy of the entire session. There was a small majority in the House against any further appropriation for Muscle Shoals development, but the sentiment in the Senate was well pronounced for continuing the work on the dam. On one hand, the measure was denounced as an effort to loot the Treasury. Those favoring the appropriation declared that the opposition to it had been stirred up by the fertilizer and powder manufacturers. Col. Hugh L. Cooper, testifying before a House committee, declared it would be a national crime to abandon the project after $17,000,000 of the people's money had been expended on the construction of the dam. Closely linked with the dam project is the matter of operating the large nitrate plants.

New Jersey Governor Opposes Port Treaty with New York

A message in opposition to passage this year of the proposed Port Treaty between New York and New Jersey was transmitted to the New Jersey Legislature by Governor Edwards March 1. Governor Edwards said that it would be unwise at this time to commit the state to the treaty until there had been further opportunity of examining and studying the plan recommended by the New York, New Jersey Port and Harbor Development Commission in its report only recently made public.

There has been much criticism of the joint Commission's plan by some New Jersey interests, and a joint resolution at this writing is before the legislative judiciary committee of the New Jersey Assembly for creating a commission to examine into and report before Jan. 1, 1922, on the plan recommended by the bi-state commission.

Sydney Harbor Bridge

Renewed activity in the project to bridge the harbor of Sydney, N. S. W., is indicated by a cable dispatch of Dec. 23, stating that the government of New South Wales plans to invite international bids for such a bridge. Its cost is set at $25,000,000.

Assay of Industrial Waste Is Progressing

A definite scheme of operation for the survey of industrial waste which the council of the Federated American Engineering Societies has undertaken at Herbert Hoover's suggestion went into effect Feb. 7 and on Feb. 21 reports on the first investigation in each industry were made. The work involves examinations in ten key industries as follows: Bituminous coal, building trades, transportation, men's ready-made clothing, printing, paper, metal trades, textiles, shoes and rubber. From three to ten plants of each selected industry are being visited by experienced engineers to secure information desired by the committee. The investigations are being carried on under the following three main subdivisions: Organization, engineering, and production and cost control.

The committee on waste elimination is headed by J. Parke Channing, of New York, chairman, and L. W. Wallace, executive secretary of the council and vice-chairman of the committee. The coal investigation, it is stated, will be completed by April 1.

Danger of Losing Federal Funds in California Denied

A denial that any part of the federal funds apportioned to California for highway improvement is in danger of loss was made recently by the California Highway Commission. The denial is in reply to a published statement issued by the California State Automobile Association that $10,000,000 of such funds allotted to California are in jeopardy.

"The assertion of the Automobile Club is a complete misstatement," says the Highway Commission. "In the first place $10,000,000 has not been apportioned to this state. The total allotment of federal road funds to California is $8,384,000. Of this amount $3,585,000 is covered by project agreements already signed. The commission has until June 30, 1922, to enter into project agreements for the remaining $4,799,000. The commisison is in a position to cover this latter amount three times over.

The only danger to federal funds that has ever confronted California, according to the commission, was the possibility that highway work would have to stop through inability to sell bonds. This danger was overcome by the passage at the last election of amendment 9, making the interest rate on highway bonds flexible and thus assuring their sale.

Power Commission Issues First Licenses

All of Niagara River Cases Disposed of and Ford Permit at Troy Granted

With the completion of its regulations, the Federal Power Commission was able at its session on Feb. 28 to authorize the issuance of its first licenses and permits. Incidentally the meeting was the final one during the term of office of the present commission. As a result every effort was made to take definite action on all pending matters so that the incoming commission would have to deal with a minimum amount of pending questions.

Licenses were issued as follows: The Niagara Falls Power Co., Niagara River; Henry Ford & Son, Inc., Hudson River at Troy, New York; Southern California Edison Co., authorizing an extension of its Big Creek system; Luther Hill, authorizing a project of less than 100 hp. in California.

Preliminary permits were issued as follows: Niagara River Power and Water Supply Co., Niagara River; Hydraulic Race Co., Lockport, N. Y.; Dixie Power Co., White River, Ark.; Washington Irrigation and Development Co., Columbia River, Washington; Pit River Power Co., Pit River, Cal.; United Mills Co., Harpers Creek, N. C. Licenses also were issued for transmission lines as minor parts of some complete projects.

The license authorized for the Niagara Falls Power Co., covers 19,500 cu.ft. per sec. and is to cover a period of fifty years. The company agrees, as a part of the consideration, to amortize completely its investment in Niagara Plants Nos. 1 and 2 and Hydraulic Plant No. 2. The investment in these plants is to be written off completely during the period of the license. Valuation is to be undertaken later. The commission voted unanimuosly that in case of a modification of the existing treaty so as to permit of additional diversion that it is the commission's judgment that it should be handled by the "over the top" development whereby the full head can be obtained by carrying the water to the vicinity of Lewiston.

A preliminary permit was authorized for the Niagara River Power and Water Supply Co., covering 30,000 sec.-ft. in the gorge. The permit is for two years with the understanding that before the license is issued the permittee will submit plans for the utilization of the water under such increased head as is found to be economically practicable. The commisison voted to issue a preliminary permit to the Hydraulic Race Co., covering a diversion of 500 cu.ft. per sec. through the Barge Canal.

The other seven Niagara River applications were rejected. The applications of the Niagara Power & Development Co. and of the Niagara, Lockport and Ontario Power Co. were rejected on the ground that the commission is without authority to issue preliminary permits for the diversion of water from the Niagara River above the falls in excess of the amount authorized by the treaty. No action was taken by the commission which would indicate approval or disapproval if the additional diversion should be arranged. The application of the city of Buffalo was dismissed because no specific plan of development was submitted. The commission also is of the opinion that the city has no legal authority to carry out any scheme of development.

The application of T. Kennard Thomson and Peter A. Porter was rejected because the application comes within the jurisdiction of the International Joint Commission and because of a doubt entertained by the commission as to the feasibility of harnessing the Niagara River below the falls. The application of the Western New York Utility Co. for the diversion of an additional 500 sec. ft. through the Erie Canal was rejected, as was the application of the Niagara Gorge Power Co. The application of Millard F. Bowen for a canal, reservoirs, power houses, conduits and locks between Lake Erie and Lake Ontario also was denied by the commission.

The license authorized for the project of Henry Ford & Son involves the use of the head of water developed by the Trow dam.

Parks Excluded from Provisions of Water-Power Act

In the closing sessions of Congress an amendment to the Federal Water-power Act was approved so as to eliminate from its provivisions existing national parks and monuments. This amendment complies with the promise made last June to the Secretary of the Interior when he agreed to remove his objection to the water-power bill, thereby paving the way for its signature by the President. The amendment was unopposed except by those who wished to strike out the word "existing" and make it apply as well to national parks which may be created in the future. The text of the amendment is as follows:

That hereafter no permit, license, lease, or authorization for dams, conduits, reservoirs, power houses, transmission lines, or other works for storage or carriage of water, or for the development, transmission, or utilization of power, within the limits as now constituted of any national park or national monument shall be granted or made without specific authority of Congress, and so much of the act of Congress approved June 10, 1920, entitled "An act to create a Federal power commission; to provide for the improvement of navigation; the development of water power; the use of the public lands in relation thereto; and to repeal section 18 of the river and harbor appropriation act, approved August 8, 1917, and for other purposes," approved June 10, 1920, as authorizes licensing such uses of existing national parks and national monuments by the Federal power commission is hereby repealed.

Am. Soc. C. E. Amendments Defeated

By a vote of about five to one all of the proposed amendments to the constitution of the American Society of Civil Engineers, sent out some time ago to letter ballot, were defeated. The result was announced by President Webster at the regular meeting of the society held in New York City, March 2. This action clears the way for the committee's new constitution to be presented at the annual convention in Houston, Texas, April 27.

Suggest Steel Superstructure for Belle Isle Bridge

At a public hearing on the Belle Isle bridge project held by the Detroit city council Feb. 24, the possibility of a steel bridge in place of either the cantilever structure designed by the bridge commission or the reinforced-concrete arch bridge for which designs have been submitted by Daniel B. Luten was suggested. Local engineers present at the hearing discussed the several designs and advocated submitting them to a board of engineers. The Detroit Engineering Society submitted a list of sixteen engineers with the recommendation that five be selected to pass upon all bridge designs for the city (see p. 396, March 3 issue).

The effect of foundation conditions on the availability of an arch design was discussed by Prof. L. M. Gram, of Ann Arbor, a member of the commission that prepared the official design (cantilever type). He challenged Mr. Luten or any other engineer to predict the stresses set up by uncertain settlement conditions. Unequal settlement of adjacent piers, he said, would not affect the stresses in the cantilever type of bridge but would be detrimental to a rainforced-concrete arch, and temperature stresses also would present a comparatively serious problem in an arch bridge.

Two Main Questions

Two main questions involved in the present issue are whether the city wishes to spend more money than the amount remaining in the bridge fund, and whether it is possible to build the Luten bridge with the money remaining.

H. H. Esselstyn, of Esselstyn, Murphy & Hanford, supervising engineers of the bridge, stated that he had checked over Mr. Luten's estimates of cost and believed them to be too low, and that the original cantilever proposed could be completed for $3,500,000, estimating the cost on Mr. Luten's unit estimates.

Proponents of a steel bridge suggested among other things that the bridge problem be thrown open for competitive designs, under specifications issued by the city, a competent board to pass upon designs. A steel bridge, it was claimed, would be lighter and cheaper than the official design, and just as substantial and satisfactory from the æsthetic viewpoint.

The majority of the council appeared to favor carrying out the original design if possible, although a further bond issue is not considered desirable. Present indications are that the bond issue will be submitted to referendum, and that an affirmative vote will be interpreted as meaning that the original design is wanted by the citizens while a negative vote will mean that the design of the bridge must be such as can be built for the available sum.

Protest High Freight Rates for Wisconsin Road Materials

A protest against what were characterized as excessively high freight rates on crushed stone, gravel, sand and other materials for highway construction and a threat to develop these materials locally at roadside plants, eliminating entirely shipment by rail, were the principal developments of a conference called by the Wisconsin Highway Commission at Madison, Feb. 18, and attended by state and county highway officials, railroad officials, highway contractors, stone, sand and gravel producers, cement producers and dealers, and representatives of surety companies.

The state has available for construction and maintenance of highways in 1921 the sum of $30,000,000. Bonds authorized to be issued for highway construction by the counties of the state aggregate $35,000,000. In the expenditure of these sums both state and counties, according to A R. Hirst, state highway engineer, are forced by the present freight rates to consider the establishment of local quarries and sand and gravel pits in order to bring down the excessive cost of materials. If the state is forced to adopt the policy of producing materials at roadside plants an aggregate investment amounting to many millions of dollars in commercial stone quarries and gravel pits may be wiped out. In order to save the situation, according to Mr. Hirst, an immediate heavy cut must be made in the freight rates prevailing on the highway material.

Quick Action Necessary

"We must know what the railroads find it possible to do," said Mr. Hirst, "not in a few months but as soon as is possible. We are holding the determination of the type of construction of certain of our projects, pending a decision on freight rates. We must act on all these matters soon, because our unemployed demand employment and in one way or the other the work must proceed."

In Wisconsin the increased rate on cement, as compared with 1914 prices, costs more than $1,000 a mile on average location concrete roads. The final stake, according to Mr. Hirst, is whether until millions of tons of materials for the Wisconsin road program are to be commercially produced and moved by rail, or whether these tons are to be largely produced at roadside plants.

The New Administration of the Am. Soc. C. E.

In this issue of "Engineering News-Record" appear the last two of the biographical sketches of the newly elected officers and directors of the American Society of Civil Engineers, as announced in the issue of Jan. 20, p. 140, following the annual meeting.

Frank T. Darrow, Director

Frank T. Darrow, director, District 10 (Lincoln, Neb.), assistant chief engineer of the Chicago, Burlington & Quincy R.R., was born in Corning, Iowa, in 1875, and was graduated with the degree of C. E. from Allegheny College,

FRANK T. DARROW

at Meadville, Pa., in 1897. He began work with the Burlington & Missouri River R.R. (later the C., B. & Q.) in 1897 as back-flagman and was promoted through the various grades on location, maintenance and construction of new lines in Wyoming, Colorado and Montana until in 1902 he became resident engineer on the reconstruction of the Plattsmouth bridge over the Missouri River.

Until 1905 he was engaged on general bridge work for the railroad, when he resigned to become general manager of the International Contract Co. at Seattle, Wash., with C. E. Fowler. He returned to railroad work in October, 1906, as engineer, maintenance-of-way, on the Nebraska district of the C., B. & Q., at Lincoln and was promoted to assistant principal engineer the following year. In 1908 he became engineer of Lines West. He was named assistant chief engineer in 1918 and has continued in that capacity to date.

Mr. Darrow received a special appointment in 1914 to devote a year's study of freight houses and freight handling in connection with the Union Station project in Chicago.

George G. Anderson, Director

George G. Anderson, director, District 11 (Los Angeles), is a consulting engineer with wide experience in the field of irrigation. He was born in Aberdeen, Scotland, in 1858 and attended the University of Aberdeen until, in 1874, he became an apprentice with Walker & Beattie, surveyors and engineers, of Aberdeen. After five years of this work he joined the staff of the London & Northwestern Ry. in England, leaving this position after about a year to come to the United States.

In 1880 he was appointed assistant engineer on the construction of the northern Colorado irrigation canal at Denver and three years later became chief engineer of that work and three other Colorado canal systems.

Mr. Anderson entered private practice in 1890 as consulting engineer, specializing in irrigation. Among the works with which he has been connected are the construction of Lake Loveland, one of the first storage reservoirs for irrigation in Colorado; the Imperial Valley project, upon which he reported in 1896; an irrigation project for the Alberta Railroad & Irrigation Co. in Canada; and works for the Canadian Pacific Ry. He built the water-works

GEORGE G. ANDERSON

for Greeley, Col., in 1906, and in association with Leonard Metcalf, consulting engineer of Boston, made an appraisal of the property of the Denver Union Water Co. in 1913 and of the rights of the Spring Valley Water Co. of San Francisco in 1915. He served on the board of consulting engineers for the Imperial Irrigation District with C. E. Grunsky in 1917.

In connection with the controversy over boundary waters between Montana and Alberta Mr. Anderson advised the Canadian Government and in 1919 acted as consulting engineer for Alberta on an irrigation project. He has served as consulting engineer for the city of Colorado Springs on water-works and power development.

Examinations for Engineer Corps

Competitive examinations will be held beginning April 25 to fill vacancies in the various branches of the army. The successful candidates will be appointed second lieutenants. There are 118 vacancies in the Corps of Engineers, which it is hoped will be filled as a result of this examination.

State Engineer Bill Approved

A favorable report has been returned by the Indiana House Ways and Means Committee on House Bill No. 296, which would create the office of state engineer as a division of the department of conservation. The bill is supported by the Conservation Commission.

Changes Recommended for Indiana Highway Commission

Radical changes in the laws governing the administration and operation of the Indiana State Highway Commission are recommended in a report of the state board of accounts, made after an investigation of the affairs of the commission from June 4, 1917, to Sept. 30, 1920. The report was prepared by W. H. Glidewell and A. L. Donaldson, field examiners, and filed Feb. 18 with Jesse H. Eschbach, chief examiner. The main findings and allegations follow:

Thousands of dollars of purchases have been made without proper competitive bids, as is required by law.

The Ohio state highway commission in 1920 expended for "administration, salaries, new equipment, repairs of equipment, transportation, and all other expenses pertaining thereto," 5.7 per cent of the amount it expended for new construction. The Indiana department spent 31.7 per cent.

The average contract price per mile for the 135 miles of roads under construction is given as $35,611, without having figured in cost of engineering, inspection, administration, office equipment, supplies, meals, lodging, auto hire, railroad fare and other overhead which would show actual cost.

The department may receive in the present fiscal year a total of $7,356,725, but it is doubted, according to the report, if the department can build roads fast enough to expend the money.

A bill was introduced in the Indiana Senate, Feb. 19, providing for the repeal of the law under which the present State highway commission operates. It was referred to the Committee on Roads. The bill provides that the funds available for the commission shall go to the State school fund when the commission winds up its business. If the bill should pass, the construction of highways would be placed entirely in the hands of the counties.

Patented Pavements Permissible in Illinois, Court Rules

Under decision just handed down by the Supreme Court of Illinois an act passed in 1919 by the Illinois State Legislature regarding patented pavements is declared constitutional. Prior to that year the use of patented pavements had been prohibited under the Supreme Court's decision of the then existing law. The Legislature then passed an act permitting municipalities to contract for patented pavements provided they are placed in competition with unpatented pavements.

Pursuant to this act the city of Rockford, Ill., received proposals for several types of pavement, including Warrenite-Bitulithic, patented by Warren Bros. Co., Boston. A taxpayer, R. J. Schultz, brought an action to restrain the contract on the grounds that the act of 1919 was unconstitutional and that the proceedings had not fully complied with the act. The Supreme Court, in unanimous opinion written by Mr. Justice Carter, has decided against the plaintiff taxpayer on all points and sustained the decision rendered by the county court more than a year ago. This case has been in the courts for nearly two years.

Bill to Register Builders in New York City

A bill just introduced in both houses of the New York state legislature provides for registering builders in New York City, and prohibits the issuance of building permits to or the conduct of building work by any persons not duly registered. The purpose is to be accomplished by amending the charter of the city by the addition of a registration clause. Under this clause a building permit can be issued only to an architect, engineer, builder, contractor or other person duly registered in the office of the bureau of buildings as a person fully qualified to undertake or supervise the work of construction or alteration covered by the permit.

Concerning the method of registration, the bill provides that the superintendent of buildings shall, within ten days after an application for registration, issue to the applicant a certificate of registration or furnish him a statement in writing setting forth the reasons for rejection.

Certificates of registration may, however, be issued to anyone who has received a permit for building work within the past three years and has not since been convicted of violation of a building regulation. The superintendent of buildings has power to cancel any certificate of registration for cause.

This bill was presented at the instance of the building authorities of New York City. According to Rudolph P. Miller, superintendent of buildings, Borough of Manhattan, its object is to place more definitely the responsibility for proper and safe construction and compliance with the building law. It is supported by a resolution of the Building Officials' Conference, advocating that building operations be restricted to persons of proved ability.

Experience in the borough of Manhattan, Mr. Miller states, has demonstrated the need for a law to fix responsibility on builders. "It has not been unusual for an applicant to submit to this bureau for approval a set of plans and then to pass on to the builder or owner a different set with the misleading information that they are approved; to work contrary to approved plans; to work without a permit; to make misstatements or misrepresentations in the application or on the plans as to surrounding conditions that vitally affect the validity of the permit; and to change the occupancy of a building after its completion contrary to the certificate of occupancy."

Ask I. C. C. Authority for Union Station at Cleveland

An application for authority and certificate of public convenience for the construction of the proposed high-level union passenger station to be located on the Public Square at Cleveland has been filed with the Interstate Commerce Commission by the New York Central R.R. The application contemplates the use of the passenger station by the New York Central, the Big Four and the Nickel Plate.

For some time it had been planned to build a union station on the Lake front. Then the project for the high-level station was launched. The two plans were described and commented upon editorially in *Engineering News-Record*, Jan. 30, 1919, pp. 241 and 217, respectively.

The granting of the present application will permit the three railroads to contract with the Cleveland Union Terminals Co. for construction and operation of the high-level station so that further legal measures and financing may go forward. The project as now put forward was approved by city ordinance Jan. 6, 1919.

Gear Train Protected in New Type of Water Meter

To prevent damage by acid, alkaline or sand-bearing water the Neptune Meter Co. has developed a Trident meter in which a circulation of water is prevented from reaching the spindles and gears of the gear train, which operates constantly in a bath of lubricant. The flanged disc forming the bottom plate of the gear train fits against the machined surface of the inside of the casing, thus making a tight joint. In assembling, the gear train is filled with a special lubricating compound which reduces friction and protects the metal parts. This new feature is adaptable to all Trident meters up to 1 in. now in service by means of a washer which fits between the shoulders of the disc and forms an equally tight joint in the older types of meters.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Convention, March 15-17.

The Minnesota Surveyors' and Engineers' Society, at its convention in St. Paul, Feb. 21-23, ratified without a dissenting vote the constitution of the proposed Minnesota Federation of Architectural and Engineering Societies and raised the dues to take care of this additional expense. The proposed registration law for architects and engineers was also indorsed. Sectional meetings devoted to municipal, highway and drainage affairs, were held in the forenoons of the 22nd and 23rd. General assemblies were held in the afternoons. W. N. Ryerson, general manager of the Great Northern Power Co., of Duluth, spoke on the civic responsibilities of the engineer. E. G. Quamme, president of the Federal Land Bank of St. Paul, told of the development of fifty million acres of land in the Great Lakes region and the part the engineer is expected to have in it. At the banquet, Feb. 22, Dean Leland, College of Engineering, of the State University and Horace Lowry, president of the Twin City Rapid Transit Co., were the speakers.

The Providence (R. I.) Section, Am. Soc. C. E. and the **Providence Engineering Society** held a joint meeting Feb. 15 at which Arthur P. Davis delivered an illustrated lecture on "National Irrigation." Mr. Davis described for the first time in public the project for flood control of the Colorado River.

The New Jersey Sewage Works Association, at its meeting, Feb. 18, elected the following officers: President, C. G. Wigley of Maplewood; vice-presidents, S. F. Miller of South Orange and M. C. Smith of Newton; secretary-treasurer, M. E. Fuller of Summit.

The Engineering Society of Wisconsin, at its annual meeting in Madison Feb. 21-23, elected the following officers: President, Prof. C. I. Corp; vice-president, Jerry Donohue. Resolutions were passed advocating that the state legislature compel the licensing of all engineers, the establishment of a college of architecture at the state university, and the deepening of the St.

Lawrence River for the use of ocean liners.

The Portland Section, Am. Soc. C. E., at a recent meeting, passed a resolution calling upon the board of direction of the society to restore the policy of publishing technical papers and discussions in full in the *Proceedings*. The present publication policy is condemned. The point is made that the principal benefit of membership in the society and for which dues are paid is the receipt of technical papers and discussions thereon. Copies of the resolution have been forwarded to all of the other sections of the society with the request that each express to the board of direction its views regarding future publications.

Personal Notes

C. T. Jackson, district engineer Chicago, Milwaukee & St. Paul Ry., has been appointed principal assistant engineer with office at Chicago.

James, Proctor & Redfern, Ltd., is the new name of the E. A. James Co., Ltd., Toronto, Ont. Mr. Proctor has been with the company as managing director since 1916 and continues his work as vice-president and managing director. Mr. Redfern during the past year has acted as secretary-treasurer for the company and will continue in that office. The business will continue as an organization of consulting municipal engineers.

A. N. Wardle, member of the engineering party sent to Athens, Greece, last summer by Ford, Bacon & Davis on the design of system of water supply and sewerage of Athens and Peiraeus has returned and become associated with the Holway Engineering Co., civil and sanitary engineer, Tulsa, Okla. Mr. Wardle was formerly chief engineer West Virginia State Board of Health.

C. R. Thomas, in charge of the publication of results, Forest Products Laboratory, Madison, Wis., has resigned to become editor of the *Professional Engineer*, the magazine of the American Association of Engineers. Mr. Thomas was formerly associate editor of *Engineering & Contracting* and more recently editor of *Successful Methods*.

Edmund T. Perkins, Edmund T. Perkins Engineering Co., consulting engineer, Chicago, will sail for Barranquilla, Colombia, South America, March 15. He is to report upon an extension of the activities of the El Prado Co., a Colombian engineering and construction corporation which is a consolidation of (1) an old Colombian construction company, de la Rosa Hermanos, (2) the engineering organization of K. C. Parrish, operating in the country for 16 years and (3) Middle West capitalists. Daniel C. Breck, Selden-Breck Construction, Co., St. Louis, is now on the ground for the same purpose with an engineer and architect.

Byron W. Benedict has resigned as city engineer of Lockport, N. Y., to become manager of the securities department of the American Gas Co., Philadelphia.

F. C. Dugan, formerly designing engineer, sewerage divison, office of city engineer, Flint, Mich., has been appointed state sanitary engineer of Kentucky, with headquarters in Louisville.

E. Y. Allen, valuation engineer of the Central R.R. of N. J., and the Philadelphia & Reading Ry., will, from March 1, devote his entire time to the department of valuation of the Reading System.

W. W. James, formerly assistant valuation engineer, Central R.R. of N. J., has been appointed valuation engineer to succeed E. Y. Allen. Mr. James has been connected with the company for about 18 years.

Besselievre, Disher & Miller, Inc., engineers and constructors, have opened offices in New York City. E. B. Besselievre is a consulting engineer with 14 years' experience and specialization in the design and construction of sewerage systems, sewage treatment plants and general sanitary engineering practice for municipalities, industrial plants, etc. He is at present acting as advisory engineer for the Chemical Warfare Service, U. S. A., Lakehurst, N. J. Q. F. Disher has supervised, as chief field engineer, construction of many sewerage and water systems, sewage and water treatment plants, roads, and general utilities for municipalities in many states. C. W. Miller is experienced in the design and construction of general utilities, power plants, gas plants, and general engineering layouts.

D. G. Fishbeck, formerly with the engineering department of the Turner Construction Co., New York, has accepted a position on the faculty of West Virginia University in the department of mechanics.

G. D. Hastings, formerly city assessor and acting manager, has been appointed town manager of Guelph, Ont.

C. C. Cunningham has been appointed division engineer of the Kansas division Chicago, Rock Island & Pacific Ry., with headquarters at Herington, Kan.

W. W. Schlecht, project manager U. S. Reclamation Service, Yuma Project, Yuma, Ariz., has resigned. He has been with the Reclamation Service almost continuously since its establishment.

George F. Drew has resigned as chief engineer of the Pejepscot Paper Co., Brunswick, Me., and contemplates taking up the practice of general mill engineering with office at Brunswick.

Obituary

Major-Gen. Alexander MacKenzie, U. S. A., retired, and former Chief of Engineers, died Feb. 23 in Washington, D. C. He was born in Potosi, Wis., in 1844 and was graduated from the U. S. Military Academy, West Point, in 1864, when his service with the Corps of Engineers, U. S. Army, began. After serving in the Civil War with rank of captain he engaged in important public works construction, including the improvement of the harbors of Lake Michigan, the construction of the Louisville and the Portland canals. From 1895 to 1903 he was first assistant to the Chief of Engineers, a member of the Missouri River Commission and member of the Lighthouse Board. He was promoted to colonel in 1901. On Jan. 23, 1904, he was made brigadier-general and Chief of Engineers. He was retired after fourty-four years of active service, May 25, 1908, but continued his interest in engineering matters. During the World War he again entered the service and continued on active duty until about a year ago.

Col. Michael J. McDonough, Corps of Engineers, U. S. Army, died Feb. 13 in Denver, Col. He was born in Boston, Mass., in 1877 and was graduated from the U. S. Military Academy in 1899. He began his army service with the Artillery, later being transferred to the Engineers. From 1900 to 1902, he was stationed at Ft. Barrancas, Pensacola, Fla., on electrical installations, concrete work in seacoast batteries, building construction, harbor construction, dredging, and installation and development of a system of fire control for seacoast guns. He left this work to enter the Engineer School of Application, Washington Barracks, Washington, D. C. In 1903 he became assistant instructor in practical military engineering at the U. S. Military Academy (under Major M. M. Patrick). During this time he assisted Major Patrick in constructing a pipe line from Ft. Montgomery to West Point, and in similar projects. He was instructor of cadets in topographical surveying and in military road reconnaissance. Colonel McDonough is joint author with Col. P. S. Bond of the widely known book "The Technique of Modern Tactics." In 1917, when about to leave with his regiment for duty in France, he developed tuberculosis and was placed in the U. S. Army general hospital. He has spent about three years in the West. Col. McDonough was graduated as number 15 in his class at West Point.

Civil Engineers Fail To Elect Secretary

In accordance with a decision made at the meeting of the board of direction of the American Society of Civil Engineers in January the election of a secretary of the society was one of the principal items of business at the board meeting, March 7. A committee of past-presidents, in accordance with previous instructions, reported on the qualifications of the candidates. Balloting was then ordered by the board, said balloting to continue until a choice is made, the result to be announced at the Houston convention.

Chicago Railway Terminal Commission Changes

John F. Wallace and Bion J. Arnold, consulting engineers, have resigned from the Chicago municipal commission on railway terminals. Mr. Wallace is succeeded as chairman by W. F. Lipps, who was formerly chairman of the city council committee on railway terminals. Edward J. Noonan, chief engineer for the commission, succeeds Mr. Arnold.

Clinton, Iowa, Rejects Municipal Ownership of Water-Works

By a vote of 3,201 to 722, Feb. 11, Clinton, Ia., rejected a proposal to acquire the privately-owned waterworks now supplying the city. A proposal for a $435,000 bond issue to supplement an existing debt of $465,000 against the property was also voted down 3,252 to 724.

Six-Year Comparison of Wholesale Commodity Prices and Building Materials Costs

Aberthaw Construction Company's Analysis Shows Latter Are Now Approaching Commodity Level

By H. E. Keyes
Aberthaw Construction Company, Boston

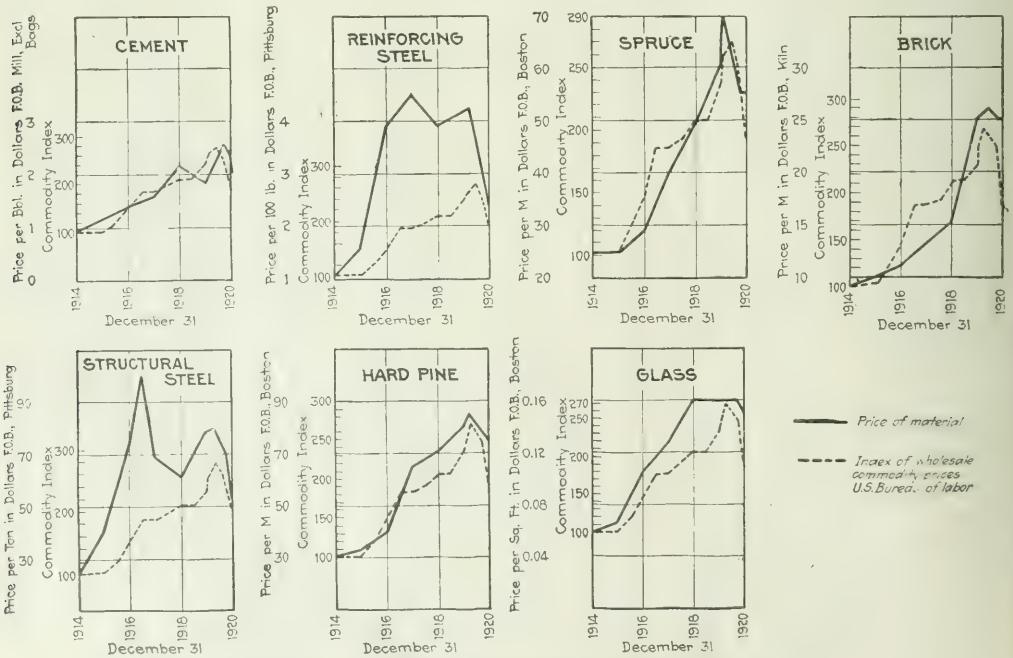
The close of 1920 put an end to skyrocketing of building material prices and saw the majority of those prices moving tamely but swiftly toward the level of commodities in general. This is clearly shown in the accompanying set of charts prepared by P. F. Ayer, planning department, Aberthaw Construction Co., in which the relation between the prices of building materials and of wholesale commodities is compactly presented for the period from 1914 to 1920.

The commodity index scale starts at 100 in 1914 at the level of a particular commodity price at that time. The figure 200 on the commodity index scale is at the same level as twice the 1914 price, so that the price curve of the particular material under consideration can be read either on the price scale, showing actual material prices, or on the commodity index scale, showing the relative price of the material to the basic 1914 price.

The commodity price index used is that of the United States Bureau of Labor Statistics. The scale of building material prices is the scale of actual cost of the materials—not their quoted prices. This is particularly important in the case of steel, which, throughout the war and for some time subsequent thereto, exhibited a wide disparity between quotations and delivery prices.

The chart offers a text for a variety of discussions. Perhaps its most obvious indication, however, is that of the extraordinary sensitiveness of steel prices to actual conditions of demand and supply. The great sinews of modern war are of steel. Hence, steel, even though weighted by government control, was the first structural material to make a conspicuous rise from the general commodity level. With the special demand withdrawn, steel has made the swiftest approach to the level of other things.

It is to be observed that the charted line extends only to the close of 1920. The first few weeks of 1921 have witnessed still further declines both in the commodity index and in the quoted prices for building materials. The commodity index has declined to 177 since Jan. 1, 1921. Actual prices of building materials—that is, prices for cash purchases in quantity—are only formally quotable, since there is no market worthy of the name and hence no real knowledge of the purchasing power of a dollar that has the courage to venture out in actual quest of goods.



RELATION OF BUILDING MATERIAL COSTS TO COMMUNITY PRICES

Construction Conference Urges Price Deflation

Lower Re-discount Rates and Governmental Economies Essential—Local Conferences Urged

Frankly stating that public distrust of the construction industries is the cause of the present stagnation in building, the National Construction Conference at Chicago on March 2 and 3 advised "drastic deflation of prices and wages to an irreducible minimum." While each charged responsibility for inaction to the others, labor, management, capital and transportation all agreed on this main fact. Organized labor, it is to be particularly noted, was as prompt in accepting its duty in readjustment as were capital and management. With the decision that deflation is necessary the conference recommended that local conferences be held to state the problem and arrive at means for concerted action and that individual industries review and revise their prices to secure complete deflation at the earliest possible moment.

Cheaper Money Essential

Striking the keynote of the conference with the statement that no remedy was possible unless all interests approached the situation with a determination to sacrifice something Harry A. Wheeler, vice-president, Union Trust Co., Chicago, announced that "it is obvious that cheaper money is essential to the start of building operations." If it may be expected that labor, materials, transportation and money will recede no further then this is the time to begin to build, and to convince the public that such is the case. If, on the other hand, we may expect that these commodities will be cheaper, every effort must now be made to arrive at that stage of an "irreducible price level" when reconstruction may start.

Rediscount rates, expressing the financial remedy to the building trade Mr. Wheeler said, are the main obstacles facing the construction business. "If re-discount rates were lowered today current money rates would fall within 48 hours," he said. "From our viewpoint," he continued, "that is the biggest item now obstructing the financing of building projects. If the Federal Reserve system will lower its re-discount rate in conformity with the rate now prevalent in a number of commodities the banks will immediately lower their interest rates on money."

Railways Cannot Reduce Rates

C. H. Markham, president of the Illinois Central R.R., spoke on the transportation problem as it affects the construction industry, urging builders to co-operate with the railroads in furthering liquidation. He was supported by A. J. County, vice-president, Pennsylvania R.R., who stated that there will be no increases in rates despite the frequent deficits, but on the other hand there can be no decrease for some time to come. Mr. County stated that the "railroads have made a serious deflation in their outlays and costs, and are looking to the other trades and industries to help in making a basis on which business can resume." High costs and profits must be deflated to meet present conditions, he said. Industries can get close to their customers with prices for raw materials and finished work that will influence them to enter the market. We must also look for the government to assist this deflation program by definite steps: (1) The fixing of war indemnities and the funding of the war debts and costs of the various nations, as well as our own, so that the same may be spread over a fifty-year period; (2) reduction to a peace basis of governmental staffs and bureaus—federal, state and municipal—to bring about a reduction in heavy taxes."

The government, he asserted, must join in a program of cutting off large expenditures for non-productive work, and those that will not reduce expenses, and finish only those projects so far advanced that it will mean a waste of capital to stop the work.

High Prices Control—Not High Wages

Speaking for organized labor James Bulger, president of the Denver Trades Division of the National Federation, said: "Everyone who has taken part in this conference has taken a keen pleasure in 'passing the buck.' The railways have laid the trouble to labor and rates. The banks, as represented here, mention re-discount rates as the trouble, and labor. Coal representatives who have spoken at this conference have stated that 80 per cent of the cost of coal is due to labor. Construction men have plainly intimated that housing operations would start just as soon as labor reduces its wages. Labor may be somewhat at fault. That may be said of a number of things pertinent to the construction industry. But deeper than that it is indisputable that the real obstacle in the way of commencing building operation and one of the principal causes of unemployment are the high prices of building materials."

Conclusions

Summarized briefly the conference disclosed that current costs of construction materials still remain much and erratically higher as compared with pre-war costs and compared with the average of all other commodities. Current construction labor costs have not had proper adjustment to accord with present conditions. Practices and conditions surrounding financing of building construction require modification. Relations between employers and employees call for improvement and stabilization to secure continuity of operations in all building construction, and employers and contractors have not progressed to the needed extent in effecting reasonably prompt deflation of values throughout the construction industry (and all stages thereof from raw materials to finished products), including their own overhead and profit.

The conference was held under the direction of the National Federation of Construction Industries, Ernest T. Trigg, Philadelphia, Pa., president.

Chicago Expert Builders Formed

Chicago Expert Builders, an association of all classes of industry and science engaged in or connected with the construction industry, was formed last week. The application for a charter sets forth the objects of the association as follows: (1) To build Chicago better; (2) to further and promote high ideals in civic development and to encourage efficiency and public faith in municipal works; (3) to make available to the community the highest type of expert advice in construction and engineering problems; and (4) to make possible full co-operation between all classes of interests engaged in construction.

In personnel, the charter membership list contains names of engineers, architects and contractors, representatives of material producers, bonding companies, real estate operators and legal advisers. With no definite program established, it is felt that free intercourse between these various interlocking interests will result in the formulation of a program productive of benefit to the entire community. Following are the officers of the new association: William M. Lawton, attorney for the Real Estate Association of Illinois, president; Robert Isham Randolph, consulting engineer, first vice-president; Frank D. Chase, of Frank D. Chase, Inc., second vice-president; Ivan O. Ackley, real estate operator, secretary; and Hiram S. Cody, Chicago Trust Co., treasurer. Others among the incorporators are Wensel Morava, steel contractor, Harry B. Wheelock, architect, Peter Aagaard, contractor, Justin G. McCarthy, paint manufacturer and F. H. Rudderham, lumber dealer.

Building Report of Manhattan for February

According to the report of the superintendent of buildings, Borough of Manhattan, New York City, plans were filed during February for the construction of thirty-three new buildings costing a total of $8,861,360. Plans were filed for one tenement house, costing $250,000; one hotel, $1,500,000; six stores and loft buildings, $1,316,250; five office buildings, $3,355,000; one factory, $75,000; one church, $75,000; one municipal building, $79,000; one place of amusement, $1,500,000; nine garages, $505,600; and seven other structures, $5,610. Applications were made to alter [illegible] buildings at a total cost of $1,582,615.

Pennsylvania and Illinois Reject Road Bids

Nineteen of the twenty-six road construction projects on which the Pennsylvania highway department received bids Feb. 19 were rejected. All of the bids received Feb. 18 by the highway department of Illinois were rejected, the cause being the same in each case—excessive prices. In the case of Pennsylvania the low bids averaged in excess of $70,000 per mile, while in Illinois the average was about $50,000.

In rejecting the Pennsylvania bids State Highway Commissioner Sadler said that he did not believe prices submitted were representative of the downward trend of prices in labor and materials. The projects will soon be readvertised.

Call for Bids on Hudson Vehicle Tunnel Shafts

The second call for bids on construction connected with the Hudson River vehicular tunnel has been set for March 29. The work involved is the construction and sinking of two ventilating shafts to be located in the Erie R.R. yards at the Jersey end of the tubes. Due to more favorable ground conditions than existed on the Manhattan side, where steel caissons were called for, reinforced-concrete caissons have been selected as the type for the Jersey shafts.

Conditions in the Common Brick Industry

According to the March digest of the Common Brick Manufacturers Association of America, 98 out of 142 concerns reporting have made no recent reduction in the price of brick. Seven concerns have cut the price $3 a thousand; twenty, $2 a thousand; sixteen reduced less than $2 a thousand, and one concern reported a cut more than $3 a thousand. The 142 concerns represent approximately 40 per cent of the country's total production. After from three to six months of almost complete inactivity in the brick industry, prices range from $13 to $25 per thousand at the plants, with only four concerns out of the 142 quoting the lower figure.

More brick was shipped than during the preceding month, stocks on hand being reduced to 352,000,000 brick. The ratio of orders also has decreased, being 34 per cent as compared with the preceding report of 50½ per cent. Eighty-one per cent of the plants reporting are closed as compared with 86 per cent the month preceding. There is less than one month's normal supply of brick in the yards. Nearly all manufacturers who have resumed production, report labor supply and efficiency favorable and coal supply ample.

There is only one section of the country — Southern California — which is over-sold on common brick. The burnt brick on hand in that section, including California, Arizona and Nevada is approximately 15,000,000, whereas the orders on books total approximately 16,500,000 brick.

Manufacturers declare a further recession in prices depends on a downward revision in freight rates.

Lumber Orders and Shipments Greater Than Cut

For the first eight weeks of 1921 orders received from the seven associations of the National Lumber Manufacturers Association were 8 per cent in excess of the cut for the same period. The total shipments, though not so large as the orders received, exceeded the production by 5 per cent. The total production for the 8 weeks was 945,106,500 ft. b.m.; the shipments 993,624,038 ft. b.m.; and the orders 1,016,236,358 ft. b.m. These figures represent approximately 50 per cent of normal production, orders, and shipments.

January Imports and Exports Show Decline

According to a report recently issued by the Department of Commerce there was a sharp falling off in American trade with Europe and South America in January as compared with December. Our exports to Europe in January were $325,530,000 as compared with $388,587,000 in December, and the total export trade amounted to $674,740,000 in January as compared to $720,852,000 in December. Imports totaled $208,814,000 in January as compared with $266,112,000 in December, 1920.

Oil Pipe Line Abandoned

The oil pipe line from Le Havre to Paris, which was to have been constructed by a co-operative arrangement between French and American interests, as noted in *Engineering News-Record* of Sept. 16, 1920, p. 555, has been abandoned. Original plans provided for the engineering work to be done by the American Oil Engineering Co. and the construction under the general supervision of James Stewart & Co.

Wage Reduction in Shipyards Due on April 1

According to an announcement made March 7 by an attorney representing a group of shipbuilding companies wages in most of the plants located in Brooklyn and Staten Island, N. Y., and in Hoboken, N. J., are to be reduced 10 per cent beginning April 1. It is said that approximately 30,000 employees will be affected.

Panama Lock Gate Claim Settled

Settlement of the long-standing claim of the McClintic-Marshall Construction Co., Pittsburgh, for losses due to extra work required in building the steel lock gates for the Panama Canal, was accomplished by an appropriation of $714,007.39 by Congress in the session just closed. The company's original claim for extra work exceeded $2,000,000, but a commission appointed to investigate the expenditures reported five years ago that the company was entitled to the sum which Congress has now appropriated.

Wages Cut in Building Trades

During the past few weeks building trades employers in several cities have announced wage reductions. According to press reports the mason contractors of Detroit have reduced bricklayers wages 20 per cent, the new scale being $1 per hour. The master plumbers association of Fairfield County, Conn., cut plumbers' wages March 1 from $10 to $7 per day, at the same time reducing master plumbers' pay. Voluntary reductions have been accepted by the Boise, Idaho, building trades workers, as a result of a conference between contractors and workers in which plans for a stimulation of construction work were laid.

As a result of its refusal to accept a wage reduction of 12½ per cent the building trades council of Portland, Ore., has been informed by the employers that the wage agreement existing between the two associations will terminate May 1.

Several important industrial concerns have recently announced wage reductions, among them being the Truscon Steel Co., and the General Fireproofing Co., Youngstown, Ohio; the Baltimore Drydocks and Shipbuilding Co.; and several independent steel manufacturers, including the Jones and Laughlin Steel Co., Pittsburgh.

Miscellaneous Building Leads in Active Week

Despite the rejection of bids for state highway work in both Illinois and Pennsylvania during the past week, highway contracts have been let that represent a total outlay of about $2,000,000. Miscellaneous building, such as educational, office and bank, amusement, loft, apartment, continues active, thirty-eight contracts having been let which calls for a total expenditure of $11,741,121. In that figure are included four apartment houses in New York City to cost, together, close to $1,000,000.

The highway commission of Ohio let contracts for 32 miles of highways, mostly concrete or reinforced concrete, the total of the contracts being $965,709. Other smaller road and pavement contracts let brings the total for the week to approximately $2,000,000. Ohio is to receive bids March 18 for highway construction projects on which the engineers total estimate exceeds $1,500,000.

Considerable public works construction is being undertaken, the largest contracts let during the past week being Detroit municipal sewer contracts awarded on four sections for a total cost of $722,458.

The number of proposals noted in this week's construction news section indicates that miscellaneous building promises a healthy increase during the coming months.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren Editor

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Barge Canal Back to State Control

BY VIRTUE of the act of Congress signed the last of February the federal adventure on the New York State Barge Canal is to be brought to an end. The traffic and operation organization will be dispersed and the new and old floating equipment, which had only just begun to be used with any approach to efficiency, will be sold. New York once more gets back actually the control which it has always nominally exercised, and what the waterway advocates contend is the only fair test—that is, a unified control—may at last commence. The federal operation had its defects, but at least it recognized that the canal problem is now one of traffic. The state, if it appreciated that, certainly has not got results. The new state administration now has the whole canal in its hands. Will it set to work to develop an operating organization which will see that there is furnished a responsible, continuous and safe service, and at the same time make some effort to get people to use that service? Or will it content itself with offering a satisfactory waterway and persist in wondering why people do not use it? Will it continue the federal policy of a government-owned freight service sufficiently large to test the possibilities of the canal, or will it revert to its own original theory of the canal as a free waterway to be developed by competitive service?

Railway Track Labor Problem

AN ARRAIGNMENT of the railways, and indirectly of the engineering departments, for neglecting improvement in unsatisfactory track labor conditions is contained in the report of the committee on economics of railway labor, presented at the annual meeting of the American Railway Engineering Association. Neither efficiency nor economy can result from a high labor turnover, since so much of railway track work is in reality skilled work, but it appears from the committee's report that the railways have done very little toward stabilizing conditions of maintenance-of-way labor. There are manifest difficulties but certainly the railways have been outdistanced by public utility and industrial companies in respect to employment and housing conditions. One of the principal evils—and the remedy, it must be conceded, is not easy to find—is the failure to distribute track work throughout the year, resulting in increasing forces each spring and reducing them before winter. With steadier employment, better housing and boarding accommodations would naturally follow. It is encouraging to note the frankness of the committee report in recognizing the evils. It is becoming generally recognized that a movement to improve these conditions would be to the direct interest of the railroad as well as of the laborer. In carrying out a general program a serious difficulty is the radical difference in local conditions and in practices on individual railroads. Nevertheless, it would seem to be a proper function of the American Railway Engineering Association to conduct a broad investigation of track-labor conditions with a view to formulating recommendations to the American Railway Association for a campaign of betterment.

Sewage Removal Outruns Disposal

SEWAGE removal has been so far perfected and so generally applied in our cities and towns as compared with carefully planned and executed means of final disposal that it is no exaggeration to say that sewage removal far outruns disposal. Why should this be so? A ready and short answer is, "out of sight out of mind," but this is incomplete. The fundamental fact is that the removal of sewage from buildings is more essential to comfort and far more vital to health than its disposal. Accordingly, we have perfected our house plumbing, our lateral and main sewers, while, comparatively speaking, we have given little attention to sewage disposal. Those who complain of the little thought and effort given to sewage disposal, compared with water-supply, should bear in mind (1) that public water supplies are of prime importance for convenience of the citizens, for fire protection and for health; (2) that adequate means of sewage collection and removal, first from our houses and next from our streets and cities, have been provided; and (3) that the disposal of sewage, once it is removed from inhabited districts, has no such vital relation to public health as has water-supply.

Engineer Corps Vacancies

SENIOR students in engineering colleges, as well as graduates under 30 years of age, will have an opportunity next month of becoming officers in the Corps of Engineers, U. S. Army, hitherto very largely restricted to West Point graduates. There are 118 vacancies to fill in the grade of second lieutenant and the examination, as announced in last week's issue, is set for April 25. The pay of a second lieutenant, $2,120 including bonus, is more than most graduates will receive in private employment immediately after leaving college, but to the best men, of course, outside opportunities for financial advancement, after half a dozen years of experience, are more attractive than are those of the Army. Nevertheless to the young man who likes the Army life the chance of a commission in the Corps of Engineers should not be lightly passed by. He will, in all probability, have a varied experience, including service with troops, instruction and inspection of organized reserves, and construction work connected with fortifications and the improvement of rivers and harbors. His changes of station are apt to be frequent and he will be able to visit different parts of the country, and, if he has eyes to see, broaden his outlook thereby. Some men are temperamentally and constitutionally unfitted for Army service. Others take to it naturally. For the latter service in the Corps of Engineers offers permanent and honorable employment.

Predicting Concrete Strengths

ALL the theorizing and experimenting that is being done on concrete is directed toward the bettering of the material in practice, but it is sometimes difficult to see where the practical applicability lies. For a while this was especially true of the studies that started some years ago with the papers by Professor Abrams and Captain Edwards. It was evident that the investigators were opening up new trails toward a better concrete and, what is more important, a uniform concrete, but for a time these trails seemed pretty well cluttered up with the underbrush of testing data. Practical progress is now beginning to be made and nowhere is it serving a more useful purpose than in the work of the Ontario Hydro-electric Power Commission, where R. B. Young has been applying the new theories to concrete actually placed in large quantities. The article on another page, which reports the latest results of the work, shows that a remarkable conformity of prediction to results has been achieved. In the 2,500-lb. concrete class only one batch of concrete tested out of twenty-six fell below 200 lb. less than the strength desired and the average of the remaining ten deficient batches averaged only 95 lb. below; the grand average was 55 lb. above 2,500 lb. Better results were achieved with the leaner concretes; only two out of fourteen being below average in both cases. This is predicting strengths with consistent accuracy. The possibilities unfolded by these methods are many. They prove that better concrete than is usually produced can be attained when proper care and science are conjoined.

A Question of Fact

ATTEMPTING to account for unexpectedly good performance of engineering work is a necessary proceeding if full value is to be derived from the experience. In the case of the train wreck on the Georges Creek bridge, followed by repair of the bridge as described in our issue of Jan. 20, page 100, which revealed a surprising ability of the bridge to withstand severe battering, a study of what gave the bridge this quality was suggested in connection with that article. A. W. Buel's statement of the factors of resistance, on page 463 of the present issue, is illuminating, even though it may be considered incomplete. In fact, besides his discussion of rivet-hole reaming, the argument on short paneling contained in his article attracts attention because it is squarely opposed to the trend of modern opinion. The argument is too pointed to be disposed of by mere reference to the growing favor of long panels in modern steel bridge construction. The relative beam strengths of the members in long-panel simple-web trusses on the one hand, and short-panel subdivided-system trusses on the other, has to be considered in connection with the larger secondary stresses in the latter type. Some engineers hold that simple web systems, with longer panels, inherently give opportunity for more substantial and robust construction of the members than sub-paneled webs, and this is perhaps one of the motives for the increasing use of simple systems. But the logic of this contention is not obvious. And, what is more to the point it is by no means certain that the expected advantage is always obtained. The relative service resistance of simple and subdivided systems is in the last analysis not a theoretical question but a question of fact, to be determined by service experience.

Planning for the Unexpected

ENGINEERING PLANNING nearly always deals with uncertain conditions, and, though it gains in sureness by employing exact methods, its solutions cannot be exact. Hence the large part played by trained practical judgment in the art; and hence, also, the value of oft-renewed discussion of the objectives and guiding principles of engineering planning in any particular branch.

Recently, in such a discussion, which as usual brought forth both broad and narrow views, an engineer emphasized the point that it is the unexpected, rather than the normal and foreseeable event, that must govern engineering planning. In making this point he but stated an axiom of the art, one that has been recognized as such since the earliest days; yet his restatement of it came with striking force—perhaps simply because in our ever-growing sense of the exactness of technical procedure we incline to forget what a large borderland of future uncertainty surrounds the service of engineering works.

In ordinary cases many of the considerations derived from emergency requirements do not lie on the surface. It is instructive, therefore, to look at special fields in which the dominance of the unexpected, of the *possible* rather than the probable or average event, is particularly obvious.

In the fire protection of buildings, for example, all rules and practices are framed for the extreme unexpected happening; the stairs, doors and passages are proportioned for panic events, not for the movement of orderly assemblages. The whole value of the planning, in fact, is defined by its efficiency of functioning in emergencies, and any detail that fails in the crucial test of an emergency is worse than valueless. Railway and rapid-transit construction, and, indeed, most items of the engineering for communities, are equally clear demonstrations of the axiom in question: the chief criterion of excellence of a signal system is how it works when something goes wrong. The adequacy of a water supply, as to either quantity or purity, is tested by emergency happenings—which govern none the less definitely for being themselves ill-defined and subject to variable estimate. But after only a few such examples are examined it is easy to perceive that in every other piece of engineering as well, a controlling influence is exercised by the requirements of unforeseen, abnormal service.

Sound engineering, then, rests on the ability to foresee and shrewdly appraise future contingencies. The necessary knowledge is not to be drawn from books, however, nor does the young engineer obtain it in college. Many, in fact, fail to get it even in the school of experience, perhaps because in their makeup they lack an essential of engineering sense.

It is in observing engineering work—old as well as new—and in studying current engineering literature that the individual engineer finds the best aid to his native good judgment, in developing the ability to allow for the unexpected. The part played by current literature in this education constitutes, in fact, one of its highest elements of value.

Whatever the means of self-training he may choose to employ, however, the engineer who aims to measure up to his professional responsibilities to the world must progress steadily in the ability to foresee contingencies and provide for them sufficiently but not excessively.

Size vs. Specialization in the Colleges

NOT LONG AGO the presidents of Princeton and of Johns Hopkins universities announced that they were seriously considering the limitation of the number of students. Johns Hopkins is short of funds; Princeton believes that it cannot preserve its present individuality if its numbers are increased indefinitely. The thought of the Baltimore institution is based solely on restricted means; Princeton's thinking takes a different turn, and connects itself naturally with Arthur E. Morgan's plea for college specialization, as advanced in his recent article in the *Engineering News-Record* on the new Antioch plan. The Princeton president suggests that candidates for admission might be selected not on mere scholarship qualifications, but on the "Rhodes' scholarship idea," that is, on a demonstration in their earlier school work that they have qualities of leadership and have formed the habit of study. The leadership in the Rhodes' idea is naturally the leadership of action, and so Princeton's specialty would be the training of leaders in the active phases of life. Johns Hopkins' limitations would also require selection, selection would logically suggest specialization, and that specialization would, in accordance with the university's traditions, be along highly intellectual and research lines.

In both cases the thinking is to be welcomed. The universities have sinned just as grievously as the less thinking elements of the community in their striving after bigness. University greatness has been consideed proportionate to size. The result has been inevitable—the spreading of available resources so thinly that it has not been possible to maintain high-grade faculties. Whatever diverts the trend of university development from the quantity back to the quality idea will be of great help to the country, for the universities and colleges are centers of great influence and what they think today is felt in the world at large tomorrow.

We know well the objection that will be made, particularly in the state-supported institutions of the Middle West, against restriction of student bodies. The argument is that the state is obligated to furnish to each of its citizens, equipped therefor and desiring it, a thoroughgoing college or university training, and that the university has a public duty to meet whatever demands are made upon it for new courses.

But there is an argument that runs in a counter direction. If the university has an obligation to provide means of higher education, it is also under obligation to spend with the utmost efficiency the funds placed at its disposal. To erect not only courses, but whole departments and schools, that after ten years' operation turn out only a handful of students annually, when institutions in neighboring states have thoroughly matured departments of the same kind, cannot be considered a businesslike use of the funds that the state makes available. We see no great hardship in forcing a student to go several hundred miles into another state if he can thereby benefit from the superior teaching brought about through many years of specialization in a particular subject. Not only will the student personally be the gainer, but his own local institution will be able to concentrate its funds on fewer courses, to their manifest improvement.

Mr. Morgan made his plea for specialization in the small college. The thought applies equally well, however, to the big institution. In the Middle Ages the university could well be the teacher of all knowledge, though even then certain schools had built up reputations in certain subjects. In this terribly complex age, however, the call upon any one institution to teach everything is manifestly impossible of fulfillment.

Economy in Public Works Planning

DESPITE the engineering difficulties and unpleasantnesses created by the refusal of the Detroit city council to award contracts for the Belle Isle Bridge, the judicially minded will perceive that the council's striving for economy in a large undertaking is in tune with the spirit of the times. The present is a time for wise thriftiness, as everyone knows from his own private affairs. Moreover, governments are as much subject to the commandment of thrift as are individuals, and therefore it is natural to sympathize with those who insist that the Belle Isle project be brought within the original estimate despite price inflation. Even in engineering matters it is often possible and proper to make one dollar do where a fuller purse would have willingly appropriated two.

Were the officials not justified by the general need for studied economy their holdup of a needed improvement would merit condemnation, especially now, when construction activity is uncomfortably scant. Engineers know that regular prosecution of public-works construction is vital to the well-being of a large fraction of the nation's organism, and that whatever hampers or delays such construction is of evil. Because of this very knowledge, however, engineers are peculiarly obligated to see that the planning of public improvements is done in conformity with financial as well as the purely technical conditions. It is as much their duty as it is that of administrative officials to take note of the slimness of the public purse, to hear the grumbling of the people at oppressive tax burdens and increasing bond-issue obligations, and to guide public expenditures along lines of economy and efficiency. If they do not give active, initiatory service in this respect engineers can not expect to lead, but must needs continue to take orders.

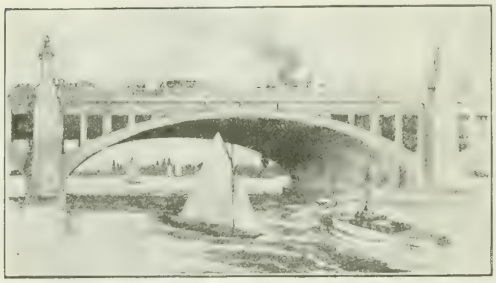
Of the numerous unusual elements of the Belle Isle bridge case, summarized on page 452 of this issue, the latest development—the order to the engineers to revise the plans by modifying details—is significant. The expectation appears to be that upwards of a million dollars can be saved by detail modifications. This would mean that nearly one-third the cost of the whole project was incurred for two or three subsidiary items of architectural effect, such as avoiding cantilever sidewalk construction and walling the approaches. So large a ratio of cost of æsthetics to basic structural cost is surprising, when considered in the light of the principle that æsthetic effort is to be sought in the manner of attaining a desired structural objective rather than in the addition of costly beautification. It may be, however, that the Belle Isle project is not for a bridge but for a piece of park architecture, which would alter the case. Viewing a bridge as an essential object is rather different from viewing it as an incident in park or other architectural development.

Because of its numerous knotty technical questions the case will doubtless be followed with general interest until its final settlement. It is to be hoped that the decision of the several questions will be left to engineers. From present indications the final outcome is bound to represent an effort toward economy of cost and this should mean increased structural efficiency.

Redesign of Belle Isle Bridge to Reduce Cost

Arch Structure Proposed Because Bids on Adopted Cantilever Design Exceed Available Funds—Arch Type Held Liable to Injury From Settlement of Pile Foundations in Clay—Revise Cantilever Plans

WITHIN the past four months two separate sets of bids for construction of the monumental Belle Isle bridge projected by the city of Detroit exceeded the bond issue voted by the people a few years ago, and the city council has in each instance rejected



CANTILEVER SPAN OF ARCH APPEARANCE, BELLE ISLE BRIDGE

Devised by the commission of 1917 because it considered a true arch not permissible in view of the risk of foundation settlement, this design has proved too costly to come within the funds voted for the bridge by the citizens of Detroit. As a result one of the major municipal projects of the year is in an impasse, and Detroit engineers are busy discussing what should be done, especially since Daniel B. Luten submitted a design for a reinforced-concrete arch bridge. Both designs propose to found the piers on piles at similar loading, and both involve eccentric footing pressure.

all bids. This condition has created a knotty problem as to how the city is to obtain the bridge without further postponement, and yet within the sum voted; at the same time a sharp engineering controversy has arisen over the matter through the events reported in our news pages Jan. 27, p. 190; Feb. 24, p. 359· March 3, p. 396, and March 10, p. 442.

Because of the importance of both the administrative and the technical questions involved, and the desirability of placing them before the engineering profession with a view to aiding in their clarification, *Engineering News-Record* requested H. H. Esselstyn, of the firm appointed as supervising engineers for the bridge, L. M. Gram, who was engineer to the commission that decided upon the design three years ago, and William H. Adams, at whose instance an alternative design was presented a month ago, to state the essentials of the situation as regards the official design, the foundation conditions, and the alternative design. Statements by Mr. Esselstyn and Mr. Adams follow, together with a summary of the facts and conclusions concerning the foundation. This latter has been prepared from data supplied by Mr. Esselstyn and quotations from the original commission report, to which Prof. Gram referred our request.

Briefly reviewed, the case rests on these facts: That the commission concluded the subsoil to be not dependable enough to make it wise to bring arch thrusts to bear on it, and therefore adopted a steel-concrete cantilever design comprising steel frame "umbrellas" projecting both ways from the piers, and short I-beam connecting spans, all embedded in concrete; that this design, which necessarily involves a large tonnage of structural steel, proves to be excessively costly at present; that a concrete arch design was laid before the city council recently which, though the precise cost figures are in dispute, is very much cheaper than the official design; that the local engineering society protested to the city that a cheap or unsubstantial structure is not wanted, and asked that a board of engineers be appointed to pass on designs; and that the council has requested the supervising engineers for the bridge to prepare a modified—cheapened—cantilever design.

Development of Official Design and Its Revision

By H. H. Esselstyn
of Esselstyn-Murphy, Detroit, Supervising Engineers for Belle Isle Bridge

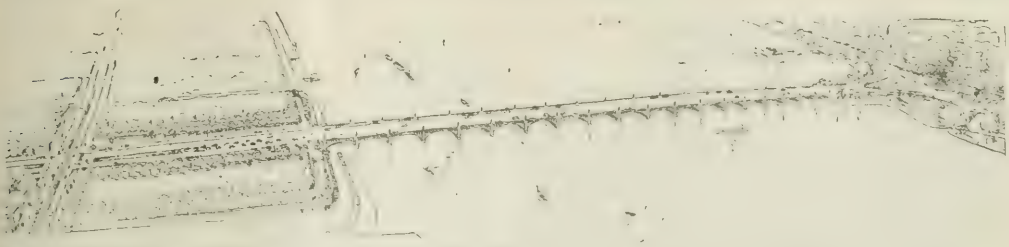
IN THE SITUATION that has been created by the failure to award contracts for the construction of the Belle Isle bridge, on two occasions during the past winter, and the more recent proposal of a substitute design totally at variance with the principles laid down by the commission of engineers that developed the present design, it is important to set down the fundamental reasons why the structure was designed as a concrete cantilever, and what is involved in the present situation.

Thorough investigation of the project for a bridge for the Belle Isle site was made by a commission of engineers appointed in 1916, which after a year and a half of study rendered its report in November, 1917. The commission was composed of Mortimer E. Cooley (ch.), Francis C. McMath, William R. Kales, Emil Lorch, and Henry R. Riggs. Lewis M. Gram was chosen as engineer. Mr. Lorch acted as architect to the commission. On May 1, 1918, George H. Fenkell, commissioner of public works, recommended the design developed by the commission to the city council, and it was subsequently adopted. Since that time no other project or design has been in question but that of the commission.

The foundation problem was of fundamental importance in the commission's study, and special investigation of soil conditions was made by borings, pile tests, and the like. (See preceding article.—Editor.) As a result of careful scrutiny of the data, the commission decided that the following requirements must be met by the structure: (1) It should be as light as possible; (2) the foundation reactions must be entirely vertical. A pile loading of 18 tons was recommended, though the detail design has been made on the basis of 14 tons dead load per pile, no live load considered.

Prior to this conclusion, the commission considered some ten different types of structure, including the reinforced-concrete arch type. They included: Plate girder with cantilever sidewalk, steel truss with alternate cantilever spans, steel truss simple spans, concrete arch, steel two-hinged arch, concrete two-hinged arch, steel three-hinged arch, concrete three-hinged arch, open steel cantilever, and finally concrete cantilevers, the latter type being ultimately adopted.

All the types were considered with and without cantilevered sidewalks, and the final choice was in favor of the design with the outer rib placed under the outer edge of the deck, so that the concrete work of the piers could be carried up through the structure in order to



BRIDGE AS PLANNED BY THE 1917 BOARD OF ENGINEERS—CANTILEVERS AND SUSPENDED SPANS

give a more effective architectural development than can be obtained with cantilever sidewalks, where the pier feature could not be carried above the balustrade.

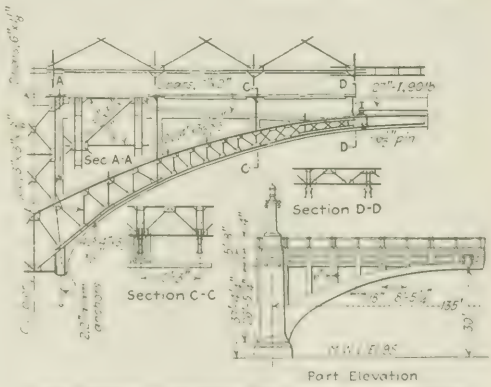
Upon the decision to base the choice of type on the two principles stated above, the arch designs were necessarily eliminated. That it is untenable from an engineering standpoint to consider for a moment a reinforced-concrete arch bridge for the site was moreover brought out very emphatically by the preponderance of evidence against the arch bridge proposal at the public hearing before the council three weeks ago, when a number of engineers presented their views.

As originally estimated by the commission, the cost of the bridge would have been less than $3,000,000, including the Jefferson Ave. subway in the north approach. A bond issue of $3,000,000 was subsequently voted by the people in a referendum election, and later the writer's firm was appointed as supervising engineers for the design and construction. In the preparation of contract plans the commission's general design drawings were closely followed, yet in bids received for parts of the work last November a total cost of $5,000,000 was indicated, and in bids received after readvertising the lowest bid was about $4,500,000, exclusive of the subway, as compared with a sum of $2,500,000 available after final payment for the subway approach contract already in process of construction. It was subsequent to the refusal of the city council to award contracts on these bids that the proposal of designs for a reinforced-concrete arch structure was made to the council by an outside engineer.

The latest official act of the council on the matter was the passing of a resolution on March 1 recommending "that Esselstyn-Murphy be authorized and directed to make such modifications of the original reinforced-concrete cantilever bridge recommended by the Belle Isle Bridge Commission as will bring the cost within the balance of approximately $2,500,000 remaining, such modifications to consist of the elimination of approaches and the substitution of dirt fill therefor and such other changes as may be deemed necessary." The resolution was subject to veto, but the time for such a veto has now passed, and work is already in progress on the modified design called for in it. The new design will be ready for presentation to the council in a month.

The commission had made a study of the structure with cantilevered sidewalk, as already stated, and it is this design we are now coming back to, because of its economy over the official design. In the modified design no sacrifice is being made as regards carrying capacity, stability, or the like.

However, it should be emphasized that the matter of



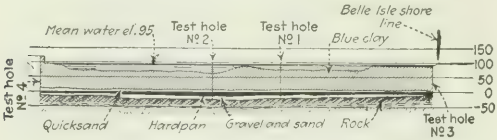
STRUCTURE AND STEEL FRAME OF CANTILEVER

changing the design of the bridge is a very delicate one, and we as engineers for the bridge have all along fought to have the original commission reappointed and kept in office until the structure is completed. This has not as yet been done and we have been instructed by the resolution just quoted to prepare a modified design. It is proper to say that we are treating with the most careful consideration the original accepted design, and we believe that by adopting one of the original designs considered by the commission we are acting in the spirit of those who carried out the fundamental engineering studies.

Soil Conditions Back of Cantilever Design

AT THE site of the bridge, rock occurs 103 to 125 ft. below water level, and the main part of the overlying soil is blue Detroit clay, a material that often proves troublesome. The foundation problem being of first importance, whatever the type of bridge chosen, special investigation of the underlying soil conditions was made by the commission, by means of borings and test piles, the results being checked against data obtained from others who had made similar surveys in Detroit.

For a depth of 90 ft. below water, a light blue clay of nearly uniform hardness, containing fine sand in



PROFILE OF STRATA AT BRIDGE SITE
One hundred feet of clay, hardpan and sand overlie rock.

spots, was encountered; in one hole near the middle of the river a 7-ft. quicksand layer was found at 90 ft. depth. The pile-driving records for the temporary bridge nearby also indicated softer material near the middle of the river. At 100 to 110 ft. hardpan was encountered, and below this generally some 10 ft. of sand and gravel over rock. The profile developed is shown herewith.

It was considered impracticable to extend foundations through 30 ft. of water and 90 ft. of the more or less plastic clay to bedrock, especially in view of the great cost of caisson work in Detroit, where gas and quicksand pockets are often encountered in the clay, producing considerable trouble. Common practice in heavy work along the water front is to drive wooden piles into the clay and on top of these to cast a concrete mat. It was decided by the commission that this would be the only feasible type of foundation to be used.

Pile tests were made with piles of 15-in. butt diameter and 8-in. point, driven to 51 ft. penetration. Four test piles driven by steam hammer showed penetrations of 0.27 to 0.38 in. per blow at 40 ft. penetration; one of them, driven continuously to 50 ft., showed a final penetration of 0.18 in. per blow, and another, driven to 50 ft. after 20 hrs. wait, showed a final penetration of 0.05 in. per blow. This last-mentioned pile was placed under test load two weeks later; under 20 tons its settlement was 0.023 ft. in 14 days, increasing to 0.035 ft. after 32 days, while under 42 tons the settlement increased to 0.074 ft. the first 15 days and to 0.124 ft. in 58 days. None of these piles extended below the blue clay. These results led to the conclusion that piles "would carry 18 to 20 tons without serious progressive settlements." A loading of 18 tons was recommended for design.

As the result of its foundation studies the commission formulated the two principles quoted in the article of Mr. Esselstyn (p. 452), and shaped its decision of bridge type thereby. The commission said:

"Arches and cantilevers are types which economically follow pleasing lines, and therefore investigation of their relative adaptability was made by means of sketches and estimates of costs. Two-hinged, three-hinged and hingeless arches were considered, and while each has its advantages, all are dependent for stability upon lateral resistance of the soil. Furthermore, an intelligent analysis of stresses must be based upon assumed and uncertain displacements of the piers. For these reasons and in view of the soil conditions, as described above, a structure based upon the cantilever principle with vertical reactions is considered preferable."

Summarizing its choice of design, the commission stated that its foundation studies "indicate that a structure designed upon cantilever principles would best fit the natural conditions. Other structural types were carefully considered but the great distance to rock and the plastic condition of the overlying soil were the most important eliminating factors. Moreover the curved arms of the cantilever construction give pleasing lines consistent with the character of the bridge as a civic and park structure. The water level is subject to slight changes, hence the curved arms can spring from the piers at a low point and an open-spandrel treatment is practicable, giving an effect of lightness without sacrificing that of strength and dignity. The advantages with respect to appearance as well as permanence were deciding factors in the selection of reinforced concrete as the most suitable material."

Data of Reinforced-Concrete Arch Design Recently Proposed

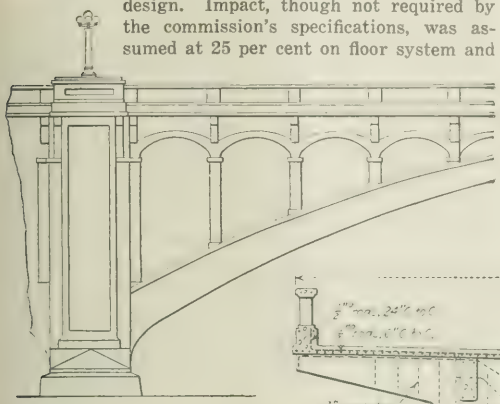
By William H. Adams
Consulting Engineer, Detroit

THE official design for the Belle Isle bridge, of structural-steel-and-concrete cantilever type, was twice advertised in the fall of 1920. The lowest bids ran nearly $2,000,000 over the funds available, and the city council rejected all bids. Matters stood thus when at the writer's suggestion the council granted a hearing on Jan. 14 to Daniel B. Luten on a proposed modification of the bridge program, and Mr. Luten presented preliminary sketches for an arch bridge which he stated should be built within the funds remaining from the $3,000,000 bond issue—about $2,500,000. By resolution the council thereupon permitted Mr. Luten to submit, within thirty days, detailed plans, specifications, and estimates, with the understanding that all general requirements of the bridge commission's report be met as to strength and capacity and that the bridge should have the same general appearance as that provided in the official plans.

Estimates of cost submitted in accordance herewith, accompanying a set of detail plans, ranged from $2,486,360 for an earth-filled arch and the official approach design to $2,175,725 for an open-spandrel arch design with modified south approach. The open-spandrel design, described in the following, approaches closely in appearance the commission's design. The alternate design for the approach at Belle Isle saves about $140,000 by broadening out the fill and eliminating the ramps and retaining walls.

OPEN-SPANDREL ARCH DESIGN FOLLOWS LINES OF COMMISSION DESIGN

Sixteen spans of 95 to 160 ft. in the clear form the river crossing in the open-spandrel design, three channel arches having clear spans of 160 ft. and a clear rise of not less than 30 ft. The roadway width (85 ft between railings) and the loading (100 lb. per sq.ft. with provision for concentrated loads of an 18-ton truck or two 50-ton street cars on each track) are as in the official design. Impact, though not required by the commission's specifications, was assumed at 25 per cent on floor system and zero on arches and piers. The superstructure comprises three arch ribs supported each on its unitary pier down to a base which is common to all. Two transverse girders near the crown in each span connect the three ribs and act to distribute concentrated loads. The floor system is carried on transverse girders supported on columns from the arches; cantilever extensions support the sidewalk.

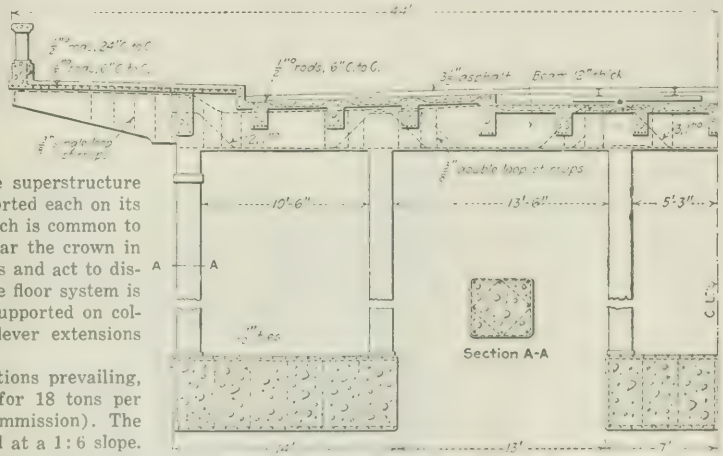


On account of the soil conditions prevailing, the foundations are designed for 18 tons per pile (as recommended by the commission). The outer rows of piles are battered at a 1:6 slope. The top 3 ft. is to be enveloped in rubble concrete, laid under water, the top of this mat being at the elevation of the bottom of the mat of the official design. Above this is a 6-ft. mat of reinforced concrete, 93 ft. long and of width varying with the span.

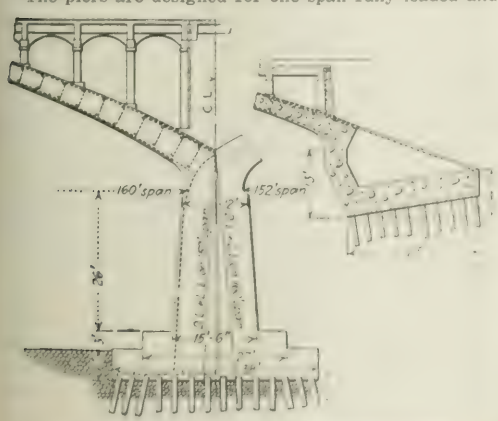
The piers are designed for one span fully loaded and the adjacent span unloaded, analyzing the piers by the elastic theory, considering arch and pier as one elastic system; or, one span half loaded, adjacent span unloaded, analyzing by the gravity method, arches as though unattached. The piers are located so as to avoid all the old piers of the earlier bridge, which are to be removed. There is no necessity for much provision against scour, as the current is sluggish and the river levels uniform.

As the longer spans have the greater rise, the thrusts for uniform loads are approximately equal. Unbalanced thrusts are slight as compared with the total load; they are fully provided for by the battered piling. The deepest pier will extend 35 ft. below water line. As it is intended that the 9 ft. of base and sub-base concrete shall act as a seal for the cofferdam, this deepest pier will have 26 ft. of pumpage.

The economies of the design consist in the elimination of over 4,000 tons of structural steel trusses and bracing, bolts and anchors, and 1,300 tons of steel sheetpiling; a reduction in concrete from about 63,000 cu.yd. to about 50,000 cu.yd., with a greater simplicity of construction and detail; the use of concrete railing throughout; simplified drainage, waterproofing and lighting, and a more economical system of centering.



ELEVATION AND CROSS SECTION OF 160-FT. ARCH SPAN



ARCH FOUNDATION AND PIER CONSTRUCTION

Track Maintenance by Piece Work

Owing to the abnormal conditions under which maintenance of way work has been conducted during the past year, no considerable amount of maintenance of way work has been handled under contract or piece work schedules, according to the report of the Committeee on Track of the American Railway Engineering Association. The standard track work system which was in effect on the Baltimore & Ohio R.R. and the Pennsylvania R.R. had as one of its essentials the establishment of unit performance or piece work schedules, but this system was abandoned by the U. S. Railroad Administration and has not been re-established. Many roads resorted to the cost-plus form of contract in handling maintenance work during the past year, but in effect this plan was little more than the recognition of the contractor as a labor agent, the work being done as heretofore under the immediate direction and supervision of the regular railway officers.

Proportioning Concrete on Job by Exact Methods

Development of Water-Cement Ratio and Surface Area Theories Permit Changes of Proportions to Produce 35,000 cu.yd. of Concrete of Desired Strengths

By R. B. Young and T. V. McCarthy

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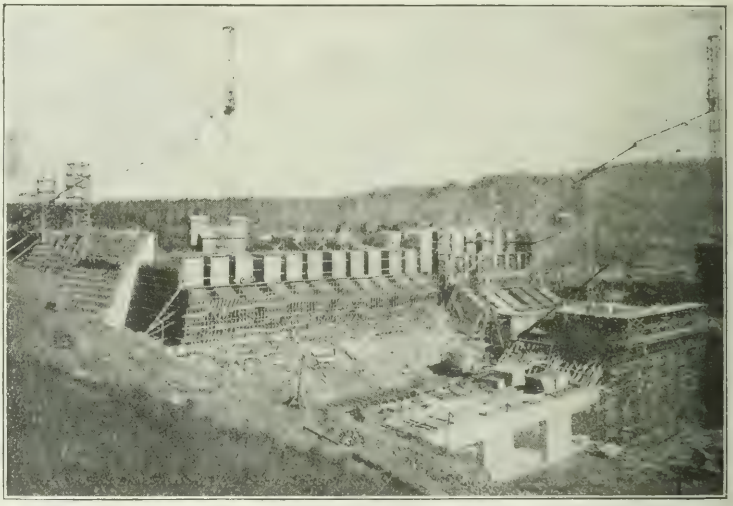
In *Engineering News-Record*, Jan. 1, 1920, p. 8, one of the authors of this article described a method of proportioning concrete which had been developed by the Hydro-Electric Power Commission of Ontario and was then in use on their work. This method was based in part on Prof. D. A. Abrams' water-cement-ratio-strength-relation and in part on L. N. Edwards' researches on proportioning concrete mixtures by surface area.

In the year just past, this method has yielded very satisfactory results on the construction of a hydro-electric power development in Northern Ontario where approximately 35,000 cu.yd. of concrete were placed. Despite many unfavorable conditions, concretes of the specified strength were secured and it was found possible at all times to set a mix which would give a compressive strength within a few hundred pounds of the value sought.

A brief description of the job will help to make clear the conditions which had to be met. The work consisted of the construction of a hydro-electric power plant and dam at Cameron Falls on the Nipigon River about fifteen miles north of that river's entry into Lake Superior. The ultimate development at this point will be 75,000 hp., but only 25,000 hp. is being developed at this time. The head available is 78 ft. The construction involved some very complicated reinforced-concrete work including two turbine scroll cases and nineteen heavily reinforced piers. A general view of the development under construction is shown.



GENERAL VIEW OF NIPIGON POWER DEVELOPMENT WHERE 35,000 YD. OF CONCRETE WAS PLACED

Two concrete mixing plants of conventional design were used. Both were equipped with overhead bins, separate measuring hoppers and twin mixers. The concrete was placed by means of towers and chutes, which are shown herewith in a view of one of the mixing plants.

With the exception of the cement, the materials for the concrete were obtained locally, the sand from deposits close to the work, the crushed rock from stone obtained from the power-house and tailrace excavations, crushed to the required size on the job.

Each of these materials complicated the problem of determining the proper proportions to be used for the different qualities of concrete. Because of the peculiar conditions existing last year in the cement industry, it was necessary to obtain supplies from six different mills. Contrary to popular opinion, cements from different sources have different cementing values and this introduced an added variable difficult to estimate.

All cement shipments were sampled at the mills by a representative of the commission and either tested there or at the commission's laboratories at Toronto. By this means it was usually possible to accept or reject the cement before its arrival at the job and this permitted its use directly from the cars, a considerable advantage where storage facilities were limited and labor of all sorts both scarce and costly.

The sand was obtained from two sources, a gravel pit and a sand pit. Material from the former had to be washed and screened and this screened sand was, until it gave out, mixed with the pit sand to improve the grading. This gave rise to a much greater variation in the grading of the fine aggregate than would otherwise have been the case and made proportioning more difficult. In addition the pit sand was fine and micaceous and required the use of more cement to obtain the desired quality of concrete than a better graded sand would have done. The sand was sampled daily and its mechanical analysis, moisture content and weight per cubic foot determined.

The stone used was a crushed granite from which the dust had been removed, screened to pass a 2½-in. ring. It contained a considerable portion of low-grade stone which occurred in such a way that it could not be entirely eliminated from the rock sent to the crushing plant.

A small laboratory was installed on this work and was

equipped with an inexpensive 100-ton hydraulic type testing machine, sieves for the analysis of sand and stone and miscellaneous apparatus for determining their weight per cubic foot, moisture content, cleanness and freedom from organic impurities. A small building was erected to house the apparatus and for the storage of the concrete test specimens.

Inspection covered both materials and operations. The materials were not only tested but a watch was kept on the sand and gravel pits, washing plant, crusher and stock piles. The inspection of concreting operations included all details in connection with proportioning, mixing and placing. An effort was made to see that all materials were accurately measured, that the batches were properly mixed and that the chuting plant was arranged so as not to interfere with the quality of the concrete delivered. Inspection was also maintained on the placing of concrete in the forms, spading, cutting off of laitance and removal of forms.

TABLE I. CEMENT-RATIO AT NORMAL CONSISTENCY AND WATER-CEMENT RATIO CORRESPONDING TO CLASSES OF CONCRETE SPECIFIED FOR NIPIGON POWER DEVELOPMENT

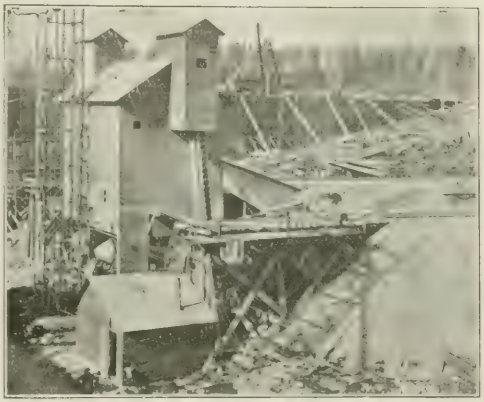
Class	Minimum Specified Compressive Strength in Lb per Sq In	Cement, Lb per 100 Sq Ft Surface Area Normal Consistency	Range of Water-Cement Ratio (by Weight) Min	Max
A	2,500	2.60	0.54	0.58
B	2,000	2.25	0.62	0.68
C	1,500	1.80	0.73	0.88
D	1,000	1.30	0.85	0.91

Test specimens of concrete, three to a set, were taken from time to time as circumstances demanded, their frequency depending on the amount of concrete placed or on changes in the materials, consistency or class of concrete used. These specimens were made from the wet concrete in the forms. A number of samples were taken at different places from a depth of several inches below the surface, carried to the laboratory, dumped on a batter board, turned over to rectify any segregation which might have occurred in transporting to the laboratory and then immediately placed in 8 x 16-in. steel cylinders. These specimens were stripped, usually in 24 hours, and then stored in moist sand until broken. Generally one of each set was tested when seven days old, the others when 28 days old.

Three classes of concrete, called for convenience Classes *A*, *B* and *C*, were in use on this work. Class *A* was specified as being of such quality as to show a minimum compressive strength of 2,500 lb. per square inch at the age of 28 days when tested in accordance with the standard methods of the commission. Classes *B* and *C* were required to have minimum compressive strengths of 2,000 and 1,500 lb. per square inch, respectively, under the same conditions.

The test data used in the design of these concretes is given in Table I. Here is shown the relation between surface area of aggregate, cement and water for each class of concrete, for the materials used on this work. The cement requirement is stated for a normal consistency mixture in terms of the number of pounds of cement per 100 sq.ft. of surface area of the combined sand and stone and the water is stated in terms of its relation to the cement in the mixture or water-cement ratio.

The cement required per batch for a normal consistency mixture can be determined from the mechanical analysis of the aggregates used, their weight per cubic foot and the quantity of each in the batch, as described



CONCRETE PLANT NO. 2 WITH STOCK PILE AT NIPIGON

in the previous article noted. The water required per batch is obtained by multiplying the amount of cement required per batch by the proper water-cement ratio. This is the maximum quantity of water per batch which can be used. The water present in the aggregate must be deducted from this maximum allowable quantity to obtain the amount of water which is to be added at the mixer in gaging. The proper deduction is determined by reference to the tests for moisture content made daily on the aggregates. If the quantities of cement and water are thus determined, the resulting mixtures will be of a uniform consistency and the finished concrete will have the required compressive strength.

Normal consistency is a consistency which has been arbitrarily chosen in the laboratory and represents approximately the driest mixture which can be placed under best field conditions. Any other degree of plasticity either drier or wetter can be obtained without appreciably affecting the quality of the finished concrete by increasing the cement and water content proportionately. A consistency which required 15 per cent more cement and water than did this normal consistency has been found suitable for chuted concrete and was used largely on this work.

Water-cement ratio as ordinarily defined is the ratio of the volume of water to the volume of cement. As here used it is the ratio of the weight of water to the weight of cement. Using the volumetric water-cement ratio in practical proportioning gave rise to considerable confusion which has been almost entirely overcome by a change to the weight basis.

On this job some 80 sets of test cylinders were taken representing 36,000 cu.yd. or approximately one set for each 450 cu.yd. Many sets represented as little as 50 cu.yd., others as high as 700 cu.yd. On several occasions test specimens were taken but every second or third day when conditions were uniform and in the judgment of the engineer in charge of concreting daily samples were unnecessary.

In Table II have been tabulated the test results obtained from 53 sets of test specimens covering a period of 4 months or 48 days of actual concreting and representing 21,000 cu.yd. of concrete. The proportions are given in volumes and the standard Canadian bag of cement weighing 87½ lb. is considered to contain one cubic foot. The change in proportions made from time

TABLE II. RESULTS OF TESTS ON SPECIMENS OF CONCRETE PLACED FROM MAY 1 TO OCT. 1, 1920, ON NIPIGON POWER DEVELOPMENT

Date	Proportions (Volumetric)	Water-Cement Ratio (Weight)	Compressive Strength Lb. per Sq.In. 7 Days	28 Days
		Class A		
June 5	1:2 5:3 0	0 54		2,330*
June 6	1:1 8:3 2	0 55		2,660*
June 11	1:1 7:3 2	0 54		3,360*
June 16	1:1 8:3 2	0 54	2,360	3,415
June 27	1:2 4	0 57	2,190	3,288
June 30	1 2 3 9	0 57	2,740	3,238
July 7	1:2 1:3 4	0 573	2,181	3,050
Aug 3	1:2-1:6	0 51	1,655	2,545
Aug 3	1:2 2:3 7	0 56	1,509	2,982
Aug 5	1:2 2:3 7	0 56	2,281	2,902
Aug 11	1:2 7.4 0	0 60	2,790	2,820
Aug 19	1:2 25:3 67	0 59	1,125	3,505
Aug. 20	1:2 25:3 67	0 575	1,535	2,225
Sept. 2	1:2 2:3 8	0 573	1,221	2,525
Sept 2	1:2 2:3 8	0 573	1,442	2,830
Sept 4	1:2 2:3 8	0 573	1,194	2,352
Sept 8	1:2 2:3 8	0 59	1,235	2,396
Sept. 9	1 2 2 3 8	0 59	1,390	2,625
Sept. 13	1 2 2 3 8	0 583	1,203	2,468
Sept. 13	1:2 2:3 8	0 583	1,307	2,477
Sept 15	1:2 2:3 8	0 583	1,280	2,465
Sept. 16	1 2 2 3 8	0 583	1,115	2,085
Sept. 21	1 2 2 3 9	0 60	634	2,535
Sept. 24	1:2 2:3 9	0 60	927	2,425
Sept. 24	1 2 2 3 9	0 60	1,100	2,445
Sept. 30	1:2 2:3 9	0 60	1,173	2,363
		Class B		
May 24	1:2 5:4 5	0 60		2,535*
May 28	1:2 5:4 5	0 60		2,560*
May 30	1 2 0:3 1	0 55		2,460*
June 2	1 2 0 3 1	0 55		2,430*
June 9	1 2 5:3 65	0 60		2,110
June 11	1:2 3:3 8	0 60	1,314	2,270
June 15	1:2 3:3 3	0 60	1,512	2,937
June 20	1:2 3:3 3	0 6	961	2,032
Aug 14	1:3 0:5 5	0 61	1,990	2,821
Aug. 17	1:2 6:4.6	0 643	1,395	2,605
Aug. 26	1:2 6:4 4	0 675	755	2,180
Aug. 28	1:2.6:4.4	0 665	835	1,365
Sept. 18	1:2 6:4 6	0 643	1,354	2,060
Sept. 25	1:2 2:3.9	0 64	1,030	1,683
		Class C		
May 13	1:2 3:4	0 56		1,640*
May 30	1:2.5:4.5	0 72		1,835*
June 14	1:3:5	0 72	1,300	2,125
June 29	1:3:5	0 80	1,310	2,090
July 7	1:3 2:4.5	0 80	1,110	2,592
July 17	1:3 0:5 4	0 80	395	1,430
July 20	1:3 3:5.5	0 80	1,680	1,927
July 30	1:3 3:5.5	0 75	1,062	1,630
Aug. 7	1:3 3:5.5	0 785	1,180	2,335
Aug 10	1 2 9 5 0	0 77	1,390	2,062
Aug 12	1:3 3:5.5	0 77	1,250	2,752
Aug 13	1:2 0:5.5	0 71	1,180	2,125
Aug 22	1:3 3:5.5	0 80	1,100	2,022
Aug 24	1:3 3:5 5	0 80	398	1,437

* Tested when 8 days old.
† Average of tests on three cylinders

to time correspond to changes in the aggregates in use or changes in the consistency. The 7-day values are the result on only one cylinder, the 28-day values, except where otherwise noted, are the average of two.

Our experience on this and on several smaller jobs has led us to the conclusion that good concrete requires not only proper materials properly proportioned and the right equipment properly handled but also close supervision and inspection of all details of concreting by men who are conversant with both the theoretical and practical phases of their work.

Our experience has led us also to believe that every step taken to eliminate guesswork in the process of concreting is a step toward the ultimate goal of a uniform and controlled product and to this end have been adopted the field laboratory, the periodic tests of aggregate and concrete, the method of proportioning outlined and the continuous inspection by experts. The results obtained appear to justify this conclusion.

As a proof of confidence in this system of controlling the quality of concrete, the commission is now making the necessary arrangements to carry out the same procedure on a 500,000-hp. hydro-electric development at Niagara Falls. It is confidently expected that as a result of this care, better concrete will be obtained at a less cost than would be possible under the usual system.

Precipitation from Treated Boiler Water

From report of Committee on Water Service, American Railway Engineering Association. Prepared by C. H. Koyl.

IN THE EARLY DAYS of water softening in this country it was noticed that after water had been through the process, there was a deposition of flakes of carbonate of lime found on standing. It became evident that the chemical reactions had not been completed in the softening plant and that the lime (to mention only one reagent) had not been thoroughly mixed with the water. I made a series of tests to determine the amount of mechanical mixing necessary to effect a softening down to 3 grains per gal., at which point the reactions in ordinary water are nearly complete, and found it to vary from 25 min. in clean well water at 60 deg. F. to 50 min. in river water at 45 deg. The addition of a 50-min. mixing or reaction chamber as a preliminary to the settling chamber of every "continuous" water softening plant did away with this precipitation, but it was remarked that if the water was undertreated in lime, after-deposition still took place, as untreated water requires much longer mixing than 50 min.

It was noted also that when the best of treated water was fed to locomotive boilers through injectors there was a sufficient deposition to interfere with the operation of the injector. This was not serious in warm weather, when the temperature of the injector does not exceed 212 deg. F. unless the check valve leaks, but it became very serious in cold weather when injectors are kept hot by steam from the boiler. In the winter of 1915-16 there was a treating plant at every water station on the Great Northern Ry. on the line from Devils Lake, N. D., to Shelby, Mont., a distance of nearly 700 miles, and while boiler leaking was unknown there was so much trouble from clogging of the injectors that its prevention became a serious study.

The material deposited in the injectors was calcium carbonate and came from the water at a temperature not far above 212 deg. F. At this temperature the content of calcium carbonate can be reduced to about 2 grains per gallon, but calcium sulphate, if it were present, would not be affected. Therefore, I decided to try to convert at least part of the 3 grains of calcium carbonate in the cold water into calcium sulphate by adding 3 grains per gallon of ferrous sulphate to the water before it left the mixing tank of the treating plant. This would leave in the water a small amount of ferrous carbonate which would give the injector no trouble.

The first test was made at Minot, N. D., where the switch engines had been the subject of continuous complaint. After the water had been treated as above for one month a switch engine was examined and the injector and all its connections were found quite clean. The treatment with ferrous sulphate then began to be extended to all treating plants on the line and the results have been uniformly good. The use of all chemicals employed in treatment of water should be under the supervision of a competent person who understands the reactions involved.

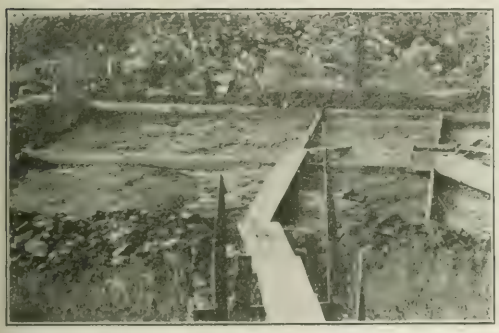
The Basis for Extension of Water Mains

Charges for extending water mains in Terre Haute, Ind., by the water company are based on actual costs according to a paper by Dow R. Gwinn, president of the Terre Haute Water Co., presented recently to the Indiana Sanitary and Water Supply Association. The Public Service Commission allows a return of 8 per cent and 1 per cent for depreciation. Operation and taxes are figured at 10 per cent of the valuation so the rates are fixed to net 19 per cent of the cost. In a city block of 365 ft. in built up territory with six houses the minimum monthly rate should be $1.50 and a fire hydrant for which the city should pay $50. This is on the assumption that a 6-in. main was laid. In real estate additions the land owner should pay the whole cost and be reimbursed by the water company without interest when the income reached the above 19 per cent

Sewage-Treatment Testing Station at Grand Rapids, Mich.

Dortmund Tank Installed in 1919 Transformed Into Dorr Clarifier—Sludge with Paper Mill Waste Dries in 10 to 30 Days

SEWAGE heavily charged with strawboard mill and gas-works wastes is treated at the sewage testing stations at Grand Rapids, Mich., where tests were started in June, 1919. The original Dortmund tank has been rebuilt into a Dorr sewage clarifier. Sludge-digestion tanks for Dortmund or Dorr tanks have been found unnecessary, the sludge drying in 10 to 30 days and then burning easily without odor. On account of foundation difficulties, experiments to reduce the depth to the limit will proceed in 1921. The following notes were obtained (1) from a visit to the plant in November, 1920; (2) from subsequent information from Gerald J. Wagner, commissioner of public works; and (3) from a paper presented recently to the Illinois Society of Engineers by Milton P. Adams.

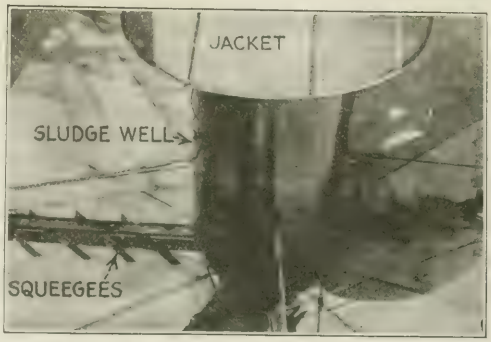


FLAKY DRIED SLUDGE IN FOREGROUND AND NON FLUID MUSHY SLUDGE IN BEDS

Grand Rapids, a city of 150,000 people, has an average daily water consumption of 100 to 110 gal. per capita. The sewage flow is about 30 m.g.d., one-half being ground water. Of the 17.6 square miles of area, 11.7 square miles are sewered. There are two intercepting sewers on the east side and two on the west side of the Grand River.

The experimental work has not had the wide scope common to sewage testing stations. Rather, it has been an intensive operating study of a life-size sedimentation unit. The problem at Grand Rapids is one in plain sedimentation and sludge disposal, efforts being directed toward the meeting of a State Supreme Court injunction rendered in 1913, calling for the removal of the sludge-forming materials in the sewage before the latter is discharged into the local water course.

The testing station was located at the junction of the East side trunk sewer and the Prescott St. sewer containing strawboard waste. The suction of the 1-m.g.d. centrifugal pump may take sewage from either sewer. Originally the plant consisted of a Dortmund tank, 32 ft. outside diameter and 30 ft. deep, with a hopper bottom having 45-deg. slopes. The sewage entered 13 ft. below the surface and flowed out over the peripheral weir with notches every 2 ft. Adjoining this tank are three sludge-digestion tanks, each 20 ft. in diameter by about 28 ft. deep, with hopper bottoms, and four tanks each 4 ft. in diameter by 26 ft. deep. A sludge-bed area of 40 x 80 ft. is provided, divided into 12 units. The beds are built upon tamped clay. On this are placed underdrain tile, and above the clay and tile are laid 10 in. of cinders and 4 in. of sand.



EMPTY CLARIFIER SHOWING CENTRAL INLET JACKET, SLUDGE WELL AND DORR THICKENER

The present testing station consists of a Dorr clarifier, built out of the Dortmund tank, with a water depth of 14 ft. at the center and 12 ft. at the periphery. The sewage enters at a depth of 5½ ft. The clarifier mechanism (or Dorr thickener) revolves once in 17 min. The sludge well sets 9 in. off the floor, is 11 ft. in diameter at the bottom and narrows to 4 ft. at the top. A small bucket elevator is provided to remove sludge from the well. The advantages of the flaring well over the ordinary cylindrical type are as follows: (1) It increases the area of sludge opening into the well by making the opening equivalent in length to the circumference of a much larger circle. (2) The storage and covering of a larger volume of sludge within the well makes far better conditions in the outer sedimentation compartment and gives greater flexibility in sludge handling. (3) It concentrates as much evolved gas as possible within the well. The beneficial action of the gas in the 4-ft. well had already been noted, both as regards its buoyant effects on the sludge and the drying power it exerts in passing through the upper layers of sludge.

In November the clarifier was handling about 0.8 m.g.d. on a 2-hour detention period. This is equivalent to a rate of 960 gal. per sq.ft. per 24 hours. The tank was removing all the settling suspended matter by the Imhoff settling-glass test. The sampling schedule was intermittent, a 24-hour composite being taken on every fourth day. Based on the data of analyses, the tank was removing from 27 to 59 per cent of the 150 to 350 p.p.m. of suspended matter in the raw sewage. There was a slight grease scum on the half of the tank provided with boards. Inside the sludge well a scum forms which at times averages as low as 75 per cent moisture. The sludge entering the well at the bottom runs 88 to 92 per cent moisture. The total organic nitrogen is low, averaging less than 1 per cent.

During August and September the clarifier treated 18.5 m.g. of sewage with an average removal of suspended solids of 50 per cent. During the next two months of operation this figure fell to 24 per cent. From August to November 48.2 m.g. of sewage was

treated, 2,311 cu.ft. of sludge averaging 83.2 per cent moisture were produced, and of this amount 933 cu.ft. of 79.2 per cent sludge were actually removed by conveyor, the balance remaining in the tank at the end.

On removal the sludge has been put on a sand bed for drying. Fresh Dortmund sludge dried in 10 to 30 days and the so-called digested sludge (3 to 4 months old) dried no faster. The Dorr sludge dried in about the same time. The air-dried sludge was firm with a skin of fine straw on it. A part of the sludge was lagooned. This gave off no marked odors.

The situation is unusual in that the main sewer outlet receives the drainage from a strawboard and paper mill and gas works, located only ¼ mile above the present testing station inlet. The fibrous character of the sludge and its lack of odor indicates that the strawboard and paper mill waste has some influence on the process. A casual inspection of the strawboard mill showed a fine (60-mesh) screen on the outlet of each mixing mill. On the other hand, straw stock was working around the outlet pipes and passing out. The waste had not yet been measured.

The Dortmund Tank

The original Dortmund tank was operated on displacement periods ranging from 1.7 to 5 hours, with flows of 0.4 to 1.1 m.g.d. The upward velocity at the 1.5-hour period was about 12 ft. per hour. The removal of suspended matter over eight months (by a composite of 16 hourly samples on every third day) was 45 per cent. By the cones 95 per cent was removed. In the summer boiling occurred in from 7 to 10 days.

The original 45-deg. slope on the bottom did not prove sufficient; 57 deg. worked much better. The sludge averaged 93 per cent moisture with a minimum of 87 per cent. A sludge containing 94 per cent moisture was found not to move satisfactorily on planed timber slopes of ⅛ in. to the foot; ⅜ in. to the foot seemed to be required.

In the separate sludge-digestion tanks the sludge has a marked tendency to separate into bottom sludge and top scum even in two or three days. The sludge from the digestion tanks dried in about the same time as the raw sludge (10 to 30 days) to a water content varying from 60 to 70 per cent. The wet sludge applied 14 in. thick dried to 4 in. when removed. This sludge when dried burned readily. The fresh Dortmund sludge contained considerable oily matter and had a strong odor of tar.

As the plant layout permitted the taking of sewage from either fork above the junction, the Dortmund tank was run for five months on the Prescott sewer and three months on the East Side trunk sewer. The Dorr tank, however, has been run on a mixed sewage below the junction.

A summary of the operating results on the Dortmund tank shows that on the Prescott St. sewer the sludge accumulation averaged 7.84 cu.yd. per million gallons with a moisture content of 93.6 per cent and specific gravity of 1.015. On the East Side trunk sewer the sludge accumulation averaged 1.40 cu.yd. per million gallons with a moisture content of 93.3 per cent and specific gravity of 1.017.

On the Prescott St. sewer the periods of flow ranged from 1.7 to 4.1 hours, averaging 2.6 hours. On the East Side trunk sewer the periods of flow ranged from 2.1 to 5, averaging 3.3 hours.

The plant was closed in November, 1920, but it is planned to reopen it in the spring, applying the clarifier to a still shallower tank, reduce the sludge opening into the present well and develop an overflow sludge delivery from the bottom of the tank.

From Mr. Adams' paper the following comments are taken relative to "pin-point" boiling, sludge experience and general conclusions:

The surface of the tank in operation represents any quiet body of water over which fine particles of grit or dust are being sprinkled. This is caused by the bursting of minute gas bubbles at the surface. This gas is evolved in the sludge on the tank bottom and released by the periodical moving of the squeegee arms (Door thickener) through the sludge. On shutting down the mechanism in warm weather, this "pin-point" boiling stops altogether — the tank surface is clear for from 8 to 10 hours, while gas is collecting and being retained in the sludge below. Finally, enough gas is entrained to buoy masses of sludge to the surface, where it is released—the action being identical with "tank boiling" experienced in the former Dortmund tank. On shutting down for a few days in June a 6-in. leathery scum of sludge formed over the tank surface in 24 hours. Thus the necessity of the operation of some kind of agitator in a tank of the type in promoting good sedimentation is clearly evident.

Tiny globules of oil generally accompany these fine gas bubbles to the surface. It is this iridescent coloring of oil on water which constitutes the only visible effects of this action. One-half of the tank was baffled during the last three months of operation, the oil being caught just before passing out over the outlet weirs. As a result the effluent from this half of the tank was greatly improved, although the appearance of the baffled half of the tank was accordingly sacrificed by the collection of the thin layer of scum retained upon it. It could not be proved that this "pin-point" boiling decreased the efficiency of sedimentation.

Sludge Experience

The 80-per cent sludge produced during 1920 was a fairly stiff semi-solid and dried much less rapidly on the beds than the 94 per cent sludge of 1919.

The original Dortmund tank went into operation June 30, 1919. On July 25 the first sludge was drawn from the tank and delivered to a secondary tank. Its tarry odor, brownish-black color and curdy consistency, as we have since come to know them, were at once evident. The moisture was 94 per cent. On Aug. 7 about 300 gal. of this sludge were allowed to run directly to the sludge beds from the primary tank. Eighteen days later this same sludge was removed from the beds in pieces—a matted, porous, fibrous cake. After a few days further drying this sludge was burned in piles on the dike surrounding the beds. A fluffy, reddish ash was left behind. This performance was duplicated many times during the summer and early fall with the same favorable results. Contrary to the behavior of most sludges, which fissure vertically in drying, this sludge seemed to dry in layers, separating laterally. Visitors at the station often compare the appearance of this sludge to that of heavy brown paper.

This very unusual behavoir of a practically raw sewage sludge drying on sand beds under all sorts of weather conditions, without nuisance or even appreciable odor, caused us to dispense entirely with secondary tank digestion during 1920. But two of the sludge digestion tanks were ever used for this purpose. They were operated on the fill-and-draw principle. Since there was so little to be gained by the use of secondary tanks they were abandoned with the idea that we would operate the station under the hardest conceivable conditions by drying a primary tank sludge on the beds and kick up a nuisance if possible, but we failed.

Since we had precisely the same sludge experience during 1920 that we had in 1919, and one that differs so radically from that in other cities, we have attempted to explain the mystery by a combination of circumstances. (1) We have a sewage that is comparatively dilute, amounting to more than twice the average water consumption. Thus the

medium is provided by which many of the finely divided organic solids can be carried off in the effluent. (2) The presence of tarry oils, always noticed in the sludge, are discharged in alleged small amounts by the local gas works. The antiseptic action of these light oils has long been recognized. (3) A large proportion of the sludge is made up of pulpy rag and strawboard wastes, discharged into the Prescott sewer by a local paper mill. This material is practically inert and forms the fibrous mat which facilitates the drying and burning of the sludge. Samples of this dry sludge had a heat value of 7,000 B.t.u.

In conclusion, it must be admitted that from the Grand Rapids standpoint, with a sludge promising so little difficulty to handle, the high concentration is very desirable. Especially where an almost unlimited space for sludge beds can be provided. There are 130 acres in the tract selected for the site of the permanent plant—fairly well isolated from the city. But there are several points still to be settled before final recommendations can be made. While much depends on the results of the 1921 experiments, the Dorr clarifier in my opinion has great possibilities. Compared with the Dortmund tank it has given practically the same sedimentation efficiency and delivered a much more concentrated sludge for at least six months in the year with but half the excavation required for the Dortmund. Against these advantages are the greater depreciation in Dorr super-structure and mechanism and the greater expert attention required for the successful operation of a plant of this type.

The city has expended $63,000 to date for sewage disposal purposes, of which $30,000 has been applied toward the purchase of land for the permanent site, $13,000 is the outlay for building and equipping the sewage testing station, and the balance covers operating and other expense incidental to sewage disposal studies since April, 1917.

Hoad & Decker, consulting engineers, Ann Arbor, were the designers of the original Dortmund tank and testing station. The Dorr Co. organization has taken an active interest and co-operated greatly with the city in conducting its experiments during the past six months. All samples were analyzed at the laboratory of the water filtration plant under Walter A. Sperry, chief chemist.

Tie Records From Test Tracks

From report of Committee on Ties, American Railway Engineering Association

IT IS highly important to know the life and comparative value of different kinds of ties in the same locality and in localities having different climatic and traffic conditions. Without reliable information of this kind, it is not possible to purchase or treat ties economically or distribute them wisely. The method of test sections is the best for obtaining the necessary data, but methods of installing the sections and of collecting and reporting the data on different railroads are not uniform, although the work of the Forest Products Laboratory has tended toward uniform methods of reporting. Some larger roads have installed only one or two test sections. Others have installed at least one on each roadmaster's district. Some have put in only a few ties of each kind and few kinds; others have placed not less than a hundred of each kind and many different kinds.

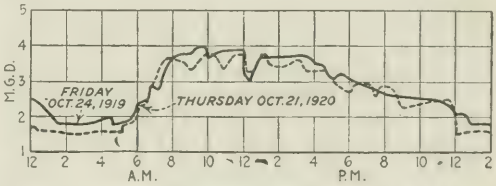
The principal criticism of the test section method of obtaining data on the life of ties has been that it often gave abnormal results, due probably to the fact that the ties are in most cases selected, the maintenance is above the standard and the renewals are watched with unusual care. The chief object of the tests is to secure comparative data and the test sections usually give this comparison, but the tests might be made more nearly representative if care were taken to keep the conditions as near as possible to average actual practice. Of forty railroads only five submitted data to show that a systematic record of test sections had been kept; namely, the Chicago, Burlington & Quincy, the Great Northern, the Baltimore & Ohio, the Pennsylvania and the Northern Pacific. Several other roads are keeping a more or less complete and comprehensive record of this kind.

Water-Waste Prevention Methods and Results in Superior

A Fully Metered City Supplied Through Master Meter Runs Down Eight Million Gallons Per Month in Service Leaks

By W. C. Lounsbury and Allen W. Fowler
General Manager and Assistant
of the Superior Water, Light & Power Co.

AS WATER is pumped twice in order to supply an iron-free well water to the water-works system of Superior, Wis., the local company has utilized all of the precautions to insure as high a ratio as possible of water paid for to that pumped. For many years the city has been entirely metered except for a few large fire services and a few consumers who do not have sewer or waste pipe connections. Such a widespread use of meters is an effective check upon voluntary waste.



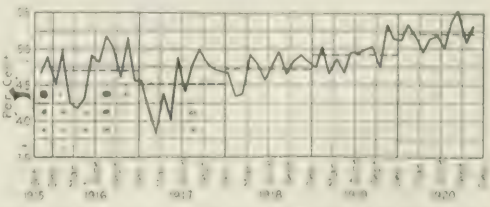
TYPICAL HOURLY CONSUMPTION ONE YEAR APART SHOWING RESULTS OF WASTE SURVEY

The ratio of water sold to that pumped, as shown on the accompanying chart, takes into account only water paid for—not that supplied free to public buildings and schools although such water is metered.

In Superior water is used or wasted in the following ways:

1. Sold to consumers through meters.
2. Unregistered water passing through consumers' meters.
3. Sold to flat rate consumers.
4. By public buildings, including fire halls, city hall, municipal jail and school houses.
5. For fire department purposes.
6. For street sprinkling and washing.
7. For drinking fountains from May to November.
8. For sewer flushing.
9. For park fountains and sprinkling.
10. For flooding public ice rinks.
11. For company uses in connection with the pumping station and filter plant.
12. By loss from known leaks pending repair.
13. By pipe and service leakage.

To account for the water pumped estimates must be made for each of these uses and it is not difficult to account for all of the water lost in any system by estimating these liberally enough, but the writers believe



FIVE YEARS' RECORD OF THE PERCENTAGE OF WATER SOLD TO THAT PUMPED

the large personal factor which enters into such estimates makes many reported statistics of water accounted for entirely unreliable and our own estimates repeatedly made to try to account for the entire pumpage in Superior have always seemed unsatisfactory. Nevertheless, studies made along these lines led to the belief that entirely too much water was getting away.

A careful survey was made of the water used in many of the ways enumerated above and meters were installed on all services entering public buildings. Particularly was the night rate studied and an accumulation of data indicated that the minimum rate of consumption was higher than is warranted in a city like Superior.

All of the construction work in the distribution system has been done under the direct supervision of one man who has had charge of this work for a great many years and who was a workman on the mains when the original installations were made 31 years ago. Moreover, practically all of the joints have been calked by two employees equally long in the service. Knowing the workmanship of these men and appreciating the character of the soil, which is uniformly a dense clay, it did not seem that there could be much water getting away because of joint leakage. Nevertheless it was decided to make a survey of our distribution system by the well known hose-and-meter method. The company undertook to make this survey with its own men and for three years the writers have annually made such a survey. This work was done at night between 1 and 5 a.m.

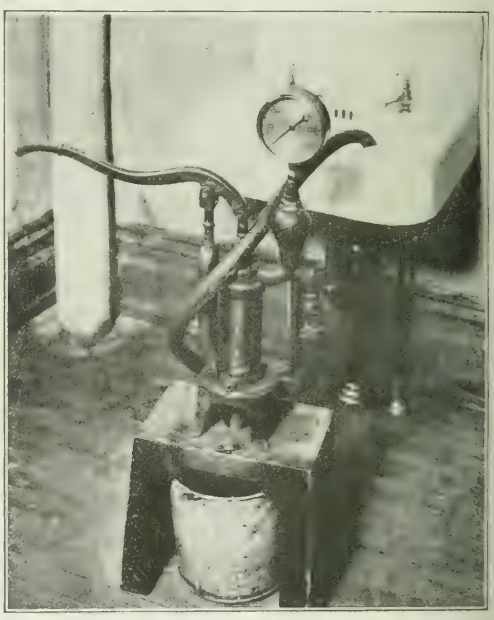
Tests Made by Districts

The city was first divided into eleven districts, which were tested separately on consecutive nights. The practice was to isolate a district by closing the control gates and then to observe the pressures with a recording gage, supplying the district by fire hose so arranged as to pass the water through a carefully calibrated 3 x 1-in. venturi meter. The test of each district covered the consumption of that district for about one hour, the recording gage recording the changes in pressure during that time. An allowance for reduction of pressure was made in computing the normal flow to the district. During the period that these tests were being made careful records were kept of the pumpage from the station both by means of a master meter and by pump revolutions. After the tests of the eleven districts had been completed each year some of those showing the largest consumptions were further subdivided and attempts made to locate the leaks. No large leaks or illicit uses of water were found by this method but it was demonstrated that the leakage was widely distributed.

For reasons before given it did not seem probable that this widely distributed leakage was from defective mains. Since all service pipes to the curb cocks are of extra strength lead it did not seem likely that the leakage would be found in these connections, but inasmuch as the connections from the curb to the consumers have been the work of plumbers and galvanized-iron pipe is invariably used it was surmised that the customers' services might be defective.

An endeavor was made to locate small leaks on customers' services by supplying a small section of three to six blocks through the hose and meter and then shutting off the customers' services in a single block, observing carefully the changes in flow at the meter. The services were then opened and those in another block similarly tested. This method enabled us to detect 27 small leaks, aggregating 58 gal. per minute, on six miles of mains in the oldest part of the city. This work was, however, laborious, disagreeable and expensive on account of its having to be carried on at night, using a crew of four men and a truck.

To overcome these objections W. H. Winslow, vice-president of the company, suggested that a special apparatus be devised, consisting of a small force pump with its outlet carrying a few feet of garden hose. The pump is mounted on a small stand and is arranged to draw water from a calibrated pail. With this apparatus one can determine whether or not a service pipe leaks, and if it does at what rate. The house shut-off valve is closed and the meter disconnected. The outlet hose of



FORCE PUMP WITH HOSE AND GAGE FOR TESTING CUSTOMERS' SERVICES

the pump is then attached to the outside service connection. The shut off, usually a stop-and-waste cock, is opened again and the city water pressure shows on the gage. If there is an excessive leak the gage indicates it at once. A second inspector is stationed at the curb and while the pump is being connected he is opening the curb box and placing a curb cock key in position. Upon a signal he closes the curb cock. The inside inspector then attempts to pump water into the service pipe. If the pipe is tight no water can be pumped into it. If it is leaking, the inspector has to pump more or less rapidly to maintain the pressure. By timing the fall of the water level in a calibrated pail with a stop watch the rate of leakage is easily determined. If a service leaks so badly the pressure cannot be held up to normal with the pump a correction must be made or the result will show a smaller leakage than exists. In our work such a correction has not been made.

Since June 1, 1920, services numbering 4,295 out

of a total of 6,767 now in use have been tested with this apparatus, and 205 underground leaks have been found which would not have been discovered by ordinary inspection, and which were permitting a leakage of more than 8,000,000 gal. per month.

Listening on the pipe either directly or with the use of any of the well-known instruments for this purpose might have indicated a leak but would not prove its existence on the service pipe belonging to the consumer. The pump apparatus leaves little for the judgment and actually measures the leak.

SUMMARY OF LEAKS FOUND IN 1920

Month	No. of Services Tested	Underground Leaks	Leak in Gal. per Month	Payroll Cost of Inspectors
June	996	38	2,093,000	$169.54
July.....	850	32	1,274,000	175.00
August.....	725	40	1,641,000	175.00
September....	552	34	1,447,200	151.00
October.....	595	30	896,400	176.00
November....	577	31	799,200	175.00
Totals.....	4,295	205	8,150,800	$1,021.54

These leaks have all been repaired by the owners of the property, as the company does no service work on the consumer side of the curb. Inasmuch as the fuel item alone makes a cost of 1¼c. per thousand gallons pumped it is evident that the annual saving may run considerably over $1,200 with a total investment of less than this amount.

The ratio of water sold to water pumped has increased during this period and the monthly pumpage has decreased an amount approximately equal to the saving indicated.

The apparatus has also been used to demonstrate leaks in toilets and in house connections, particularly where they pass below the basement floor. When used in such a way the meter is removed and the pipe capped or the stop and waste plugged. Water is then pumped back into the house through a connection with an open faucet or from the meter loop. Records of such tests have not been kept for they were apart from the purpose of the study.

A Large Rain Gage and Heavy Rainfall

By B. F. Rush
Assistant Engineer, U. S. Geological Survey, Honolulu, T. H.

A RAIN gage with a diameter of 27 in., a height of 5 ft., and a capacity of 900 in. of rainfall sits lonesomely on top of Waialeale, one of the highest peaks of the mountains which traverse the island of Kauai, in the Hawaiian Islands. The ratio of the area of the small opening at the top of the main body of the container is 1 to 20.

Waialeale has an elevation of 5,080 ft. At the location of the gage the mountain range drops off to an abrupt descent of from 2,000 to 3,000 ft. to the north. The slope to the south is gentle.

The trade winds coming from a northerly direction strike the cooler surface of the mountains and here unload an enormous supply of their saturated vapor in the form of rain. The precipitation here is reported to be, if not the greatest, at least one of the heaviest in the world. The measured rainfall from Jan. 8, 1920, to Feb. 3, 1921, was 590 in., or an average of about 1½ in. per day. The gage is visited yearly by a member of the U. S. Geological Survey.

A hose was used to siphon the water from the container, for when this can is full there is danger of denting its sides if it emptied in the ordinary way by tipping it over.

The Georges Creek Accident and Ruggedness in Bridges

Collision Resistance Increased by Subpaneling and Heavy Gusset Plates—Material and Workmanship

By A. W. Buel
Consulting Engineer, New York City

THE article in *Engineering News-Record* of Jan. 20, p. 100, describing and illustrating the train wreck on the Georges Creek Junction bridge suggests the question, what features of the construction account for the remarkable reserve strength that enabled this bridge not only to continue to stand but even to carry trains on one track after the wreck was cleared? As the bridge was designed and fabricated under the writer's supervision he is glad to contribute remarks on these items to complete the record and assist in bringing to the attention of bridge designers any lessons the accident holds.

As described, the bridge consisted of two double-track through spans, each 150 ft. long. The trusses were of the Baltimore form, with five main panels or ten subpanels of 15 ft. each. They differ from the double Warren system with vertical posts used by the late George H. Thomson of the New York Central for many years, by lacking the upper half of one diagonal, which change reduces ambiguity and saves weight. The happenings in the wreck do not indicate that the Thomson form of truss would have behaved any better.

Subdivided Web and Short Panels

Subpaneled trusses have been criticised severely in recent years for two different reasons. The single-intersection or Pratt truss has been claimed superior because it is lighter (which is true only when the subpanels are relatively short). Other things being equal, the engineer naturally prefers a design with fewest members; but the Georges Creek accident goes far toward showing that other things are not all equal. In other words, the greater number of members, which is often objected to, proved to be a distinct element of value in this accident, by increasing the resistance of the truss webbing to destruction by the wrecked cars.

Second, measurements of stresses in bridges have disclosed the presence of important secondary stresses in riveted bridges, and have shown that subpaneled trusses are apt to have larger secondaries than trusses without subpaneling. This criticism has led to a distinct loss of favor of subpaneled trusses in recent years. But it may very properly be claimed that the sections of members required in a 150-ft. span do not involve large secondary stresses until the overload on the bridge approaches 50 per cent. "It is not used any more" is the way the subpaneled truss is nowadays disposed of. It seems that modern structural design is putting some pretty good old practices on the shelf.

In the writer's opinion it is largely the short panels of the Georges Creek Junction bridge that account for its ruggedness. The short panel length, of course, is closely related to the use of a subdivided web system. With 15-ft. panels a coal car is never carried by less than three floorbeams, and two-thirds of the time its weight is distributed over four, of which a single one would be capable of holding it up. This fact is adequate to account for the strength of the floor after complete rupture of several hangers.

Gusset-plate strength, however, was also a probable

factor in the matter. All the gusset plates of this bridge, at subpanel as well as main points, are $\frac{11}{16}$-in. thick, so fixed as to make the bearing value equal to the double shear value of the rivets. Heavy gusset plates may possibly tend to increase secondary stresses, but their use in this structure unquestionably contributed part of its reserve strength.

The subpanel diagonals provide effective collision struts, not only for the end posts but also for the main diagonals, cutting in half their unsupported lengths about axes perpendicular to the plane of the truss. At the same time the small number of main web members and their relatively massive proportions correspond to those that would obtain in a long-panel design. The addition of the subpanel diagonals and hangers is largely offset by the reduced weight of the stringers. The subpanel form of truss combines advantages of long and short panels, and the accident under discussion tends to show that it also has collision-resisting properties peculiar to itself.

Not every subpanel truss would behave in a similar manner to this one unless its details and connections insured the integrity of the structure as a whole. But even with all the care possible our knowledge of many things is so limited, particularly as to the destructive forces of accidental collisions and derailments, that our designs are far from perfect, and in fact such forces are not specifically taken account of in designing.

Possibly an intensive study of accidents such as this one may eventually lead to some conclusions that will enable designers to provide for a certain measure of collision resistance, within reasonable cost.

In the meanwhile it is gratifying to find that a bridge designed to carry only ordinary loads can show so much resistance to collision forces.

Planing and Reaming

Rather unusual toughness was displayed by the material, as indicated by the remarkable amount of bending and twisting and the fewness of fractures. This satisfactory showing is probably due more to fabrication than to inherent quality of the steel, since the latter was ordinary open-hearth structural steel except that the range of tensile strength specified was somewhat increased so that the mills could roll the steel without finishing at either too high or too low temperature. The workmanship, however, was unusual in that subpunching and reaming, and general planing of sheared edges, were called for. Further, by penalizing material $\frac{3}{4}$ in. thick and over through requiring that it be drilled from the solid, the specifications limited the thickness to $\frac{11}{16}$ in.; this statement applies to a total of over 30,000 tons of bridges, and the only exception was the turntable of a double-track swing span, where thicker material had to be used and the holes were drilled. The design and fabrication were strictly in accordance with the writer's published specifications of 1906, with one or two minor revisions made in 1910.

Distinct importance attaches to one point that was the subject of discussion at the time the bridge was designed. The railroad line in question makes through connection with a railroad having extremely dense and heavy freight traffic, and on the latter line, because of a train wreck that had destroyed a bridge some years before, the practice of equipping bridges with fender or skid girders had been adopted. Because of this fact the question came up whether skid girders should be put on the Georges Creek Junction bridge, especially because it is located on a 1.62 per cent grade descending east, with the west approach on a 2 deg. 16 min. curve. The writer reported to the chief engineer that such provision would be in the nature of casualty insurance, and submitted an estimate of the cost of the skid girders and of the necessary increase in bridge weight to carry them. It was thereupon decided to omit the skid girders.

Should Skid Girders Be Used?

Compounded to the time of the accident, the extra cost would have amounted to about $8,000. The bridge stayed up even without the skid girders, but it is nevertheless of interest to consider whether the skid girders might not have saved a large item in the cost of repairs. Will not the engineers who had charge of the repair work give us some information on its cost to assist in deciding for or against them in future bridge design?

Referring again to the reserve strength realized through short paneling and subdivided webbing, mention may be made of the writer's experience with two bridges in Central America. One, in Costa Rica, whose truss form was similar to that of the Georges Creek bridge, had first one abutment and later (after its repair) the other partly washed out in a heavy flood. For a time it was supported on three corners only, but in this condition it nevertheless carried 10-ton cars and showed no distortion, either general or local. The Las Vacas viaduct in Guatemala, 230 ft. high, described in *The Engineering Record* Dec. 8, 1906, p. 638, and Jan. 26, Feb. 2 and Sept. 14, 1907, pp. 104, 118 and 297, went through the 1917 earthquakes with practically no damage. Some anchor bolts were sheared and some trusses and towers displaced a few inches, but repairs were made and the line reopened in about 6 hr. The basic principles of design applied to this structure were identically the same as used in the case of the Georges Creek Junction bridge.

Efficiencies of Residence Water Systems

TESTS made on several displacement-pump compression-tank farm residence water-supply systems of 100 to 200 gal. per hour capacity showed over-all efficiencies of from 15 to 25 per cent under normal operating conditions, with 17.5 per cent as a fair average. These results were given by G. C. Blalock, assistant professor of electrical engineering, Purdue University, in a recent paper before the Indiana Engineering Society. The efficiency increased with the pressure but the pump is likely to operate at a reduced pressure for a large percentage of its total operating time. Motor efficiencies varied from 40 to 60 per cent, with 50 per cent as a fair average. Thus the pump efficiency in this type and size of plant may be expected to average about 35 per cent. These efficiencies result in a pumping duty of 2.1 to 1.25 kw.-hr. per 1,000 gal. per 1,000-ft. head, with 1.8 as a fair average. Considering the capacities of these units this figure compares favorably, Mr. Blalock stated, with the average for the smaller city pumping units over the state age for the smaller city pumping units over the State of Indiana. The trend of present-day isolated plants, according to Mr. Blalock, is away from the elevated storage tank formerly used with hand, windmill or power pumps toward the hydro-pneumatic tank which is the purely pneumatic system in which the tank is used for the storage of compressed air only.

Testing Turbine Efficiency by Pressure Measurement

Gibson Method and Apparatus Investigated Experimentally and Used in Practice in Determination of Discharge of Water Wheels in New Niagara Falls Plant

By Norman R. Gibson
Hydraulic Engineer, Niagara Falls Power Co., Niagara Falls, N. Y.

Abstract of a paper presented at the Hydro-electric Symposium held at Philadelphia, Jan. 28, 1921, under the auspices of the Philadelphia Engineers' Club, and the Philadelphia sections of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, and American Society of Civil Engineers.

It is the purpose of this paper to describe the efficiency tests of three large new 37,500 hp. units in Station No. 3, Extension of the Niagara Falls Power Co. and to refer particularly to the application of the writer's new invention for measuring the flow of water in penstocks. This method seemed to offer many advantages, particularly in the case of very large units supplied with water through closed conduits. It is the outcome of studies of the changes of pressure in penstocks caused by the gradual closing of turbine gates which appeared in the form of a paper published by the American Society of Civil Engineers in April, 1919. This paper will not contain a mathematical analysis of the method nor a detailed description of the apparatus employed. Patents have been applied for on the invention.

The method makes use of two well known principles, the first being Newton's second law of motion, sometimes referred to as the equation of impulse and momentum, and the second being a corollary of the first, namely, the relation between change of pressure and change of velocity of a column of water expressed in terms of the velocity of the pressure wave. The application of these two principles makes it possible to determine the mean velocity of a column of water in a penstock by recording the changes of pressure at a point in the pipe line when the flow of water therein is gradually brought to rest by closing a valve or the turbine gates. The mean change of pressure recorded is a precise measure of the velocity destroyed.

The apparatus comprises a new combination of simple elemental parts in which the pressure element is a U-tube containing mercury, the motion of which can be made to correspond in any desired ratio to the change of pressure in the penstock. It provides illumination and records photographically to exact full scale the motion of the top surface of the mercury in the tube and combines in the record the oscillations of a seconds pendulum. The resulting diagram shows to exact scale a complete record of pressure changes and time.

The first experimental equipment comprised a head-water tank feeding a 3 in. wrought-iron pipe 420 ft. long, near the lower end of which was placed a 3-in. globe valve. The flow through this pipe was made to discharge into a measuring tank about 5 ft. wide by 10 ft. long by 4 ft. high. By maintaining a constant level in the head tank and opening the globe valve various amounts it was possible to produce a steady flow in the 3-in. pipe at various velocities up to about 4 ft. per sec. The discharge was measured in the measuring tank and then the globe valve was closed by hand. The pressure recording apparatus was attached to the 3-in. pipe just upstream from the globe valve and during the closing of the latter the apparatus recorded the changes of pressure in the pipe. The results of these experiments were remarkably satisfactory considering the nature of the equipment and it was found that the variation of measurements by the new method from the volumetric measurements was seldom greater than ½ per cent.

Following this work a new set of apparatus was built and trials were made not only with the 3-in. experimental pipe but also on the 9-ft. penstock of Unit No. 2, in Station No. 3, of the Niagara Falls plant. Efficiency curves obtained by the new method were compared with curves made by pitot tube some years previously on a similar unit. The two curves have the same characteristics, the new one being just a little lower than the old one, which it was considered reasonable to expect in view of the age of the unit.

With this evidence in hand the matter was brought to the attention of the United States Division Engineer at Buffalo, who had charge of the regulation of the use of water from the Niagara River, and upon request the company was advised that the new method might be used for determining the relation between power and discharge of the new units then being installed if satisfactory proof were given as to the accuracy of the new method or the coefficient that should be used, if any. It was desired to use the new method rather than one of the older and well known methods mainly because the tests could be carried out without serious or prolonged interruption of the supply of power from the unit being tested. It requires a two-minute shutdown for each measurement and the measurements may be repeated about once every ten or fifteen minutes. A complete set of measurements at each tenth of gate opening from half to full gate may be made in less than two hours and during that time the unit would be out of commercial service only about 15 minutes. There we

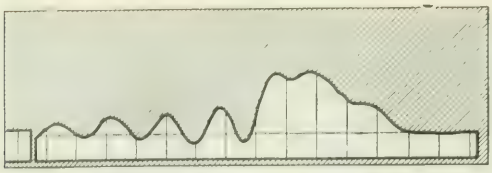


FIG. 1. TYPICAL PRESSURE-TIME DIAGRAM, STEEL PIPE 18-IN. DIAMETER, 112.63 FT. LONG. CLOSURE BY BUTTERFLY VALVE

two other reasons that may be mentioned, one that the trouble and expense of the tests would be much less than by any other method, and the other that it was believed the new method was very accurate.

The reason for the accuracy of the new method will be appreciated by a reference to the fact that a small change in velocity can be made to produce a relatively large change of pressure. The mean change of pressure corresponding to a change of velocity can be made from 5 to 20 times the velocity head or even greater if there were any advantage in doing so. In the pitot tube the velocity head only is observed or at best by differential methods only some small multiple of it. In the new method a record is made with great precision of a quantity that is many times greater than the velocity head. In other words the quantity observed and recorded is many times greater than but is proportional to the quantity it is desired to know. It is true, of course, that this change of pressure takes place in a comparatively short time and the element of time must be considered. It is comparatively easy, however, to measure time very accurately. It so happens, however, than in the new method it is not necessary to measure time directly at all, but only the product of pressure and time which may be done very accurately indeed.

In order to obtain satisfactory proof of the accuracy of the new method of measurement as required by the authorities in charge of the regulation of the use of water, arrangements were made with Dean E. E. Haskell of the College of Civil Engineering at Cornell University to have a thorough test made by comparison with volumetric measurements at the laboratory of the University. There is probably no other place where hydraulic experiments of this kind can be made so satisfactorily as at Cornell University.

The general arrangement of the equipment used at the laboratory may be noted from the accompanying photograph. In the background is the dam which impounds water in a comparatively large reservoir and at the south end of the dam is the intake to a 48-in. steel conduit. The intake comprises a submerged orifice protected by steel screen bars and a gate well into which the water flows before it enters the pipe. A 48-in. rising stem hand operated gate valve controls the flow into the pipe.

The 48-in. pipe extends for a distance of 198.37 ft. to a dead end, but about 4 ft. from the end a 30 in. cast-iron pipe branches off at an angle of about 45 deg. and after passing two bends discharges into the weir channel inside the laboratory building. In the 30 in. branch two valves at the points were placed, one a 26 in. butterfly valve with reducers and the other a 30 in. hand operated rising stem gate valve.

The weir channel is about 35 ft. long, 6 ft. wide and 7½ ft. deep below the channel walls. In it are placed heavy baffle boards for stilling the discharge from the 30 in. pipe and at high flows a timber raft is used in addition for the same purpose.

After discharging over the weir the water may be wasted or may be directed into an accurately calibrated steel standpipe which is 6 ft. in diameter and 60 ft. high. The quantity of water is measured volumetrically in this tank. The elevation of the water surface in it is determined by means

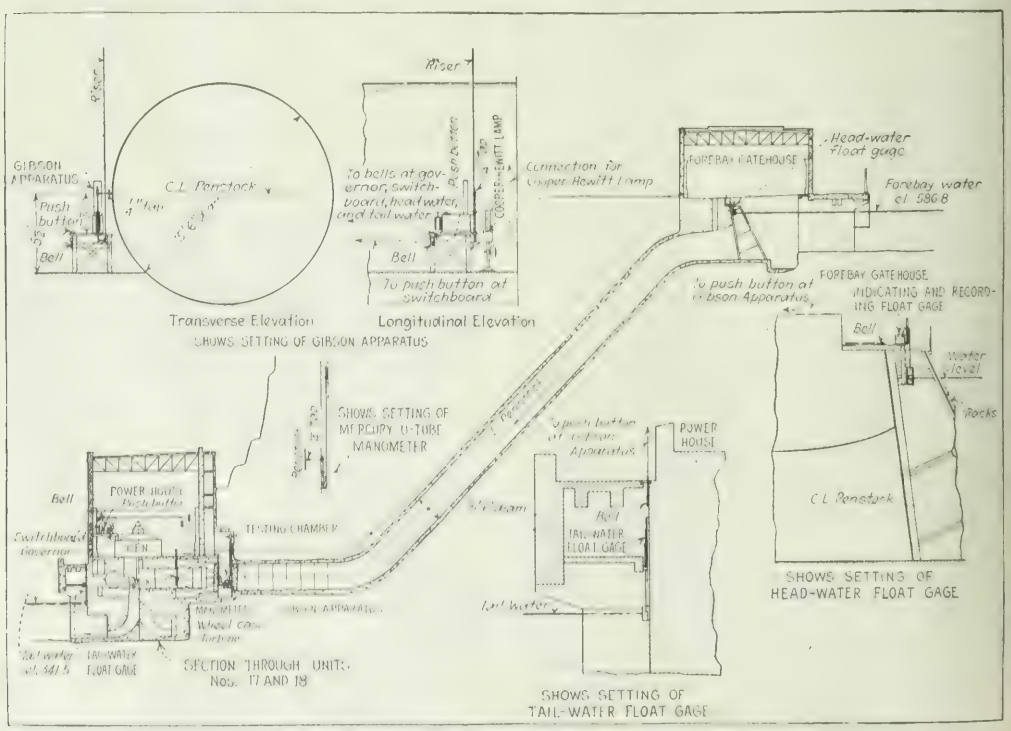


FIG. 2. SETTING OF TESTING APPARATUS AT NIAGARA PLANT

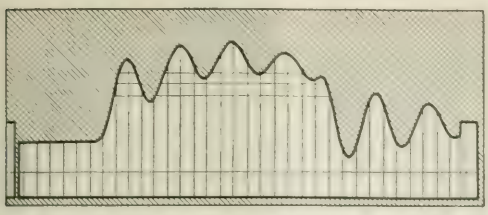


FIG. 3. TYPICAL PRESSURE-TIME DIAGRAM, FUNNEL OF PENSTOCK AT NIAGARA, 15 FT. 6¼ IN. DIAMETER, 371.5 FT. LONG. CLOSURE OF TURBINE GATES

of a counter-weighted float gage, readings being taken by observations of a steel tape which passes over a pulley. The water is directed into the standpipe by means of a counterweighted diverter which quickly cuts through the nappe of the water passing over the weir. As the diverter passes through the nappe, electric contacts in circuit with a chronograph are closed. The contacts are adjusted to close when the edge of the diverter is at the middle of the nappe.

For the tests the Gibson apparatus was placed on the concrete pedestal about the middle of the view and connected to a piezometer opening tapped into the wall of the pipe at a point 142.64 ft. from its mouth.

On account of the restricted entrance into the gate well at the intake and the consequent loss of head there was considerable surging in the gate well when the flow was shut off during a test. This variation in head water level had to be accounted for in determining the flow and the changes of level were obtained by recording the height of a float gage in the well. For convenience this was done by fitting up a second Gibson apparatus for the purpose which simply photographed the motion of an arm attached to the float gage, the photograph thus obtained being a record of the changes of level of the water in the gate well during a test.

The procedure during a test was as follows:

The lowest 30 in. gate valve was opened a fixed amount, partial opening being used for low flows and full opening for high flows. The discharge was then controlled by means of the upstream 26 in. butterfly valve which was gradually closed by hand.

During the closure the pressure-time diagram was made by means of the apparatus and a record of the surge in the gate well obtained as described above. A typical diagram is shown in Fig. 1.

After the shutdown the leakage through the butterfly valve was measured volumetrically and recorded. As the new method measures only the flow actually shut off, the comparison had to be made between the discharge as measured by that method and the net discharge measured by the volumetric method after deducting the leakage through the butterfly valve when closed.

A series of tests comprised three or four runs under as nearly as possible the same conditions of flow in the same way that check measurements might be made at any one gate opening in testing a turbine. The individual results and the average of all the results of any one series were then compared with the respective volumetric measurements and the average of the latter.

Six series, comprising in all 19 tests, were made under conditions approximating as nearly as could be had at the laboratory the conditions prevailing for efficiency tests at Niagara Falls. The table herewith shows the results of these tests, from which it is seen that the average of all measurements made by the Gibson method agree within less than 0.2 per cent with the average of all the volumetric measurements. The maximum variation of any one series is 0.8 per cent.

A careful analysis of these results has been made which indicates that part of even the slight variations between the volumetric measurements and measurements by the new method may be explained by a very slight unsteadiness of flow which is sufficient to account for some of the difference between the two measurements. This unsteadiness seems to be characteristic of all water flowing above the critical velocity, and while difficult to account for its was manifest in this case by the variations in the level of the water passing over the weir before it entered the measuring tank. The magnitude of the variations in gage height was an index of the magnitude of the variations in flow. It would be natural of course that variations in the measurements due to this cause would be both positive and negative and the mean of a series of results would not show differences of the same magnitude as might occasionally be found in any single measurement. The fact that the mean variation between the volumetric measurements and the measurements by the new method is only 0.2 per cent would indicate that while there might be a difference between the two methods of measurement for any one observation each methods might be as near perfect as the other because the quantity measured is slightly different in each case.

Having thus established by careful experiments the accuracy of the new method, the official efficiency tests of the three new units in Station No. 3 Extension at Niagara were made. The lower end of penstock tunnel is lined with steel plate and just before it connects with the Johnson valve, the lining forms a steel pipe passing through a testing chamber which has been made at the rear of the power house. Originally this testing chamber was designed for the use of pitot tubes, but it serves very well as a place in which the apparatus for recording the changes of pressure in the penstock may be set up. Fig. 2 shows the setting of the apparatus and other tests equipment with reference to the adjacent parts.

The general procedure for the test by the new method was as follows:

1. The physical dimensions of the interior of the penstock were measured from field data and available drawings.

2. Prior to all the tests that were made on any one unit, a leakage test was made to determine the quantity of water that leaked out through the turbine gates when closed. This is necessary in the new method because only the flow actually shut off is measured and whatever remains must be added to the total discharge. A leakage test of this kind is a very simple matter. The turbine gates are closed and pressure maintained in the regulating cylinders. The stop gates at the upper end of the penstock are then put in place and the water in the penstock gradually leaks out through the clearance spaces around the turbine gates. As the water leaks out the fall or pressure of the water in the

TABLE SHOWING COMPARISON OF VOLUMETRIC AND GIBSON MEASUREMENTS

(Record of Tests Made Under Approximately Niagara Conditions)

Test No.	Discharge c.f.s. Volumetric	Gibson	Percent Variation	Remarks
20-A-1	20.27	20.31	+0.2	Tube [illegible] 1.335
20-A-2	20.42	20.52	+0.5	
20-A-3	20.45	20.65	+0.9	
	20.38	20.48	+0.5	Mean of series
30-A-1	30.38	30.51	+0.4	
30-A-2	30.63			Pond drained and completed
30-A-3	30.69	31.15	+1.5	
	30.57	30.82	+0.8	Mean of series
40-A-1	42.24	42.17	—0.2	
40-A-2	41.94	42.28	+0.8	
40-A-3	42.22	42.09	—0.3	
40-A-4		41.96		Volumetric not taken
	42.13	42.12	0.0	Mean of series
40-C-1	40.36	40.41	+0.1	
40-C-2	40.36	40.90	+1.3	
40-C-3	40.98	40.88	—0.2	
	40.57	40.73	+0.4	Mean of series
50-A-1	46.82			Pressure diagram unavailable
50-A-2	46.95	46.60	—0.7	
50-A-3	46.98	46.60	—0.8	
	46.92	46.60	—0.7	Mean of series
50-C-1	50.30	49.95	—0.7	
50-C-2	50.66	51.47	+1.6	
50-C-3	50.93	51.14	+0.4	
	50.63	50.85	+0.4	Mean of series
Entire mean	231.20	231.60	+0.2	Mean of [illegible]

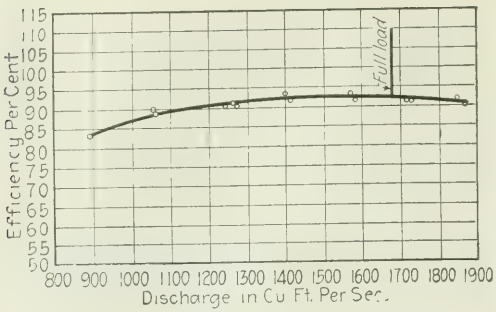


FIG. 4. EFFICIENCY-DISCHARGE CURVE OF UNIT NO. 16, NIAGARA

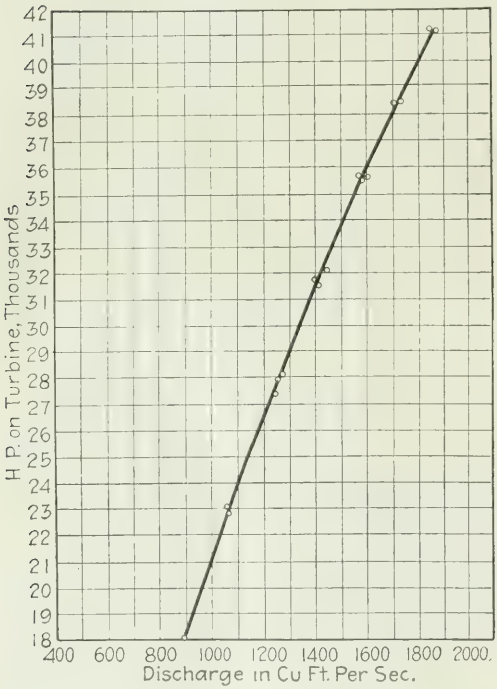


FIG. 5. POWER-DISCHARGE CURVE UNIT, 16, NIAGARA

penstock is observed by means of an ordinary pressure gage and the time and amount of each observation recorded. Then a diagram is plotted which indicates the rate at which the water has leaked out. In some cases the leakage through the stop gates at the upper end of the penstock was considerable and in order to correct for this the Johnson valve which is very tight was closed and the rate of rise of pressure in the penstock recorded as the water leaking past the head gates filled it up. This determined the rate of leakage through the head gates which could be used in obtaining the correct leakage through the turbine gates.

3. Having completed this preliminary work, the apparatus was attached to a ¾-in. piezometer opening tapped into the wall of the penstock.

4. Headwater and tailwater float gages were placed in the forebay and tailrace for observing the elevation of headwater and tailwater during a test.

5. A system of electric signal bells was established, the control buttons being placed in the testing chamber near the operator of the apparatus. When ready the assistant in the testing chamber could signal to the observers at forebay and tailrace and to the governor operator.

6. For observing the net head on the turbine a U-tube mercury manometer was set up with a connection to the penstock just at entrance to the turbine casing. Two observers recorded the elevation of the surfaces of the liquid in the two legs of the U-tube. The gage was calibrated by reference to the total static head when the water was at rest.

7. Making the diagrams. The unit being tested was synchronized with other units in the plant and allowed to run on steady load with the gates fixed for several minutes and then it was shut down at a given signal by operating the hand control pilot valve on the governor. A cord was wound around the stem of the valve and on a given signal the operator pulled the cord which spun the pilot valve wide open. The pressure fluid then flowed to the regulating cylinders which operate the gates and they were closed just as fast as the fluid could flow through the connecting pipes into the regulating cylinders. The connecting pipes can be throttled to reduce the speed of closing if necssary. On other units the pilot valve is opened by means of a hand wheel, but the effect is the same. The duration of closure was usually from about 8 to 18 seconds, depending upon the amount of gate opening.

Immediately preceding and during the closure of the gates and for a short time thereafter the apparatus recorded the changes of pressure in the penstock forming a diagram similar to that shown in Fig. 3. As the gates of the turbine closed, the load on the generator was transformed automatically to the other units operating in synchronism with it, sufficient capacity having been left available for that purpose and the unit under test being then driven as a meter at sychronous speed.

8. For two minutes prior to the shutdown the power output of the generator was determined by periodic readings of a calibrated indicating wattmeter attached to the generator leads through calibrated current and potential transformers. The power output of the turbine was obtained by using the efficiency of the generator which was determined by the Company's electrical engineers.

9. Periodic readings of headwater and tailwater gages were also made for the two-minute period prior to the shutdown and for a short time thereafter.

It required about two minutes to make a single measurement and measurements could be repeated about once every 10 or 15 minutes or at the rate of 4 or 5 to the hour. In this way a complete set of diagrams was obtained for each unit at various gate openings. On account of the ease with which diagrams can be made several were taken at each gate opening so as to obtain an average result, and in all from 16 to 18 diagrams were made for each unit.

After velocities had been calculated from the diagrams and discharges and effective heads computed, the usual power discharge and efficiency curves were prepared. (Figs. 4-5). From these will be noted the remarkable uniformity in the determination of the points along the power-discharge curves from which it may be concluded that the errors of observation, or so-called variable errors, are extremely small. The absence of any inherent or consistent error was demonstrated by the tests made at Cornell University.

In conclusion attention may be drawn to some of the advantages of the new method of measurement where it may be applied:

1. Remarkable accuracy in the determinations of the velocity of flow because small changes of velocity result in comparatively large changes in the pressure to be recorded.

2. Determinations of velocity may be made without serious or prolonged interruption of the commercial supply of power from the unit being tested.

3. Each determination of the velocity of flow may be made quickly in one operation; tedious methods involving tabulation of observed results are avoided.

4. The process is essentially simple and inexpensive. Special appurtenances in the pipe line are not required.

California Highway System Investigated by Federal Bureau

Comprehensive Report Classifies Condition of 1,262 Miles of 4-Inch Concrete Pavement—Failures on Adobe Sub-Base Studied

RESULTS of an investigation of the California state highway system by the U. S. Bureau of Public Roads, characterized by Thomas H. McDonald, chief of the bureau, as the most comprehensive study of the sort ever undertaken, have just been made public in a report, signed by Dr. L. I. Hewes, general inspector in the West, containing 58,000 words of text, 115 maps and diagrams, and 400 photographs. Dealing with both engineering and economic features the report is devoted in large part to a consideration of the adequacy under present conditions of traffic of the State's old standard 15-ft. concrete pavement 4 in. thick, with either plain top or ⅜-in. wearing surface of asphaltic oil and pebbles. The investigation discloses that the financial administration of the work has been "scrupulously honest," that the system has been well selected and laid out, but that the policy as to the use of the relatively thin and narrow concrete pavement slab was "distorted" by a desire to produce a large mileage with limited funds.

A feature of the report is the classification into six grades (A to F inclusive) of the present condition of 1,262 miles of the State's concrete pavement, showing that 12.5 per cent was in classes D, E and F and the remaining 87.5 per cent in classes A, B and C. It is pointed out that 70 per cent of the pavement in the three poorer classes was built on clay and adobe soil. Construction costs are found to be reasonable. Overhead and indirect charges of 19.2 per cent for maintenance (12.5 per cent for overhead alone), however, are found to be "rather excessive."

While conceding that the extension of a narrow paved mileage throughout the state did much to enlist public support for additional road bond issues, the report finds that the adopted paved width of 15 ft. is 3 ft. too narrow; that the "skin top" or oil surfacing is unjustified; that a minimum slab thickness of 6 in., reinforced, for the adobe soil subgrade conditions is needed; that reinforcement of so thin a slab as 4 or 5 in. has been ineffective on adverse soils; and that greater smoothness of surface finish to reduce impact is desirable.

Study of concrete cores from borings in the pavement indicates that there may be a slow, progressive deterioration or "fatigue" of the concrete itself in a thin slab subject to excessive flexure. However, there is nothing presented by the entire California study, the report concludes, to indicate that concrete is not a successful pavement. One of the clearest results, it is stated, is the need for better subgrade protection and further study of soil with respect to bearing power, capillarity and moisture content. A summary of the report's data, discussion and conclusions follow:

The statement of the condition of the funds on July 1, 1920, shows receipts, $42,007,330.07 and expenditures $41,790,884. The state laid 1,365 miles of concrete pavement of which 1,262 miles were classified as to condition.

TYPICAL EXAMPLES OF CONDITIONS OF SURFACE IN CLASSIFICATIONS A, E AND F

Data

The state has expended from the motor vehicle fund for maintenance, improvements and reconstruction $5,780,551; the overhead and indirect charges on this work were approximately 19.2 per cent (overhead about 12.5 per cent). Maintenance of the typical 15-ft. by 4-in. concrete road costs 0.6c. per square yard per year and for concrete constructed with ⅜-in. oil top 0.9c. per square yard per year on an average.

Basis of Classification—The classification of the existing condition of the concrete pavement for each one-tenth mile was in six classes, as follows:

(A) A pavement in which the plainly visible transverse cracks do not exceed the normal number expected of a pavement constructed without expansion joints, and which has no plainly visible longitudinal cracks.

(B) A pavement having more than the normal number of plainly visible transverse cracks or with some "crow-foot" cracks at the edges, or with both.

(C) A pavement similar to classes A and B and with one plainly visible longitudinal crack or with a considerable number of "crow-foot" cracks.

(D) A pavement so cracked transversely and longitudinally that numerous slabs are formed of less area than in class C but that do not average less than about 50 sq.ft.

(E) A pavement in which the plainly visible transverse and longitundinal cracks are so numerous that it is broken into slabs having areas less than about 50 sq.ft. but in which no general disintegration appears.

(F) A pavement badly broken and with disintegrated portions.

The classification result is given in Table I, which shows that 12.5 per cent of the pavement on July 1, 1920, was found to be in classes D, E and F and the remainder, or 87.5 per cent, in classes A, B and C.

On 800 miles of pavement 638 4½-in. diameter cores were drilled. The depth of concrete varied considerably, but in general ran greater than the specified 4-in. Measurements showed a surprisingly close average of 50 per cent coarse aggregate in both the 1:2:4 and 1:2½:5 concrete. The absorption showed an average of about 1½ per cent. The weight per cubic foot varied from 140 to 160 lb., with some marked deviation in a few instances. While the average compression test, when corrected for cylinders 9 in. high by 4½ in. in diameter averaged well above 3,000 lb., there is a slight decrease in compressive strength with the age of the concrete.

TABLE I. SHOWING ALL CLASSIFIED CONCRETE PAVEMENT BUILT BY THE STATE (SURFACED AND UNSURFACED)

Year Built	1913		1914		1915		1916		1917		1918		1919		1920		Totals	
Class	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent
A	2.83	13.8	71.35	42.5	139.33	39.7	73.38	24.8	6.65	11.3	37.54	30.0	53.91	32.6	33.24	42.9	418.23	33.1
B	5.85	28.6	63.75	38.0	106.35	30.3	119.62	40.5	26.29	44.4	49.50	39.6	66.78	40.4	37.32	48.2	475.46	37.7
C	3.85	18.8	18.27	10.9	68.17	19.4	53.41	18.1	15.28	25.8	24.37	19.5	23.90	14.4	4.15	5.4	211.40	16.7
D	1.83	9.0	2.67	1.6	14.65	4.2	32.59	11.0	8.66	14.6	10.24	8.2	12.20	7.4	1.60	2.1	84.44	6.7
E	0.10	0.5	0.40	0.2	3.15	0.9	11.55	3.9	2.29	3.9	3.29	2.66	8.23	5.0	1.00	1.3	30.01	2.4
F	6.00	29.3	11.50	6.8	19.14	5.5	5.13	1.7	0.00	....	0.05	0.04	0.25	0.2	0.10	0.1	42.17	3.4
Totals	20.46	100	167.94	100	350.79	100	295.68	100	59.17	100	124.99	100	165.27	100	77.41	100	1,261.71	100
Per cent of total each year	1.7		13.3		27.8		23.4		4.7		9.9		13.1		6.1		100	

A classification of subgrade soils shows that approximately 70 per cent of the concrete pavement of classes D, E and F occurs on soils of clay and adobe.

Traffic Study—The principal economic study consisted of a state-wide traffic census for one equivalent 16-hour day at 103 stations. Traffic was counted from 6 a.m. to 10 p.m. and the results are presented in Table II. It is seen that for week days the total daily number of all vehicles aver-

TABLE II. AVERAGE 16-HOUR WEEK-DAY TRAFFIC AT 101 STATIONS AND 16-HOUR SUNDAY TRAFFIC AT 16 STATIONS

Type	Average Vehicles Week day	Average Vehicles Sunday	Per Cent of Total Traffic Week-day	Per Cent of Total Traffic Sunday	Per Cent of Total Traffic Week-day	Per Cent of Total Traffic Sunday
Light automobiles	472	833	34.10	36.8	.....	....
Heavy automobiles	674	1,282	48.50	56.6	.....	....
Passenger buses	31	29	2.20	1.3	.....	....
Trucks, Class 1	73	62	5.30	2.7	42.20	50.5
Trucks, Class 2	41	18	3.00	0.8	23.70	14.6
Trucks, Class 3	28	10	2.00	0.4	16.20	8.1
Trucks, Class 4	29	12	2.10	0.5	16.80	9.7
Horse-drawn traffic	32	21	2.70	0.9	.....	17.1
Extra-heavy traffic	2	....	0.10	....	1.10	....
Total of all vehicles	1,387	2,267	100.00	100	100.00	100
Total of trucks, only	173	123	.....	....	....	

Class 1. Less than 1 ton with pneumatic and less than ½ ton with solid tires.
Class 2. One to 2½ tons with pneumatic tires and ¾ to 1½ tons with solid tires.
Class 3. Three to 5 tons with pneumatic tires and 2 to 3 tons with solid tires.
Class 4. Five tons plus, with pneumatic tires and 3 tons plus with solid tires.

aged approximately 1,387, of which 2.7 per cent was horse-drawn traffic and 12.5 per cent truck traffic. The corresponding average Sunday traffic at 16 stations was 2,267 vehicles, of which horse-drawn traffic was only 0.9 per cent and truck traffic 4.4 per cent.

Discussion

Standard Design — The standard design adopted for surface was a concrete "base" of 4 in. with a ⅜-in. wearing surface of asphaltic oil and pebbles. The concrete mix was 1:2½:5 and the width was 15 ft., with 3-ft. earth shoulders.

Although the concrete surface was doubtless originally laid as a base, only approximately 43 per cent has been given the oiled surface. The average price in the earlier years for 4-in. 1:2½:5 concrete and including grading and structures of $1.14 per square yard was remarkably low. This price was equivalent to about $10,000 per mile of completed 15-ft. road and compared very favorably with the similar price of $1.21 per square yard for oiled macadam. Neither price includes either indirect changes or overhead. The corresponding average price for the 4-in., 1:2:4 concrete laid since 1917 has been $1.84, which is also low. The concrete pavement has probably produced a smoother and more satisfactory riding surface than any of the other types.

This concrete pavement is the thinnest that has been extensively laid in any State and would have been rejected as too thin in any State subject to winter frosts. It is in general 3 ft. too narrow. The original mix of 1:2½:5 was leaner than that extensively used in other States, and the present mix of 1:2:4 is not as rich as usual in several States, but it is believed to be adequate for the traffic. California was the pioneer State in adopting concrete as the standard pavement for the State highway system.

The ⅜-in. asphaltic oil wearing surface has cost about 8 to 9 cents per square yard; it is not believed that it serves a purpose commensurate with its cost.

The 4-in. plain concrete of lean mix has proved in places very durable. There are 580 (distributed) miles built prior to 1917 that are of classes A and B. Under adverse conditions, particularly of soil, it is, however, evident that a pavement of such thinness has a very low safety factor and is inadequate. Its use has now been abandoned and a minimum thickness of 5 in. of reinforced concrete required. The original construction produced considerable rough surfaced concrete which as traffic developed doubtless materially increased impact. On the narrow 15-ft. pavement loads passing each other necessarily traveled close to the edge. The "crow-foot" defects are doubtless due to such travel of trucks. There is little, if any, decisive evidence that reinforcing introduced in the 4 or even the 5-in. concrete (particularly of the triangular mesh variety) has proved effective on adverse soils or under combinations of adverse subgrade and traffic. Nor will the widening of a 4-in. pavement to 20 ft. eliminate the "crow-foot" cracks which are observed on such width concrete, even in instances on sandy soil.

The original concrete pavement design in short now has little or no factor of safety and under unfavorable conditions has not withstood the internal stresses produced by traffic flexure and variations in temperature and subsoil moisture. It is doubtful if such a safety factor can be introduced wtihout considerably increasing the mass of concrete. It appears that under adverse soil condition there is considerable flexure with traffic.

Some special treatment of adverse subgrade soils will be necessary. Capillary action and high moisture retentiveness and violent shrinkage must be met. The amount of admixture or the thickness of protective layers of non-capillary and supporting soils is not yet known. A flat subgrade might help, to a slight extent, to counteract such defects by eliminating some transverse tension due to normal pressure. The crown of 2¾-in. in the present 15-ft. standard design may well be reduced to 1¾ in. and with a flat subgrade and an added 1¾-in. maximum thickness there is an added factor against center longitudinal cracks.

The width of the main roads should be increased from the present width of 21 to 24 ft. to a width of from 24 to 30 ft., except in heavy cuts. The crowns could well be reduced to 1¾ in. even on a wider pavement.

Grade and Alignment — Many miles of the California highways lie on flat valley floors and have excellent alignment. Defects in grade and alignment are due largely to a too strict adherence to a standard. That standard is not invariably economical. There are numbers of 50 and 60-ft. radii curves and grades of 7 per cent that might have been eliminated or reduced at slight additional cost.

Specifications — The specifications appear to have been rigidly enforced. The original lean concrete mix of 1:2½:5 should have been abandoned sooner and the permission of 6 per cent of the fine aggregate passing a 100 screen allows a possible excessive clay content. Use of alkaline or salt water should be prohibited. The originally required rough finish has been abandoned, but the finish now obtained can be improved. This rough finish was evidently for a pavement base but it shows through a ⅜-in. top and, where not covered, has doubtless tended to increase impact. The present requirement for concrete mixture of 1:2:4, if laid dry should produce a good pavement for traffic preponderately rubber tired, but it is remarked that several States use a richer mix. Reinforcement has not been required until 1920 but the present specifications for about 42 lb. of ½ and ⅜-in. steel rods in the center plane per 100 sq.ft. are excellent. The triangular mesh reinforcement used as Federal-Aid Project No. 1 was a failure, due possibly to improper

placement. In general the specifications for concrete have produced good quality and have permitted an economic use of local material with a minimum of failures.

Policy of Extension of Mileage — The total motor vehicle registration in 1920 is about six times that of 1912—and the total truck registration is approximately six times the 1915 figures. The State Highway Commission has, as yet, taken no statewide traffic census.

It can not be said in 1920, in the light of the fact that the great usefulness of the highway system is now proved, that the State would have realized its usefulness and provided funds in equal volume had not the system been extended as rapidly as it was and at some sacrifice of either temporary or ultimate durability to increased mileage. There appears, however, to be a serious question in the light of the fact that 70 per cent of the defective pavement of classes D, E and F occur on clay and adobe soils, as to the wisdom of a policy which continued the risk of a thin slab on such soils. It is undeniable, however, that a large mileage of the same thin pavement and on adverse soil still remains of classes A, B, and C. We find, however, no conclusive final demonstration of the best construction on the adverse soils and in that respect failure to vary the design on such soils in the past has postponed the solution of this problem.

The adaptability of the pavement laid to supplementary construction when it fails is indicated by about 37 miles of this work already done with 30-in. concrete shoulders and 1½-in. Topeka, or other bituminous concrete surfacing and with "second-story" concrete. None of this work is sufficiently old to prove its ultimate durability, but it appears to be carrying traffic with success.

Construction and Maintenance — The total average percentage of construction costs on both day labor and contract work, chargeable to administration, engineering and overhead, is 15.86 per cent and is reasonable. The percentage of total overruns of 6.24 per cent on final total payment on construction over the engineer's estimate, is low, in view of the recent rise in prices.

The direct charges for maintenance and improvement are found not to be excessive. The overhead and indirect charges, however, are apparently 19.2 per cent (overhead alone 12.5 per cent), which seems rather excessive. There are at present under maintenance a total of 3,293 mile of state-controlled roads. It appears that up to 1920 the commission has thought of the increase of traffic more in direct relation to the increasing maintenance costs rather than in respect to its influence on design of new construction. In 1912 the increase of traffic could not be foreseen but by the end of 1915, when 1912 registrations had nearly doubled, the 1918 registrations should have been foreseen.

Organization — The organization is highly developed. It has continued with little change since 1911. The details of the engineering standards are carefully thought out and unusually complete. There is some evidence of a cramped condition in the functioning of the organization. Headquarters control is so complete that it may inhibit those reciprocal actions necessary for healthy growth.

Conclusions

The high capillarity of adobe soils and the great shrinkage in the long hot summer produce very unfavorable conditions for a thin pavement under increasing traffic. All pavement of classes D to F inclusive, which totals 120 miles and much of which is on adobe soils is doubtless deteriorating and demands immediate repair and supplementary construction. It is doubtful if much of the pavement of these classes, especially on adobe, will ultimately prove an adequate base for a 1½-in. Topeka top. The "second story" concrete if extended to a total width of 20 ft. to thus include two new 30-in. concrete shoulders of full depth is to be preferred.

There are sufficient typical failures to show that in future only designs of increased strength and adapted to resist such failure should be used. There will be necessary every possible precaution to prevent failure on adverse subsoils of adobe, clay adobe, or similar soils. On such soils, in the absence of any proved successful design, short sections only of tentative design should be approved by the Secretary of Agriculture, or there should be first developed frank experimental construction to determine a workable and economical design for post road projects. Such a design will require the reinforcement now provided by the commission and a more massive type of concrete, not less than 6 in. in average depth and some adequate corrective treatment of subgrade and possibly a form of "mulching" of shoulders to prevent evaporation. A flat subgrade is desirable and less crown.

It is believed that on the main roads more satisfactory results will follow a considerably bolder standard of location on hill and mountain grades and that an increase in width of pavement to a minimum of 18 feet is now desirable and with more systematic widening and super-elevation on curves.

The standard of design and workmanship of structure is high and the costs have been very reasonable.

The standard of finish on concrete pavement has improved but still greater refinements will constantly be demanded and will probably pay in reduction of impact and resulting injury to and by traffic. The continued use of the ⅜-in. oil top is not justified by past experience and concrete should not be laid as a base but as a wearing surface.

There is nothing presented by the entire California study that indicates that concrete is not a successful pavement. One of the clearest results is the emphasis on the need of better subgrade protection.

There should be further studies with respect to traffic, fatigue of concrete, soils and alkali.

The 4-in., 15-ft. concrete pavement was continued beyond the point of success on adverse soils and more time will be needed to develop a type of construction certain of success on such soils. The operations have produced a large mileage of very serviceable road and from an economic standpoint are conspicuously successful and of continuing benefit to the State. The operating income from the highways is now sufficiently large to insure the economic success of a considerably increased standard of construction.

Mechanical Protection for Piles

From report of Committee on Wood Preservation, American Railway Engineering Association

SINCE CREOSOTE does not stop the attacks of limnoria on piles in water infested by marine borers, mechanical protection has been applied. The piles are creosoted, however, to prevent decay above water and to retard the action of borers until repairs can be made in case the protection becomes damaged.

Cast iron casing, made in halves bolted together and pushed down into the mud, has been used on the Gulf coast for many years, but present prices make this almost prohibitive. The enclosed space is filled with sand and capped with cement mortar. Although it is stated that borers will not live behind the casing even if the sand is omitted, it is assumed that the bottom must be closed sufficiently to cut off their food supply. Vitrified pipe made in single pieces or in halves is suitable for locations not exposed to wave action and drift. It is customary to inspect and repair them every year, as the borers will not make much headway in creosoted timber in that time. Reinforced-concrete casing is less fragile than vitrified clay and less expensive than cast iron. There is some question as to whether the thinly-covered reinforcement will corrode and cause the casing to break in pieces.

Jackets of plain concrete cast in place for a length of about 10 ft. being secured by nails projecting 3 in. from the pile, have given satisfactory results since 1915 at Charleston, S. C. The concrete has been placed at depths as great as 12 ft., but unless the forms can be pumped out, it is not safe to rely on concrete placed in more than 3 or 4 ft. of water. Gunite, or concrete applied with the cement gun, was used near Seattle in 1919, but it is too soon to report results.

Nails driven into the exposed surface prove effective, even when not more than 25 per cent is covered by the heads. This method deserves more attention and study, although the application probably would be expensive. Copper and zinc sheathing has been used with success, but

the latter corrodes and the former is expensive. Rust resisting iron might be used. Sheathing must be applied before the pile is driven and is likely to be broken in handling. Coatings of tar and asphalt, either alone or combined with fabric, are likely to be broken in handling the pile or by the pounding of drift; in general they have proved unreliable. Bark left on the piles is a protection and increases the life.

The conclusion is that piles of important structures in infested waters should be thoroughly creosoted and given some mechanical protection. On the Gulf and Pacific coasts this protection should extend the full length of the pile to assure protection against both limnoria and teredo. On the Atlantic coast the creosoting will resist the teredo but mechanical protection is required to resist the limnoria.

Assay of Industrial Waste Under Way

Committee of Federated Engineering Societies Is Making Investigation of Ten Representative Industries

THE Committee on Elimination of Waste in Industry of the American Engineering Council, the governing body of the Federated American Engineering Societies, put into operation Feb. 7 a definite scheme of conducting its investigation, and on Feb. 21 reports on the first investigation in each of the following ten representative industries were made: Bituminous coal, building trades, transportation, men's ready-made clothing, printing, paper, metal trades, textiles, shoes, and rubber. The chairman of the committee is J. Parke Channing, of New York, and the vice-chairman in active charge of the inquiry is L. W. Wallace, executive secretary of the council. The work of the committee is being directed from temporary headquarters in the Engineering Societies building, New York.

The fuel work, covering principally New York, New England, and Pennsylvania, will, Mr. Wallace announced, be completed by April 1. A meeting of the planning board was held on March 1; preliminary reports were presented and further plans were made for continuing the investigation more intensively. Among the industries now under investigation and from which full reports have been received are coal, transportation, clothing, shoes, printing, textiles, and the metal trades.

Wallace Explains Work

In a statement explaining the task of the committee Mr. Wallace said:

"Herbert Hoover, when addressing the Federated American Engineering Societies, as president, in Washington last November, said: 'It is primary to mention the three-phase waste in production: First, from intermittent employment; second, from unemployment that arises in shifting of industrial currents; and third, from strikes and lockouts. Beyond this elimination of waste there is another field of progress in the adoption of measures for positive menace in production. In the elimination of the great waste and misery of intermittent employment and unemployment we need at once co-ordination in economical groups.'

"The American Engineering Council readily consented to the request of Mr. Hoover. He then formed the Committee on the Elimination of Waste in Industry. In selecting the personnel of the committee care was exercised to secure men of broad experience, of clear concepts, of unbiased attitude toward labor problems and representative of managerial, consultant, educational and editorial activities as well as having a widely distributed and varied industrial contacts.

"At the organization meeting of the committee in January the purpose of the committee was stated to be, first, to determine the cause of labor, material and equipment waste in industry—the material and equipment phases of the problem to be studied largely in so far as they may cause labor waste; second, in so far as possible, to determine the extent of the waste that arises through each major cause; third, to suggest means of removing the cause for such waste.

Scope of Inquiry

"To accomplish the purposes of the committee it was necessary to make studies along the following lines: (1) Organization—that which assigns responsibilities and relationships, and the discharge of same; (2) engineering, which comprises the design, construction and maintenance of plant, machinery and tools and the design of the product; (3) production control and cost control—under the third division fall all the factors relating directly to production and the proper direction and accounting for the same; (4) physical factors—this division relates to the storage and inspection of raw and processed materials and to matters of internal transportation. It also includes consideration of the physical condition of the plant as regards lighting, heating, toilet facilities and such like.

"Organization may be described as follows:

"(A) Nature of operation: (1) Contractual—this form presents many problems that affect personal relations; building operations are largely contractual; this form of relationship is quite common in the clothing industry. (2) Repetitive—a large portion of industrial activity is repetitive; this phase of industry makes prominent the question of monotony, and occupational diseases. (3) Continuous—steel and chemical industries are typical representatives; in this form of operation the question of bonus and shifts are considered important.

"(B) The type of organization is some index to the quality of the management and is an essential consideration.

"(C) Personal relations: (1) Employment policies; (2) representation; to what extent each plan has been tried and with what results. (3) Strikes and lockouts, the cause for, the duration of, the man, his loss, and the total cost. (4) Unemployment. (5) Seasonal and intermittent employment. (6) Health and safety factors.

Problems Involved

"In production control and cost control, planning, establishing standards, and maintenance are factors considered. The special assay involves these considerations: (1) Two shift versus three shift; this study to be made in continuous process industries. (2) Health factors in production; the American Association of Industrial Physicians and Surgeons is to assist in making this study. (3) Standardization; this subject is to be given consideration from a broad point of view, in addition to the detail information it will receive in considering internal conditions; through the standardization of equipment, of product, of methods, large economies and general improved conditions would inevitably result. (4) Stabilizing industry; through stabilization an even demand for production would ensue—hence periods of great fluctuation in employment would not obtain. Many seasonal industries could

be reorganized so as to yield a fairly uniform production throughout the year and thus greatly lessen the evils of unemployment.

"The ten representative industries, named above, were selected because of their general importance and interest to the public. From three to ten plants of each selected industry are being visited by experienced engineers who secure the information desired by the committee. A carefully proposed list of questions is placed in the hands of each field worker. The information obtained by the field investigator is supplemented by such authoritative data as may now exist in the form of reports made by reliable parties or agencies. Through this means sufficient information is to be secured to enable the committee to formulate specific conclusions as to the major causes of industrial waste."

The Committee on Elimination of Waste in Industry consists of J. Parke Channing, chairman, L. W. Wallace, vice-chairman, Robert B. Wolf, J. H. Williams, H. R. V. Scheel, Fred J. Miller, Robert Linton, C. E. Knoeppel, Herbert Hoover, L. P. Alford, George D. Babcock, F. G. Coburn, Morris L. Cooke, Harrington Emerson, Ira N. Hollis and E. E. Hunt.

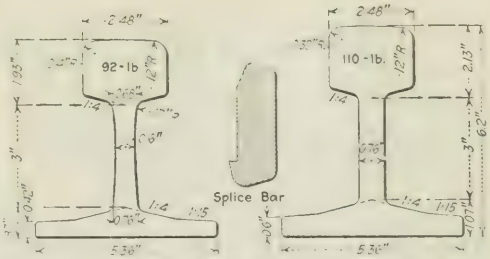
Standard Rails and Splice Bars on French Railways

GOVERNMENT STANDARDIZATION of track material for the French railways was decided upon in 1917 at a conference between the minister of war and the heads of the railway systems, a commission of engineers being appointed to prepare the necessary designs. On the recommendation of this commission standard sections for rails and splice bars have been adopted, there being one 52-lb. rail for narrow-gage lines, 72-lb. and 92-lb. rails for standard-gage lines of light and heavy traffic respectively, and a 110-lb. section for tunnels. The last two are shown in the accompanying drawing.

NEW FRENCH STANDARD RAIL SECTIONS

	French, Open Track	French, Tunnel	A.R.E.A.
Weight per yard	92 lb.	110 lb.	90 lb.
Height	5.80 in.	6.2 in.	5½ in.
Width of base	5.36 in.	5.36 in.	5½ in.
Width of head	2.48 in.	2.48 in.	2½ in.
Depth of head	1.93 in.	2.13 in.	1⅞ in.
Depth of web	3.00 in.	3.00 in.	3⅛ in.
Depth of base	0.87 in.	1.07 in.	1 in.
Thickness of edge of base	0.42 in.	0.60 in.	½ in.
Thickness of web	0.60 in.	0.76 in.	⅝ in.
Fishing angles	1 on 4	1 on 4	1 on 4
Radius of web	17 in.	None	14 in.
Radius, top of head	12.00 in.	12.00 in.	14 in.
Radius, corners of head	0.40 in.	0.32 in.	½ in.
Height to center of bolt hole	2.37 in.	2.37 in.	2⅜ in.
Side of head, slope	Vert.	Vert.	1 on 16
Bolt hole, diameter	1.04 in.	1.04 in.	

All the rails are of the flange type, thus eliminating the double-head type now used on some of the French main lines which require heavy cast-iron supporting chairs on each side. The new sections closely resemble present American standards. In fact an article in the *Revue Generale des Chemins de Fer* by M. Froebe, engineer of track material of the State Railways, states that it was proposed to adopt an American standard, but that this plan was abandoned on account of the relatively thin edge of the rail base. In French practice the ties are slightly notched to receive the rail, the shoulder thus formed being relied upon largely to maintain the gage. It was considered, therefore, that rails of the American section would tend to cut the wood shoulder



NEW STANDARD RAILS OF FRENCH RAILWAYS FOR OPEN TRACK AND TUNNELS

and widen the gage. [Presumably the French were considering the Am. Soc. C. E. standard sections, as the A.R.E.A. sections are distinctly heavier than the former at the edge of the base.]

The French standard sections differ from the older rails especially in the fishing angles, the web thickness and the width of base. In the old iron rails the slope of the fishing surfaces were generally 1 on 1 in order to facilitate rolling, but the head then acted as a wedge to separate the splice bars and strain the bolts. The same experience was encountered in some of the early American rails. When steel rails were introduced in France the slope was reduced to 1 on 2, although in other countries it was very generally 1 on 4. As the flatter slope gives a better support to the rail under load, a 1 on 4 slope has been adopted in the new section.

Thin webs of uniform thickness have been a characteristic of French rail sections, and as the web metal is harder than that of the head and base there have been frequent fractures through the bolt holes. Many railways in other countries, including the United States, have given a curved form to the sides of the rail web, thus increasing the thickness towards the junctions with the head and base. This feature has been adopted in the new French rails.

Narrow base width has been another characteristic of French rails, although American standard sections make the width of base equal or nearly equal to the height. Although the wide base gives a better support, it adds to the difficulties of rolling and the French engineers therefore adopted a compromise in the new sections. They considered also that the French screw spikes hold the rails more securely than the American drive spike and that this feature makes it practicable to use a smaller base width. In American sections the 1 on 4 slope of the base is continuous, but in the French sections this slope extends only over the fishing surface and is then reduced to 1 in 15 in order to give the desired thickness at the edge of the base.

Heavy plain splice bars or fish plates are to be used for the rail joints, the angle bar being considered to present little or no advantage, especially as a close spacing of 16.8 in. c. to c. has been adopted for the joint ties. The bars, which have a narrow rib along the lower edge, are 1.2 in. thick for the 92-lb. rail.

Rails in tunnels being subject to corrosive action from damp atmosphere and the gases from the engines, a special 110-lb. rail section has been adopted for use in tunnels on lines using the 92-lb. section on open track. In this section the head and web are unusually thick, and the web is made of uniform thickness. The same splice bars serve the 92-lb. and 110-lb. rails.

ENGINEERING LITERATURE

Remarks on Engineers' Autobiographies and That of James Nasmyth

By Edgar A. Van Deusen
Jackson, Mich.

AUTOBIOGRAPHIES of engineers are almost rare enough to be unique. In the case of the "Reminiscences of a Municipal Engineer" by H. Percy Boulnois (reviewed in the *Engineering News-Record*, Jan. 20, 1921, p. 128), the author states that he is unaware of the existence of any other than his own. The reviewer, however, calls attention to McCarthy's "Incidents" and Corbett's "Reminiscences."

The list is not complete, however, without mentioning "James Nasmyth, Engineer: An Autobiography," edited by Samuel Smiles. The book was published by Harpers, in 1883, and is generously illustrated with cuts and engravings from paintings and sketches by the author and his father, Alexander Nasmyth.

James Nasmyth was born in Edinburgh, Scotland, in 1808. His father was Alexander Nasmyth, a prominent painter and architect, and usually conceded to be the "founder of landscape painting in Scotland." James Nasmyth's autobiography is rich in reminiscence of his early days in the old Scottish capital, and of his intimacy with such of his father's friends as Walter Scott, Robert Burns, James Ballantyne, and others. It is here that Americans may learn that the birthplace of the skyscraper is not America, for one finds Nasmyth speaking of twelve and fourteen story buildings as in existence in Edinburgh more than one hundred years ago.

Young Nasmyth very early showed both an artistic and a mechanical bent, and received training along both lines. His mechanical ingenuity predominated, however, so that, even when a mere lad, he built and sold several steam engines and other contrivances of his own design.

His first sight, when a boy, of James Watt, then eighty-two years old, made a great impression on him, for he says, "his benevolent countenance, and his tall but bent figure made an impression on my mind that I can never forget." Meetings and dealings with such contemporaries as Faraday, Maudsley, George and Robert Stephenson, Bessemer and Sir John Herschel, are spoken of as enjoyable and valuable experiences.

The story of his many inventions, including the steam-hammer, the steam pile-driver and many other less known contrivances, make entertaining reading for engineers at all interested in the history of engineering, particularly the mechanical and machine-tool branch. A competition in pile-driving between the old hand pile-driver method and his new steam-hammer pile-driver on a Government dock-yard contract is described as follows:

> "At a given signal we started together. I let in the steam and the hammer at once began to work. The four-ton block showered down blows at the rate of eighty a minute and in the course of four and a half minutes my pile was driven to its required depth. The men working at the ordinary machine had only begun to drive. It took them upward of twelve hours to complete the driving of their pile."

His part in the building up of the great iron and steel industry of England, and the allied mechanical industries, is told in a fascinating but modest way. The methods employed by him for handling the difficult strike situations which arose from time to time during the operation of his large Bridgewater foundries and shops, and at a time when the trade unions were becoming conscious of a growing power, make thought-provoking reading for American engineers in these days of union ridden industry.

That Nasmyth was anything but an average engineer, from the financial point of view, is evidenced by the fact that at the age of forty-eight years he had amassed sufficient fortune, in the practice of his profession, to enable him to retire from active business. The same zeal, skill and ingenuity that characterized his engineering, he now brought to bear on astronomy, a hobby which amounted almost to a passion. Many improvements in the construction of telescopes resulted from his labors, and numerous astronomical papers and books came from his pen, including a monumental treatise on the moon.

Hobnobbing as Nasmyth did with the great Victorian scientists and engineers, his autobiography is naturally replete with incidents relating to those fine pioneering spirits. It is full of "human interest," as well as technical record, and will well repay, in enjoyment and information, the careful perusal of the engineer of today.

For the sake of historical record, of engineering example, and of inspiration, it is to be hoped that we may have more biographies and autobiographies of the world's leading engineers.

This Lapse Has Been Corrected

Sir—So many valuable articles have been contributed to *Engineering News-Record* by R. Fleming that its subscribers will read with interest any subject treated by him, even if it is on "A Few Lapses in Textbooks" (see your issue of Jan. 20, p. 125). The error which occurred formerly in the Textbook on Roofs and Bridges, Part I, about the maximum stress in any diagonal of a lateral system due to initial tension and wind stress, was corrected in 1919. As corrected, the last two sentences in the third paragraph of Art. 55, now read as follows: "In case the greatest wind stress S_w in either diagonal be equal to twice the initial tension S_i the effect of the latter entirely disappears in every member of the panel. Therefore, if the wind stress be less than this amount, the maximum stress equals $S_w + \frac{1}{2}(2S_i - S_w)$; and if the wind stress be greater, its value will be the maximum stress."

Henry S. Jacoby.

Ithaca, N. Y., Feb. 23.

Another Plea for the Personal Pronoun

Sir—Let me join with Mr. Brady and Prof. McDonald (*Engineering News-Record*, Jan. 20 and Feb. 17, pp. 125 and 307) and may there be a chorus of protest against the conspicuous and absurd avoidance of the first personal pronoun in engineering papers and discussions.

The American Society of Civil Engineers, or rather

its publication committee, now quite a number of years ago conceived an abject fear of this useful part of speech, rigidly substituting the third person for the first, going to the length of doing so even in oral discussions, anyone referring to himself being made to say "the speaker," at least by the time he appeared in print. On return post cards it was "the writer," for years. This I persistently scratched, as no doubt did others, and eventually, behold, return to the single letter of the first personal pronoun instead of the nine printed before on acknowledgment cards.

The first personal pronoun is incisive, and alive; replacing it by the third person is, in most cases, stilted circumlocution. W. H. BREITHAUPT.

Kitchener, Ont., Feb. 24, 1921.

For Concrete Foremen and Workmen

CONCRETE WORK: A Book to Aid the Self-Development of Workers in Concrete and for Students in Engineering.—By William Kendrick Hatt, C.E., Ph.D.; M. Am. Soc. C.E.; M. Am. Soc. T.M.; M. Soc. Prom. Eng. Ed.; President, American Concrete Institute, etc., and Walter C. Voss, B.S.; Assoc. M. Am. Soc. C.E.; M. Am. Soc. T.M.; M. Am. Con. Inst.; Head, Department of Architectural Construction Wentworth Institute, Boston, Mass., etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 8 in.; pp. 451; illustrated. $4.

For some years a few educators have been working on a system of engineering instruction which is deductive rather than inductive; that is, they have taken some particular job or structure and have led their students from that structure as the performer of some necessary duty down through the various processes of analysis to the elementary theories on which the design of the structure was based. During the war this system was particularly successful in the vocational or trade schools of the army. The book noted above is one of the first results of this war instruction. Both of the authors were connected with the vocational schools of the army and both have, in addition, had long experience in what might be termed the more theoretical instruction of engineering students. The volume which they have produced, which is the first of two on the same subject, is therefore a definite exposition of the newer method of engineering instruction by men who are well acquainted with the old methods as well.

The second volume of the work is to include a number of jobs in concrete construction by accomplishing which, according to the authors, the worker will learn the how and why of the elements entering into concrete construction. This second volume is frequently referred to in the first one, so that a complete analysis of the two volumes cannot yet be made. But it is evident from the volume now available that a remarkably effective piece of engineering literature has been produced. For a great while it has been evident that one of the main troubles with concrete construction is the lack of appreciation on the part of the worker and of his foreman of the essentials of concrete theory and practice. These men are "practical" men, with all of the faults which that adjective implies. There has been great need for their education, but just how such an education is to be conducted has been difficult to see. Professors Hatt and Voss have attacked this problem. Their book is intended for just such men, as well as for those who are entering the concrete business for the first time with no previous technical knowledge or practical experience. Whether the book is useful for self instruction is doubtful, but with proper direction it certainly affords the best means available for one to learn the essentials of concrete building.

Architectural Practice

A HANDBOOK OF ARCHITECTURAL PRACTICE—Issued by the American Institute of Architects for Use in Connection with Its Standard Documents. Washington, D. C.: The Institute. Cloth; 8 x 11 in.; pp. 204.

This book is issued by the American Institute of Architects and fully satisfies the rather broad import of its title. In includes the details of work which an architect must do in his relation to his clients and to the men who carry out the work for his clients and also the numerous valuable documents which have been been issued by the Institute in the form of standard contracts, agreements, etc. Chapter headings will give some indication of the scope of the work. They are: The Architect and the Owner, The Architect's Office, Surveys, Preliminary Studies of Estimates, Working Drawings and Specifications, The Letting of Contracts, Execution of the Work, The Architect and the Law, and Documents of the American Institute of Architects. These documents include such things as memoranda of procedure and progress, a circular of advice relative to principles of professional practice, architectural competitions, standard form of agreement between owner and architect, the fee-plus-cost system of charging, standard form of agreement between contractor and owner, standard form of bonds, form of law for registration of architects, etc.

Office systems, methods of keeping books and records, instructions as to competition, schedule of duties on work, relations of the architect and law, partnership agreements, are some of the subjects covered. All in all, the information included is invaluable and should be in the hands of every architect. Engineering societies could well study the form of book for possible use in their own field.

Comprehensive Work on Gas Distribution

A MANUAL OF GAS DISTRIBUTION.—Edited by Walton Forstall, Engineer of Distribution, Philadelphia Gas Works. Philadelphia, Pa.: The U. G. I. Contracting Co. Cloth; 6 x 9 in.; pp. 968; illustrated.

It is a great pity that the water-works of the country, which antedated and have always outnumbered the gas works, still lack any approach to such a comprehensive manual as Mr. Forstall has produced. The book is largely based on the author's experience on the Philadelphia gas works which dates from 1898; but he gives particular consideration to the needs of gas men in small cities. The broad scope of the book is indicated, but only in part, by its main heads: Administration, design, equipment, mains, services, street lighting, meters, house piping and fixtures, appliances, and the storeroom. Much attention is given to both organization and records. Water-works men in particular and managers and staff members of utilities in general would find many helpful suggestions in the book.

Road Construction Notes from Hong Kong

MODERN ROAD CONSTRUCTION AND MAINTENANCE. By Henry Edward Goldsmith, Executive Engineer [illegible] of Roads, Hongkong, M. Municipal and County Engineers' Institute, M. Royal Sanitary Institute, etc. Hongkong, China: Kelly & Walsh, Ltd. Cloth; 6 x 9 in.; pp. 149; illustrated.

Notes made while improving roads in the Colony of Hong Kong comprise much of the brief text of this book. Data gathered from other sources are included. The main topics are setting out work, footpaths, curbs and gutters, testing materials, water-bound and asphaltic macadam, asphaltic concrete and sand carpeting, tar macadam, bituminous surface and concrete roads. Appendices deal with nomenclature, sampling, specifications and contracts.

More About Herbert Hoover

HERBERT HOOVER: The Man and His Work—By Vernon Kellogg, Author of "Headquarters Nights," etc. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 376. $2.

Three months ago (Dec. 16, 1920, p. 1201) there appeared in these columns a review of "The Making of Herbert Hoover," by Rose Wilder Lane. The volume now before us deals—from the viewpoint of "an observer, associate and friend"—more particularly with Hoover's later life, especially with his great relief and food work, from 1914 to 1920. But this does not mean that Mr. Hoover's boyhood, and his student life at Leland Stanford and his remarkable rise as a mining engineer, organizer and administrator up to the outbreak of the world war is not adequately sketched. Both the lives of Hoover deserve a place in every engineer's library and a wide reading by the youths and parents of the land.

Social Medicine and Community Health

THE COMMUNITY HEALTH PROBLEM—By Athel Campbell Burnham, M.D., Health Service, Atlantic Division, American Red Cross; Attending Surgeon, Volunteer Hospital, N. Y. C., etc. New York: The Macmillan Co. Cloth; 5 x 7 in.; pp. 149. $1.60.

The author's attempt to present "in one small volume a fairly comprehensive understanding of social medicine in its relation to community health" has been realized. Attention is given to the prevention of all kinds of sickness and to health improvement in general. Throughout, health is considered as a community problem, to be promoted by all possible agencies, but always through action by and for individual communities—the latter extended to relatively small health and social centers. Arguments for the socialization of medicine and for efforts directed to the prevention rather than the cure of disease are ably presented. Workmen's compensation, health insurance, industrial hygiene and accident prevention are reviewed.

Principles of Highway Construction

AMERICAN RURAL HIGHWAYS—By T. R. Agg, C. E., Professor of Highway Engineering, Iowa State College. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 139; illustrated. $2.

An exposition of the broad general principles that underlie modern highway construction, maintenance and administration is achieved in this book. The author attempts no explanations of involved theory nor formulas. He seeks merely to give a thorough grounding in not only the essentials of road construction, but in its economic aspects as well. Separate chapters on administration—town, county, state and Federal—the purpose and utility of highways, drainage, design and the various types of surfacing, give the volume a well-rounded appearance and make it a good text for the agricultural engineer and a valuable reference for the popular reader who has no technical or personal interest in highway work.

A Short Manual on Landing Fields

MUNICIPAL LANDING FIELDS AND AIR PORTS: With Chapters by the Chief of the Army Air Service, the Director of Naval Aviation, and Their Officers in Charge of Landing Field Operations—Compiled and Edited by George Seay Wheat. New York and London: G. P. Putnam's Sons. Cloth; 5 x 8 in.; pp. 96; illustrated. $1.75.

Officers of the army and navy air services, officials of the Wright Aeronautical Corporation and others, have collaborated in presenting short essays on the need of landing fields, how to construct them, hangars, aerial routes, naval air ports and airplanes and seaplanes. An appendix gives a long list of landing fields, arranged by states, with designations of emergency, municipal and federal. There is also a folding aerial map of the United States, compiled in January, 1920, under the direction of the War Department.

British Notes on Concrete Roads

CONCRETE ROADS AND THEIR CONSTRUCTION: Description of the Concrete Roads in the United Kingdom, Together with a Summary of the Experience in this Form of Construction Gained in Australia, Canada, New Zealand and the United States of America. London: Concrete Publications, Ltd. Cloth; 6 x 9 in.; pp. 197; illustrated. 8/ net, postpaid 8/6.

About half of this book is taken up with descriptions of concrete roads in the United Kingdom, including the methods employed in their construction and statements regarding their condition at the time of writing—often as late as November and December, 1920. Two short chapters deal with concrete roads in (1) New Zealand, Australia, and Canada, and (2) in the United States. The last-named chapter was written by Thomas J. Harris. It contains less than five pages of text and is mere outline of the rapid spread of concrete roads in the United States. But in the chapter on Mechanical Devices for Making Concrete Roads, there are a number of references to American machines. Concluding chapters take up "Kerbing" specifications and road accessories made of concrete.

Municipal Review Enlarges Scope

With the new year the *National Municipal Review* (261 Broadway, New York City) became the "official mouthpiece" of the National Conference on City Planning, with Frank B. Williams as city planning editor. At the same time the *Review* also became the "organ" of the American Civic Association, which organization and the National Municipal League have begun a "year's co-operation" that may result in a merger of the two bodies.

PUBLICATIONS RECEIVED

COLORED WALL PLASTER—By Warren E. Emley, Chemist; Charlotte F. Faxon, Laboratory Assistant, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; illustrated. 5c. from Superintendent of Documents.

COMMERCIAL STATISTICS—Compiled by The Board of Engineers for Rivers and Harbors—Washington, D. C.: The Board. Paper; 6 x 9 in.; pp. 779.
Buried heretofore in the massive and unwieldy Chief of Engineers' Annual report, these data are now for the first time published separately. They are most valuable for reference, giving as they do the latest available figures on the Commerce of the ports of the United States.

CONCRETE HOUSES: How They Were Built; Articles Descriptive of Various Types of Concrete Houses, and the Details of their Construction, Compiled from Concrete—Edited by Harvey Whipple, Editor of Concrete. Detroit, Mich.: Concrete-Cement Age Publishing Co. Cloth; 9 x 12 in.; pp. 215; illustrated.
Enlarged edition of a book first published in 1917. Articles describing houses and groups, and giving various details.

CONNECTICUT DEPARTMENT OF HEALTH: Report of John T. Black, M.D., Commissioner of Health—Hartford, Conn.: The Department. Paper; 6 x 9 in.; pp. 42; illustrated.

ECONOMIC DEVELOPMENT OF THE UNITED STATES—By Isaac Lippincott, Ph.D., Professor of Economic Resources, Washington University. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 691. $3.50.

EDUCATION FOR CITIZENSHIP: Prepared for the War Department by Profs. J. G. de Roulhac Hamilton and E. W. Knight, of the University of North Carolina—Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 30.
An exposition of a further development of the work done by Aydelott during the war and of the ideas suggested in the Mann report.

EXCESS PROFITS TAX PROCEDURE, 1921: Including Federal Capital Stock (Excise) Tax—By Robert H. Montgomery, C. P. A. of Lybrand, Ross Brothers and Montgomery; Attorney-at-Law; etc. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 594. $4; or sold with "Federal Income Tax Procedure," 1921, mentioned below, $10.

FACTORY ADMINISTRATION AND COST ACCOUNTS: A Reference Book of the Principles and Practice of Industrial Administration and Costing for Present Day Requirements—By Edward T. Elbourne of Messrs. Brindley & Elbourne, Consulting Engineers on Factory Organization and Costing Systems. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 811; illustrated. $15.

FEDERAL INCOME TAX PROCEDURE, 1921—By Robert H. Montgomery, C. P. A. of Lybrand, Ross Brothers and Montgomery; Attorney-at-Law, etc., New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 1206. $8; or sold with "Excess Profits Tax Procedure," mentioned above, $10.

FESTIGKEITSEIGENSCHAFTEN UND GEFUGEBILDER DER KONSTRUKTIONSMATERIALIEN—Von Dr.-Ing. C. Bach und R. Baumann, Professoren an der Technischen Hochschule Stuttgart. Sweite, Stark Vermehrte Auflage. Berlin, Germany: Verlag von Julius Springer. Cloth; 8 x 11 in.; pp. 190; illustrated. 80m.

FINDING AND STOPPING WASTE IN MODERN BOILER ROOMS: A Reference Manual to Aid the Owner, Manager and Operator in Securing and Maintaining Boiler Plant Economy. Second Edition, Revised and Enlarged. Philadelphia, Pa.: H. S. B. W.-Cochrane Corp. Flexible; 5 x 7 in.; pp. 414; illustrated. $1.

THE FLY—By George W. Simons, Jr., Chief Sanitary Engineer, Florida State Board of Health. Jacksonville, Fla.: State Board of Health. Paper; 6 x 9 in.; pp. 11; illustrated.

THE FUNDAMENTAL PRINCIPLES OF WATER POWER ENGINEERING: Describing Types, Applications and Operation of Water Turbines, and Developing the Fundamental Formulæ of Waters Power Engineering—By Frank F. Fergusson, C.E., Assoc-M. Inst., C. E., Assoc. M. Am. Soc. C. E. London, Eng.: Sir Isaac Pitman & Sons, Ltd. Cloth; 4 x 7 in.; pp. 116; illustrated. $1.

GOVERNMENT WAR CONTRACTS—By J. Franklin Crowell, Ph.D., LL.D.; Preliminary Economic Studies of the War—Edited by David Kinley, Professor of Political Economy, University of Illinois, Member of Committee of Research of the Endowment (Carnegie). Washington, D. C.: Carnegie Endowment for International Peace. Paper; 7 x 10 in.; pp. 357.

HEAT TRANSMISSION CORKBOARD AND AIR SPACES—By Arthur J. Wood and E. F. Grundhofer. State College, Pa.: The Engineering Experiment Station of The Pennsylvania State College. Paper; 6 x 9 in.; pp. 139; illustrated.

HUMAN ENGINEERING: A Study of the Management of Human Forces in Industry—By Eugene Wera, M.E., E.E., Industrial Engineer; Assoc. M. A.S.M.E. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 378. $3.50.

HYDRO-ELECTRIC SURVEY OF INDIA, Vol. II: Report on the Water Power Resources of India, 1919-20—By F. E. Bull, Chief Engineer, Hydro-Electric Survey of India, and J. W. Meares, M.Inst.C.E., M.I.E.E., M.Am.I.E.E., Electrical Adviser, Government of India. Calcutta, India: The Survey. Cardboard; 6 x 9 in.; pp. 123; folding map.

HYDROMETRIC SURVEY OF MANITOBA: Progress Report, 1918-19—By C. H. Attwood, A.M.E.I.C., District Chief Engineer. Prepared under the Supervision of the Director of Water Power. Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 92; folding map.

KINEMATICS AND KINETICS OF MACHINERY: A Text Book for Colleges and Technical Schools—By John A. Dent, M.E., Associate Professor of Mechanical Engineering, University of Kansas, and Arthur C. Harper, M.E., Head Instructor of Machine Design, Pratt Institute. New York: John Wiley & Sons, Inc. London: Chapman & Hall, ltd. Cloth, 6 x 9 in., pp. 383, illustrated. $3.50.

An engineering school textbook based by the authors on notes by Prof. G. A. Goodnough used for some years in teaching the subject indicated at the University of Illinois, with which is included "almost without change," a paper on the gyroscope by Prof. F. B. Seely, also of Illinois. The authors of the present book have added chapters on toothed wheels, cams, wrapping connectors and critical speeds.

MAJOR TRAFFIC STREET PLAN BOULEVARD AND PARK SYSTEM FOR PORTLAND, OREGON—Presented by The City Planning Commission, Charles H. Cheney, Consultant. Portland, Ore.: The Commission. Paper; 6 x 9 in.; pp. 97, illustrated.

MASONRY STRUCTURES—By Frederick P. Spalding, Professor of Civil Engineering, University of Missouri. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth, 6 x 9 in., pp. 404, illustrated. $3.50.

THE MECHANICAL WORLD ELECTRICAL POCKET BOOK, 1921: A Collection of Electrical Engineering Notes, Rules, Tables and Data. London, Eng.: Emmott & Co., Ltd. Cloth, 4 x 6 in.; pp. 376; illustrated. 2/ net.

NATIONAL SAFETY CODE FOR THE PROTECTION OF THE HEADS AND EYES OF INDUSTRIAL WORKERS. Washington, D. C.: Bureau of Standards. Paper, [illegible] in., pp. 64, illustrated. 10c. from Superintendent of Documents.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Reports February, 1919, to March, 1920. Trenton, N. J.: The Board. Cloth, 6 x 9 in., pp. 564.

NEW JERSEY SEWAGE WORKS ASSOCIATION: Proceedings, 1920. Trenton, N. J.: The Association. Paper, 5 x 8 in., pp. [illegible]

THE NEW STONE AGE—By Harrison E. Howe. New York: The Century Co. Cloth; 5 x 8 in.; pp. 289; illustrated. $3.

In general this book is too scientific to be popular and too popular to be scientific, but it will probably [illegible] a book of useful [illegible]. The author has been well guided to some of the recent theories and practices of [illegible] manufacture, but has played them up too strongly.

NOTES ON SMALL FLOW METERS FOR AIR, ESPECIALLY ORIFICE METERS—By Edgar Buckingham, [illegible] Bureau of Standards. Washington, D. C.: The Bureau. Paper, [illegible] in., pp. 1[illegible]; illustrated. [illegible] from Superintendent of Documents.

OREGON STATE HIGHWAY COMMISSION: Report 1919-[illegible]. Salem, Ore.: The Commission. Paper, 6 x 9 in., pp. 1[illegible], illustrated.

PACIFIC COAST ASSOCIATION OF PORT AUTHORITIES: Proceedings and Papers of Seventh Annual Convention. Seattle, Wash.: The Association. Paper; 6 x 9 in.; pp. 143.

PENNSYLVANIA COMMISSION ON CONSTITUTIONAL AMENDMENT AND REVISION: Report to the General Assembly. Harrisburg, Pa.: The Commission. Paper; 6 x 9 in.; pp. 413.

Numerous proposed changes in the state constitution, relating to utilities, social welfare, taxation, city debt limits, benefit assessments, city zoning, excess condemnation, municipal home rule and other subjects have been embodied in a draft of a proposed new constitution. The commission recommends a referendum vote to decide whether a constitutional convention be called; a reference to the convention, if ordered held, of the proposed new constitution; and finally a referendum vote on whatever document the convention may name.

PURIFICATION OF SEWAGE AND WATER: Investigations at The Lawrence Experiment Station, 1919—By H. W. Clark. Reprinted from the Fifth Annual Report of the Massachusetts State Department of Health. Boston, Mass.: The Department. Paper; 6 x 9 in.; pp. 22.

REPORT ON ROAD MATERIALS ALONG THE ST. LAWRENCE RIVER, FROM THE QUEBEC BOUNDARY LINE TO CARDINAL, ONTARIO—By R. H. Picher. Ottawa, Can.: Department of Mines. Paper; 6 x 9 in.; pp. 65; illustrated.

ADMINISTRATION OF THE ROCHESTER BUREAU OF BUILDINGS: Report in the Department of Public Safety Submitted to the Mayor, the Commissioner of Public Safety and the Fire Marshal. Rochester, N. Y.: Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 57.

SANITATION IN COUNTRY PLACES: The Theory and Practice, Including the Bacteriolytic Tank System—By W. Ramsay Smith, M.D., D.Sc., F.R.S. (Edin.), Permanent Head of the Department of Public Health of South Australia; Fellow of the Royal Institute of Public Health of Great Britain, etc. Fifth Edition. Adelaide, Australia: The Author. Paper; 6 x 9 in.; pp. 36, illustrated.

Advocates and explains use of dry-earth closets where water-carriage system is not employed and a two-compartment tank with discharge into a soak-pit to remove excreta. Assumes anaërobic action in first compartment and aërobic action in second compartment of tank. From Sept. 23, 1908, to April 30, 1920, plans for 1686 bacteriolytic tanks have been approved by the Central Board of Health of South Australia.

SASKATCHEWAN WATER SUPPLY COMMISSION: Synopsis of Report on the Feasibility of Diverting a Supply of Water from the South Saskatchewan River for Domestic and Industrial Purposes in the Moose Jaw-Regina District. Regina, Sask.: The Commission. Paper; 6 x 9 in.; pp. 45; illustrated.

SOUTHERN PINE MANUAL OF STANDARD WOOD CONSTRUCTION—Eighth Edition. New Orleans, La.: Southern Pine Association. Cloth; 4 x 7 in.; pp. 186. $1.

New data include minimum live floor loads, safe column loads, information on sheet piling, lattice trusses, Howe roof trusses and additional standard handbook data.

STEEL RAILS FROM SINK-HEAD AND ORDINARY RAIL INGOTS—By George K. Burgess, Physicist, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 61; illustrated. 20c. from Superintendent of Documents.

THE SWIMMING POOL—By Jack J. Hinman, Jr., Water Bacteriologist and Chemist, Laboratories for the State Board of Health, State University of Iowa. Iowa City: The Author. Paper; 6 x 9 in.; pp. 17; illustrated.

THE TESTING OF MOTIVE-POWER ENGINES: Including Steam Engines and Turbines, Locomotives, Boilers, Condensers, Internal Combustion Engines, Gas Producers, Refrigerators, Air Compressors, Fans, Pumps, Etc.—By R. Royds, M.Sc., A.M.I. Mech.E., Head of Motive-Power Engineering Dept., Dundee Technical College. Second Edition. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 392; illustrated. $7.50 net.

The first edition was reviewed in the Engineering Literature supplement of *Engineering News*, Jan. 18, 1912, p. 130.

TRAIN OPERATION BY SIGNAL INDICATION: Part I; The Principal Methods of Directing Train Movement. Part II; Directing Train Movements by Signal Indication—By Henry M. Sperry, M. Am. Soc. C. E. New York: The Author, 347 Madison Ave. Paper, 7 x 10 in., pp. [illegible], illustrated.

A review and analysis of the two principal methods of directing train movements generally in practice, namely, the time-interval method and the space-interval method, together with a comparison of safety and operating efficiency. This is followed by discussion and analysis of train orders vs. signal indications, single-track operation without written train orders, progress in the installation of block signals and operating efficiency, with [illegible] on the principles of train dispatching and decreased costs through increased average speeds.

VORLESUNGEN UEBER INGENIEUR-WISSENSCHAFTEN—Von Georg Christoph Mehrtens, [illegible] Ingenieur-Wissenschaften [illegible] Dresden. Zweiter Teil [illegible] Allgemeinen Vollwand-Und [illegible] Leipzig, Germany: Verlag Von Wilhelm Engelmann. [illegible] illustrated. [illegible]

THE WELDING ENCYCLOPEDIA: A [illegible] Reference Book on Autogenous Welding—Compiled [illegible] and H. S. Card of the [illegible] The Welding Engineer. Chicago, Ill.: The [illegible] Publishing Co. Cloth; 6 x 9 in.; pp. [illegible]

[illegible]

[illegible]

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Comments on the Belgian Specification for Structural Steelwork

Sir—Some comments regarding the Belgian standard specification for structural steelwork, an abstract of which was given in your issue of Jan. 13, p. 71, may not be amiss. It is evident that the specification was prepared with care, and as representing the resultant opinion of a national association it commands attention.

Assuming a "standard" pressure for wind loads and using coefficients of that pressure for various heights and conditions has much to commend it, though objections can easily be raised. The standard pressure of 20 lb. per sq.ft. agrees with the Chicago Building Code, though many codes require more. The 41 lb. to 62 lb. for buildings outside of Belgium seems high, but probably the compilers had sugar mills mainly in mind, and these are often in localities subject to terrific winds. The Honolulu Iron Works Co., of New York City, which has had a large and varied experience in the building of sugar mills, usually designs for a horizontal wind pressure of 40 lb. per sq ft., assumed as the resultant of a velocity of 100 miles per hour. E. W. Walker, their engineer, advises that a sugar mill recently erected by them in Formosa was designed for a velocity of 125 miles per hour.

The normal pressure on roofs and inclined surfaces obtained from the Belgian formula is much less than that from the Duchemin formula, being only one-half as much for the common slope of 6 in. to 1 ft. The teachings of the school of Stanton and other English writers, as well as of some American professors, are seen in the requirement that for monitors and roofs resting on walls an uplift of 0.7 times the standard pressure shall be assumed. Unfortunately the loads on the sides of buildings are not clearly specified. Reduction of wind pressure when truss and column are treated as a rigid frame is an interesting point, not found in American specifications. The allowable 20 per cent reduction for the wind loads alone in combination with snow and moving loads is in contrast with American practice, where usually wind stresses are neglected unless they exceed 50 per cent of the live and dead load stresses.

As the reduction for floor loading on columns is stated to be taken from American practice it is inferred that the 90 per cent of full value is intended for the uppermost floor, the 85 per cent for the floor next below and decreasing percentages for floors below until 50 per cent is reached. This is a common American practice, though the Boston code of 1919 allows the same percentage of reduction for all floors above the section of column considered. Here again the Belgian specification does not state clearly what is intended.

The assumption of a standard unit working stress, using coefficients therewith for determining the tension, bending and compression streses, similar to the method of assuming a standard wind load, has both advantages and disadvantages which need not be discussed here. The figure of 17,000 lb. per sq.in. is in general commendable; it could also have been applied to crane girders and crane columns, instead of 14,200, by adding 20 per cent impact to crane stresses. Rivet bearing 2½ times the shear is rather high, unless the bearing is enclosed. Tension on bolts and rivets at the stress fixed for shear is certainly too high, and it is not easy to see any reason for figuring bolt tension on gross section—curiously enough, anchor bolts are figured for section at root of the thread.

The distinction made between compression members of solid web-section and open web-section is practically ignored in all but a very few American specifications by the requirement that the segments of latticed columns shall have as great an l/r for the portions between panel points as for the whole column. The time may be near when a smaller l/r for the segments will be required than for the column as a whole. If so, a clause embodying the principle of that of the Belgian specification will be pertinent. In general, column stresses according to the specification, are not far from those of the formula $16{,}000 - 70\ l/r$, for column lengths of 60 to $100r$, but are lower for both longer and shorter columns.

The formula for column shears gives values that are decidedly small for short columns. For latticed columns with l/r (in a plane parallel to the lattice bars) of the same value both for the column as a whole and the segments between connecting rivets of lattice bars, the column shears are: When $l/r = 20$, 0.5 of 1 per cent; $l/r = 40$, 1.1 per cent; $l/r = 80$, 3 per cent; $l/r = 100$, 4½ per cent of the axial load on the respective columns. A common requirement in American specifications is that column shears be assumed at 2 per cent of the axial load; the A. R. E. A. specifications of 1920 require 2½ per cent.

The formula for the compression flanges of lattice girders to resist side buckling is quite complex. An effort is made to take advantage of the lower flange of a girder to help the top flange, a proceeding of doubtful value. The sentence, "Plate girders without lateral bracing are to be designed in such a way that lateral buckling of the compression flange cannot occur" leaves too much to the designer. A more serviceable provision is found in American specifications: that where the unsupported length of the compression flange exceeds 10 times its width, the compression shall not exceed that obtained by a given formula, for example, $19{,}000 - 250\ l/b$.

The requirements regarding single angle members in both tension and compression at first reading seem needlessly severe, especially where the end connections contain but one rivet. Owing to difficulties in frabrication and erection, connections with single rivets are seldom, if ever, used in American building work. For two-rivet connections the minimum size of angle that can be used is usually in excess for the small stresses obtained. Thus, much of the seeming severity disappears in actual practice.

It will be seen from the foregoing that there are many points of similarity as well as of dissimilarity between the Belgian specification and American practice. These points are worthy of consideration when it comes to writing a specification that can be truly called American.

R. FLEMING,
New York City, Feb. 3. American Bridge Co.

More About Air Valves on Conduits

Sir—I want to take a good hard friendly wallop at the article in *Engineering News-Record*, Jan. 13, p. 76, without casting any reflection on the author, H. L. Thackwell, who is evidently entitled to credit for being thoughtfully interested in his work and for a very laudable desire to assist in the improvement of existing engineering formulas.

The discharge through an 8-in. valve under a head that (from the description of the apparatus proposed) cannot be greater than 15 ft., will be relatively so small that the conditions in the vertical 15-ft. length of 3-ft. pipe will not at all approach the ordinary conditions for which a 3-ft. pipe must be designed, and there could certainly not be a satisfactory test of a 6-in. air valve.

A 6-in. air valve would probably be safe equipment for a 60-in. pipe under fairly severe service. Our test would roughly reproduce the following service conditions: A disturbance in a pipe line which would cause a displacement, or a necessity for air supply equivalent to approximately 9 sec.-ft., which means a velocity of a little more than 1 ft. per second in a 3-ft. pipe and a little less than 0.5 ft. per second in a 5-ft. pipe. Not a very satisfactory test.

The principle of the proposed apparatus appears to be all right, and it might do the work if made very large and costly, but the results would be of little value. Reliable empirical formulas are not made that way. They are based on years of actual successes and actual failures. It is not generally possible to predict emergency conditions with such

accuracy that they can be dependably produced in the testing laboratory.

An air valve is a comparatively inexpensive fitting which protects in some cases thousands of dollars' worth of property. As such its size and cost are not properly susceptible of reduction to a minimum. Use first-class air valves and be liberal with them the same as you would be liberal with fire hose in a frame building.

In time there will no doubt be a better formula to aid the designer in choosing air valves; but this equipment must always be regarded as a protective device, not to be tampered with. As Mr. Hazen states in his letter in *Engineering News-Record*, Jan. 20, 1921, p. 134, the old rule is not so bad, and is safe enough if used with judgment in cases where extreme service may be expected.

Seattle, Wash, Feb. 2. CHARLES P. DUNN.

[Proof of the foregoing letter was sent to Mr. Thackwell. His reply follows.—EDITOR.]

Sir—I would infer from Charles P. Dunn's criticism (above) of my article on "Air Valves for Pipe Lines" that he has not thoroughly understood the purport of the suggested apparatus. My intention was to outline a form of equipment suitable for college thesis work. Realizing that funds for such work are not as readily obtainable by students as by professional research workers, I allowed economy to dictate the details of the equipment.

Since the largest quick-opening gate valve in my catalog was 8 in. I used that in the illustration. A balanced needle-valve, of larger size, would of course give a wider range of discharges, but would be very much more expensive.

At the time I made the drawing I had in mind a range in size from 20 to 36-in. pipe. This would give a theoretical velocity range from 4.95 to 1.53 ft. per second. A formula based on such sizes could no doubt be used with safety on larger pipes.

Mr. Dunn does not seem to grasp the fact that a 6-in. cluster valve is a very different article from a 6-in. single valve. These cluster valves are so arranged that the size or opening can be made to equal that of a 2 in. single valve, and as I tried to illustrate it, the valves would be blocked up, and only the size desired would be used on any single experiment.

Mr. Dunn's statement, "reliable empirical formulas are not made that way; they are based on years of actual successes and actual failures," is certainly a radical departure of opinion from that held by many able experimenters, who have given us the vast numbers of formulas, which have been based upon experiment and plotted data. The real tools of the engineer today are fundamental laws, all of which have been arrived at by observation, and that generally in the testing laboratory.

I recently designed a 33-in. pipe line, in which the cost of air-valves alone exceeded $20,000, which is not an inconsiderable item to the man who has to pay the bill.

In my own experience I have found rule of thumb methods very costly, which confirms my views that more reliance should be placed on experimental data.

Denver, Col., Feb. 19. H. L. THACKWELL,
Hydraulic Engineer.

Defects of Long Beach Dome Design

Sir—Referring to the article in your issue of Feb. 17, p. 294, describing the failure of a concrete dome at Long Beach, Cal., it seems incredible that a design so faulty should have passed along the entire line from the designer to the structural-steel detailer and contractor without someone's rising up and proclaiming that he at least would assume no responsibility for the results. As it is, it appears that the whole line must share the responsibility.

The article does not specifically call attention to the worst points in this design. The fact that this construction was designed for dead load only is by no means the worst point. If there were no other bad points, it would undoubtedly be still standing, since the evidence does not show that there was any live load of any character. If the sketch in your article is an exact representation of the shop drawing, the very worst point is the joint between the 10-in. and the 12-in. channels of the top chord of trusses *C* and *D*. This joint could not withstand the top-chord stress unless there was a definite brace directly at this point. Without this brace, it would buckle even if the two adjacent panel points were braced. If the channels are not faced, the gusset plate for a depth of 12 in., which is all that can be counted, would be under a stress of 32,000 lb. per sq.in. due to dead load only.

The next worse point is the use of channels for the top chord which are very deficient in lateral strength, and would buckle under the dead-load stress, considering the length between trusses *D* and the 15-in. beams. The next worse point is considering that the 15-in. beams and trusses *D* constitute bracing of any character at all. They certainly do not. The anchorage of beams is not sufficient to resist lateral pull of any amount. Even if the beams are capable of resisting lateral pull, their connection to trusses *C* and *D* is at the wrong point. It is also quite certain that a square placed diagonally into another square does not constitute bracing of any character.

The next worse point is the connection of trusses *C* and *D* to the columns. As far as the detail shows, the connection consists of six ¾-in. bolts or rivets through the bottom flange of two 9-in. channels. The resistance at right angles to the truss would be about 40,000 in.-lb. Assuming a height of column of 35 ft. and allowing for an anchorage at the bottom equal in strength to the top connection, the connection would break under a lateral force of 1 lb. per sq.ft. on a vertical surface from the bottom of the truss to the lave of the dome. Structural steel columns should have been used and carried to the top chord of the truss. To provide additional stiffness in the columns, they could have been encased in concrete.

Some years ago, in relation to a certain university building, I was asked why the university did not have the engineering students design the structural part of the building. My reply was that although the students could probably work out the stresses, they were not acquainted with the various pitfalls which lie between the stress sheet and the completed building. If the design described in your article is the result of employing experienced engineers, it is about time to try the university students.

Detroit, Feb. 24. J. T. N. HOYT,
Chief Structural Engineer for Albert Kahn, Architect.

Concrete Dome in Long Beach Failure Was Overstressed

Sir—In connection with the article by Edward R. Bowen in *Engineering News-Record* of Feb. 17, p. 294, on the failure of the steel truss supports of the dome of the Long Beach Christian Church, no mention has been made of the extremely weak and inadequate design of the concrete dome.

We had occasion, after the failure, to make an investigation of the concrete and steel design for the Industrial Accident Commission of California. The critical stresses in the dome were found at the spring line, located 90 in. above its base. At this point there is a bending moment due to the line of pressure being eccentric to the center line of the arch ribs by 10 in., a moment due to the horizontal thrust, and an axial load due to the weight. These combined produce a stress in the extreme fibers on the compression side of the ribs in excess of 2 000 lb. per sq.in. under dead load only.

It is possible that the initial cause of the failure was the buckling of the arch ribs at the spring line due to the thrust. The impact on the trusses of the falling mass of the dome, weighing approximately 200 tons, might have increased the highly strained condition of the top chords of the trusses *C* and *D* and caused them to buckle. It was reported that the artificial stone covering of the dome was being laid at the time of failure.

Had more details of the dome been published with the article the weakness at the spring line would have been apparent. FRANK A. JOHNSON,

San Francisco, Feb. 23. HARRY W. BOLIN,
Asst. Engineers with H. J. Brunnier, Consulting Structural Engineer.

Antioch Plan Omits Public Service Training

Sir—Admirable as is the "Antioch Plan" outlined by President Arthur E. Morgan in *Engineering News-Record*, Jan. 20, 1921, p. 108, it is remarkable that the author makes no specific mention of training for administrative public service. While the idea of training to carry ultimate responsibility is stated and re-stated, it would appear from the author's illustrations and from the outline of the proposed practical work, that it is the industrial field that the college will primarily serve.

The shop atmosphere appears to pervade President Morgan's article; indeed, he finds it desirable to liken an educational institution to a factory. He considers the technic of administration which is to be transmitted to Antioch students as including the "ability and habit of analysis of a job into factors that count for its success, such as cost analysis, plant operation, financial management, personnel organization, buying, salesmanship, development of morale, production methods, and analysis of supply and demand." As work at Antioch will center around training for proprietorship and administration, "it is planned to build a factory building on the campus and to locate there a number of small industries." The administrator, of which the author speaks, "sees all phases of industry." These and many other references to the industrial field give the reader the impression that Antioch is to be primarily a "vestibule school" to the manufacturing and commercial field.

Since so much that is commendable is planned for the revivified institution, it is to be regretted that the author did not give some special indication that Antioch proposes to train men whom the United States, as well as Canada, needs most of all—those who can direct with skill, efficiency and devotion the countless enterprises of the people. Fortunes are not to be made in such work, but the present writer believes it to be the duty of educational institutions offering technical courses to point out the magnificent opportunities in the public service and to prepare young men to undertake the administration of works departments, or indeed of all departments of towns and cities; the bureaus, services and departments of governments; the work of public service commissions, and of such institutions as Antioch itself.

C. R. Young,
Associate Professor of Structural Engineering, University of Toronto, Toronto, Canada.
Toronto, Canada, Feb. 14.

Sir—I find little to take issue with in the foregoing letter by C. R. Young. The article in question was reduced from a considerably longer manuscript and suffered in the reduction by the elimination of emphasis upon the development of social and moral purposes. The fact is, the writer's interest in Antioch would be considerably less did he not see there an opportunity for helping young people to define their social, economic and moral purposes, and to put them in the position of economic independence, where practical expression of those purposes will be economically feasible.

The one point which should be made clear is that Antioch is in no sense to be simply a vestibule school to the manufacturing and commercial field. Technical and professional education has suffered from the limited attention it has given to general cultural education. No young person will be able to graduate from one of the vocational courses at Antioch unless, in addition to his vocational training, he has secured the fundamentals of a liberal education which enables him to have an intelligent view of his place in society and his inheritance of wisdom and culture from the past.

As to undertaking a course for the preparation of young men and women in public service, the combination of a liberal education and of a general vocational course aimed to develop administrative capacity will be no mean preparation for public service. As to training for specific public duties, the absence of such courses is simply due to the fact that Antioch cannot cover the whole field. The attendance will be limited to not more than 600 students, and the best work can be done by limiting courses to a few that can be adequately covered.

Antioch will have performed its greatest service if it is a successful demonstration of a general principle of educational method. With the success of Antioch the way will be opened for many other small colleges to undertake work in a specific field, instead of dissipating their energies by covering many fields in a superficial manner. The way to success for the small American college is through diversity, and it would seem entirely feasible for some institution to take as its peculiar work preparation for social and public service of specific kinds.

Seldom a day passes without a suggestion reaching me concerning some course in study which is "so fundamentally necessary to social welfare that it ought by all means to be included in the Antioch program."

Yellow Springs, Ohio, March 2.
Arthur E. Morgan,
President Antioch College.

Sir—The thought that comes to me in reading Mr. Morrison's article on "The Antioch Plan; What to Teach" (*Engineering News-Record*, Feb. 24, p. 349) is that if his advice is good for the engineering schools it should be equally valuable to the other professional schools. I therefore suggest to the medical schools that they teach their students of the organization and duties of the public health service; of the organization, operation and financing of hospitals; cost accounting and bookkeeping; how to be pleasant and courteous to patients; how to vote on election day; deportment at dinner parties; and a little about a few diseases, such as bad colds and stomach ache; and a little more about surgery, enough, say, to tie up a sore toe. After this, furnish them with a complete bibliography of medical and surgical books, and, as I understand the plan, everything should go along happily.

Under this plan, it seems that we will train our men to be executives, financiers and captains of industry; and will be relieved of the necessity of training them to become engineers. Then, too, it would do away with so many irksome courses, such, for example, as calculus and mechanics. All that the graduate would have to do would be to look up his problems in the handbooks. It would surely enormously simplify the present program, and I vote for it with three rousing cheers. Also, my students tell me that they are heartily in favor of Mr. Morrison's suggestions; particularly those of them who are now wrestling with moment of inertia. They assure me that they see no earthly reason for multiplying dm's by r^2's; and that they would be much obliged if I would "junk" the stuff and give them a course in table manners. The ayes have it, Mr. Editor.

L. S. Le Tellier,
Charleston, S.C., March 2.
Professor Civil Engineering, The Military College of South Carolina.

"Let Engineers Be Heard"

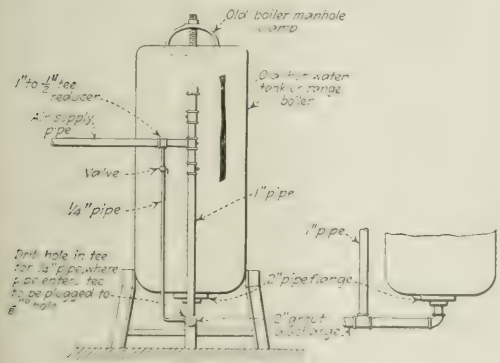
American engineers to the number of many thousands, under the leadership of Mr. Hoover and others, are taking concerted action to impress upon the government and the people of America the fact that it is high time that the counsel of engineers was taken as well as the advice of politicians in technical affairs. The war, it has been said and seen, was an engineers' war; but at all times and in all places partisan political affiliation was allowed to interfere with its most effective prosecution. Politics, nominally adjourned, was given right of way over disinterested policy. Our major public utilities, in making large tracts of desert land arable, in developing projects of canalization and inland waterways, in utilizing water-power for hydroelectric developments, in the proper and equitable exploitation of Alaska and in many other connections, demand the best brains of experts, not the casual attention of politicians with axes to grind, fences to mend and feudal armies of heelers to maintain. In the service of the country already are many excellent engineers who have admirably performed. They are entitled to the guidance of those who are familiar with the problems they are facing. They must not be victimized and their work must not be nullified by the ignorance and incompetence of directors whose personal power and private gain come before the nation's good.—Philadelphia Public Ledger.

HINTS FOR THE CONTRACTOR

Hot-Water Tank Makes Grout Machine for Repairing Chilean Dam

By Donald G. Coombs
Civil Engineer, Seattle, Wash.

During the winter of 1919 severe floods carried away a considerable portion of the downstream apron of a concrete diversion dam across the Rio Cachapoal at Chacayes, Chile. This dam was at the intake of an 8-mile power canal furnishing water for the Coya generating station of one of the large American mining and smelting companies in Chile. At low water several months later this apron was rebuilt and extended and as a precaution against any possible flow of water under the dam and apron it was decided to grout the gravel foundation on which it was built.



TWO VIEWS OF RANGE BOILER RE-FITTED AS GROUTING MACHINE

With this in mind 2-in. pipes had been embedded in the apron the entire length of the dam, extending well into the gravel foundation.

With a portable gasoline-driven air compressor the only available equipment, the general foreman in charge evolved the idea embodied in the accompanying sketch. As can be seen it is simply an ordinary hot water tank, or range boiler, of approximately 50-gal. capacity. For charging the machine an air-tight door was made of an old boiler man-hole clamp. The grout was mixed in a small steam driven mixer after the sand had been carefully screened, but to insure an absolutely clean grout it was further screened, after mixing at the grout machine.

To prevent any possible clogging of the discharge pipe when the rather thick grout was used at the beginning of a hole, the air by-pass was installed as shown on the attached sketch. Where this ½-in. pipe entered the main discharge pipe it was plugged to not over an 1-in. hole, and this volume of air kept the grout sufficiently agitated to prevent plugging. After the valve in this by-pass line was properly set it was left open during the run.

As many as 400 sacks of cement were used in one hole. With 85 lb. at the compressor no trouble was experienced in filling all voids in the foundation and for considerable distances on each side. All the material necessary for building this grout machine are found on any ordinary construction job, and the above experience showed it to be as efficient as any high-priced standard grout machine.

Frank B. Prescott was superintendent in charge of repairs, John Peraldo was general foreman, and the writer was office engineer.

Anchored Barge and Timber Spuds Hold Cofferdam in Swift Water

By George W. McAlpin
Point Pleasant, West Virginia

In building box-type cofferdams in the Ohio river, great difficulty is often experienced in holding the framing and sheeting in place until they can be filled, due to the swift current. In most cases guide piling can be driven, against which the cofferdam leans until filled, but, in some cases, the swift current has scoured the river bed to such an extent that there is practically no material to hold piles, only a few feet of deposit being left upon the rock. To overcome this difficulty and to hold the cofferdam the following arrangement has been used by the superintendent for the National Contract Co.

A cluster of piling is first driven 300 ft. or more upstream from the line of the cofferdam, or far enough to secure a good penetration. From the cluster, or from an anchor if a cluster is not driven, lines are led to a barge made fast in line with the lower side of the cofferdam. Spuds, made from 14 x 14-in. timbers, iron pointed, are then dropped over the side of the barge, the force being sufficient to cause the points to penetrate the deposit and go several inches into rock. The upper ends of the spuds are held by lines, so that they will remain in a vertical position. The cofferdam is then assembled and when lowered to place slides down the spuds.

After the sheeting is placed and the cofferdam filled sufficiently to hold it, the spuds are pulled, and the barge moved ahead for another section. In this manner a length of Cofferdam equal to the length of the barge used can be built and filled without great danger of losing it in the swift water.

Plan Water-Works Now

Because of the present marked depression in industrial activity and the widely distributed condition of unemployment George W. Fuller, consulting engineer, urged on members of the Indiana Sanitary and Water Supply Association at their recent meeting immediate planning and construction of water-works. The prices of both material and labor are commencing to show substantial reductions and contractors are anxious to undertake work at reasonable figures. During the present period of industrial stagnation, continued Mr. Fuller, progressive cities will proceed with the rehabilitation of water-works and other public improvements. This policy will serve in large measure to relieve unemployment conditions and to stabilize the industrial system of the country.

NEWS OF THE WEEK

New York, March 17, 1921

Engineers Discuss New York Port Report

Proposal of Deep Tunnel Loop and Automatic Electric Operation Criticized in Discussion

The report of the New York-New Jersey Port and Harbor Development Commission was discussed at the regular business meeting of the American Society of Civil Engineers in New York, March 2, 1921, following a paper by B. F. Cresson, Jr., chief engineer of the commission, embodying a presentation of the commission's report. The engineering plan for developing the port, as recommended by the commission, was made public Jan. 24, and reported in abstract in *Engineering News-Record*, Jan. 27, p. 182, and Feb. 10, p. 271. The plan would make the harbor a railhead port, with the exception of Manhattan, in which local distribution and collection of freight would be conducted through twelve or more zone-warehouse terminals served by a deep tunnel, "automatic-electric" railroad in the form of a loop, with two tunnels under the Hudson River, connecting with a joint transfer yard on the Hackensack Meadow in New Jersey. Mr. Cresson said that the important thing now is to obtain a treaty between the two states, constituting a port authority, and that the plan itself will probably be subject to considerable revision. In regard to the "automatic-electric" system, Mr. Cresson said that the automatic feature is something that can be developed from manual operation and experimental trial and that this feature is the important one of the system.

T. Kennard Thomson, consulting engineer, New York City, opened the discussion with criticism of the deep tunnel system of the automatic-electric railroad and of excavations necessary below the proposed terminal buildings as dangerous to the foundations of adjacent buildings and subways. A statement by Gustav Lindenthal was read embodying criticisms of the commission's recommendations in comparison with the Hudson River bridge plan, as outlined elsewhere in this issue.

B. F. Fitch, president of the Motor Terminals Co., New York and Cleveland, and J. P. Hallihan, consulting engineer, New York City, suggested serious consideration of early building of units of automatic-electric zone terminals to be used as temporary distribution and reconsolidation points for motor-truck distribution and collection in Manhattan, carrying demountable unit container bodies between New York and New Jersey rail transfers over existing ferry routes, which, the commission's report indicates, have sufficient surplus capacity for the service. It was stated by Mr. Fitch that a large measure of immediate relief, with release of Manhattan railroad pier stations, could be accomplished by such a program pending the building of the tunnel system. Mr. Hallihan said that such a program would very probably point the way to the inclusion of store-door delivery in the commission's plan.

G. W. Kittredge, chief engineer, New York Central Lines, closed the discussion by urging the society's support in development of relief for the port of New York.

Federation Urges Reorganization of N. Y. State Government

Any corporation or business interest would go into bankruptcy if its affairs were conducted as are those of the State of New York, the committee on New York State government reorganization of the Federated American Engineering Societies declares in a report to the chairman of the joint judiciary committees of the Senate and Assembly. The report is signed by the three members of the committee who were appointed by Herbert C. Hoover. They are H. deB. Parsons, chairman; Paul G. Brown, and Lewis B. Stillwell.

The work of this committee, which is co-operating with the New York State Association in plans to reorganize the state government by constitutional amendments, is part of the program of public service entered upon by the American Engineering Council, the federation's governing body.

The committee urges the passage of the three state reorganization amendments involving a consolidation of state departments, an executive budget system and a four-year term.

"A department of public works," says the committee, "would be a most important division of the state government. The same can be said of a department of conservation. A large proportion of the expenses of the state are incurred for public works. Both engineering and architectural functions should be grouped under the department of public works where they can be systematically and efficiently managed without duplication and waste of public funds. Great economies can be attained through the departments of public works and of conservation. If large enterprises are to be handled efficiently, it is of vital importance to have one man in authority with respect to policy, finance, labor, materials and other controlling items, who can be reached without delay. It is essential that those in actual management of detail work should have ready access to this man."

Minnesota Societies Form Engineering Federation

Architects Join in State Movement—Ten Organizations Represented—Constitution Ratified

The Minnesota Federation of Architectural and Engineering Societies was organized at a meeting in Saint Paul March 11. Adolph F. Meyer, president of the Minnesota Joint Engineering Board, presided. The board was instructed by resolution to act as the first board of directors of the federation, to take over the *Bulletin*, published heretofore by the five state societies, to employ a secretary-editor, and notify all member societies that the federation was now in existence and prepared to function in the interests of engineers.

The federation consists of the following ten societies and branches of national organizations: Minnesota Surveyors' and Engineers' Society; Minnesota Chapter, American Institute of Architects; Minnesota Chapter, American Society of Heating and Ventilating Engineers; Northwestern Section, American Society of Civil Engineers; Engineers' Club of Minneapolis; Engineers' Society of St. Paul; Minnesota Section, American Institute of Electrical Engineers; Minnesota Section, American Society of Mechanical Engineers; Engineers' Club of Northern Minnesota; and the Duluth Engineers' Club. These organizations had previously ratified the constitution of the federation.

No Individual Members

The federation has no individual members, membership being vested in the various societies. Each society pays dues according to the number of its members, but there will be no duplication of dues on account of duplicate membership. Each society has two representatives on the board of directors. The board has full power to act on any matter affecting the two professions, and no society can take action on state-wide matters in contradiction to that taken by the board. Jurisdiction in purely local matters is left undisturbed.

At a banquet in the evening W. B. Powell, president of the Engineering Society of Buffalo and member of the executive committee of the American Engineering Council, outlined the formation, aims and purposes of Federated American Engineering Societies, urging the five local societies to seek charter membership separately. Action has been deferred by all, except the Duluth Engineers' Club, waiting the formation and action of the State Federation on this matter.

Spring Valley Water Co. Purchase Fails at San Francisco

At a special election, March 8, in San Francisco 42,900 votes were cast for and 31,000 against the purchase of the water-works system of the Spring Valley Water Co. As a two-thirds majority was necessary to approve the proposal, the plan failed to carry.

The vote was on the question of purchase at a value of $37,000,000 fixed by the Railroad Commission and accepted by the company. Funds were to be provided by bonds which would not be included in the 15 per cent limit of bonded indebetedness set by the city charter. The value was fixed as of Jan. 1, 1920, and to this was to be added the appraised cost of improvements to date, these not to exceed $1,000,000. This price included 61,560 acres of the total of 87,437 acres of land owned by the company, the selection of areas desired by the city having been made by the city engineer and other authorities.

A city-wide campaign for the purchase was conducted by city officials for weeks previous to the election. In fact, city officials stated after the election that few projects in the city's history have been so well advertised as the purchase of the Spring Valley system which was backed by the city administration and the public press. There was very little organized opposition to the measure, practically all of the civic, social and labor organizations of the city having officially endorsed the purchase.

James Rolph, mayor of San Francisco, commenting on the defeat of the proposal, said: "Let us not forget that the purchase of Spring Valley is an ever recurring problem which we must solve for our own welfare." Supervisor Ralph McLeran pointed out that the Spring Valley Water Co.'s application to the Railroad Commission for an increase in rates, which is now pending, will doubtless be granted and the citizens may expect an increase of rates within 90 days. This could have been avoided, he said, had they voted for the purchase.

In the Board of Supervisors, James B. McSheehy was practically the only member actively to oppose the purchase. He based his opposition on the grounds that the price asked was too high. "We are now asked $10,000,000 more than in 1910 and nothing is allowed for depreciation," Mr. McSheehy said. "By buying Spring Valley," he added, "the city would find itself with a bonded indebtedness of $150,000,000, or 25 per cent of its assessed valuation, which is $600,000,000. These facts were told at 42 meetings."

This is the third time the proposal to purchase the Spring Valley system has failed to receive the necessary two-thirds vote. The previous elections were held in 1910 and 1915. A summary of the water situation in San Francisco by J. Waldo Smith appeared in *Engineering News-Record* Feb. 7, 1921, p. 305.

Overloaded Wall Buckles

Storage of waste paper stock in a warehouse at the foot of Center St., Newark, N. J., overloaded the floors of the building to such an extent that the entire rear wall, five stories high, buckled outward on March 3. The owner of the building had warned the tenant that he was overloading the floors, but took no further steps to safeguard the property, being protected by a lease clause calling for all damage to be repaired by the tenant. The city building authorities were not informed of the overloading until after the accident.

New York Governor Wants State Water Power Control

In a message to the Legislature on March 11 Governor Miller of New York recommended that a state water power commisssion be created, consisting of the attorney general, the state engineer, and the conservation commissioners, to have power over the state waters quite comparable to the power that the Federal Water Power Commission has over federal waters. In other words, the Governor recommends for the State of New York a policy of private operation and limited term ownership under state control.

The commission he proposes would have power of licensing and duties of examination and inspection and control of power plants, but the regulatory powers as to rates and service would be vested in the State Public Service Commission. The Governor furthermore stated that in his opinion the Federal Water Power Act is unconstitutional in so far as it relates to the federal government's claim to control the boundary waters, such as the Niagara River, and he has instructed the attorney general of the State of New York to take legal action in the matter. Legislation to carry out the Governor's program will soon be introduced in the New York Legislature.

Injunction Against Furnishing Impure Water Issue

Following action brought by the attorney-general of Pennsylvania at the instance of Edward Martin, state commissioner of health, the Dauphin County Court on Jan. 7 gave the Tri-Borough Water Co., which operates in Tarentum and Brackenridge Boroughs, ten days to show cause why it should not be restraind from supplying water alleged to be inferior. In the bill in equity filed by the attorney-general it was charged that the water for some time past has been "impure, detrimental to the public health and the cause of disease and mortality, in that said water contained and now contains in large quantities the germs of typhoid fever." The bill also states that the company was notified Nov. [illegible] to continue furnishing the water notwithstanding which no improvement was made in the quality of the water delivered.

How Federal-Aid Road Bill Was Defeated

(Washington Correspondence)

Friends of the federal-aid road policy are at a loss to understand the reasoning of those who are claiming victory for the Townsend policies. The recent vote in the Senate which blocked the federal-aid bill was not on the bill itself but on the question of the suspension of the rules. To suspend the rules requires a two-thirds vote. Considerably more than a majority of the senators voted to suspend the rules, near the close of the session when there was every desire to avoid taking up legislation which would consume considerable time.

That so many voted under those conditions to suspend the rules is held to be most encouraging to those who would see a continuance of the existing policy. Forty-two senators voted for suspension, while 33 voted against such action. Had the vote been on the federal-aid bill itself it is believed that the majority would have been greater by at least two or three votes.

Certainly those who voted to suspend the rules could be relied upon to vote for the federal aid bill whenever it comes up.

How Senate Voted

Owing to the wide interest in the vote, there is given below the names of the Senators who voted to suspend the rules:

Ashurst, Arizona; Beckham, Kentucky; Capper, Kansas; Chamberlain, Oregon; Culberson, Texas; Curtis, Kansas; Dial, South Carolina; Fletcher, Florida; Gay, Louisiana; Glass, Virginia; Gooding, Idaho; Gore, Oklahoma; Grondna, North Dakota; Hale, Maine; Harris, Georgia; Harrison, Mississippi; Heflin, Alabama; Henderson, Nevada; Hitchcock, Nebraska; Jones, New Mexico; Kellogg, Minnesota; Kendrick, Wyoming; McKellar, Tennessee; McNary, Oregon; Myers, Montana; Overman, North Carolina; Phelan, California; Pittman, Nevada; Ransdell, Louisiana; Reed, Missouri; Sheppard, Texas; Simmons, North Carolina; Smith, Arizona; Smith, Georgia; Smith, South Carolina; Stanley, Kentucky; Sterling, South Dakota; Sutherland, West Virginia; Swanson, Virginia; Trammell, Florida; Underwood, Alabama; Walsh, Montana.

Some of the senators in the above list will not be members of the new Congress, but it is understood that the incoming senators hold the same views as did their predecessors. It will be seen that the south and the west are almost solidly in favor of the continuance of federal aid. Since those two sections have a majority of the votes in the Senate, probabilities point to a continuance of the federal-aid policy. The majority in the House, which has gone on record for that policy, is overwhelming.

It is [illegible] by the advocates of federal-aid that the Sells bill is not entirely satisfactory and it is believed that the measure which will be presented at the next Congress will contain important revisions of the existing policy. It is expected that the bill will contain strict requirements in the [illegible] of maintenance of federal-aid highways.

Indiana License Bill Law

Governor McCray March 10 signed the Indiana engineers license bill making it a law. The law is founded principally on the model proposed by Engineering Council modified by a few features promulgated by the American Association of Engineers, the Indiana chapters of which are responsible for the passage of the bill.

Chicago Engineers Organize

Consulting engineers of Chicago who specialize in designing and directing the installation of mechanical, electrical and sanitary equipment for buildings have formed an organization under the name of the Chicago Association of Consulting Engineers. H. A. Durr, 123 W. Madison St., is secretary.

Mechanical Engineers Announce Spring Meeting

The American Society of Mechanical Engineers will hold its spring meeting at the Congress Hotel, Chicago, May 23-26. Sessions are planned by the professional sections on aeronautics, fuels, management, material handling, machine shop, power, forest products and railroads.

New York City Opposes Port Treaty with New Jersey

On March 11 the Board of Estimate of New York City adopted a resolution, presented by Mayor Hylan, opposing the port treaty between the states of New York and New Jersey. The resolution declares that the proposed plan is contrary to the federal constitution, the constitutions of the two states and the public policy of the city of New York.

The resolution states that the treaty "provides for the organization of a corporation without time limit for its franchises, to be known as the Port Authority, with power to acquire and operate railroads, surface and subway, and terminals, and to make rules and regulations with the force of statutes, and fix charges without limit, and generally to control the methods of merchandise in said port district."

The Board of Directors of the Brooklyn Chamber of Commerce in a report made public March 13 came out in opposition to the proposed port treaty between the States of New York and New Jersey in its present form.

The reasons given were that the treaty was inadequate to bring about a unified port development, that it would not co-ordinate the many authorities now functioning in the port.

On March 9 George H. Stege, president of the West Side Taxpayers' Association of New York City, sent a letter to Commissioner of Markets Edward J. O'Malley vigorously protesting against the plan of the bi-state commission, stating that it would destroy the present primary wholesale market and require New York food wholesalers to take their deliveries in the Jersey meadows.

Form Engineers' Exchange

John Ericson, former city engineer of Chicago, now consulting engineer for the city, J. W. Pearl, civil engineer, and other consulting engineers have founded the Engineers Exchinge, Inc., which is an association of consultants for the collection and distribution of information for engineers and clients. The objects of the association include the following features: To provide a reference library and a central office for conferences; to assist clients in negotiations for experienced engineering service; to serve as adjusters; to address officials, discuss the value of engineering service and present the merits of co-operation by members regularly engaged in the design and construction of specific parts of the project under consideration; to discourage "free" service and to uphold the standards of practice. Other members of the board of trustees are John P. Cowing, Chicago; M. L. Jones, Benton Harbor, Mich., and A. L. Burridge, Crystal Falls, Mich.

Bridge Design Ordered Modified

Recommendations that an additional bond issue of $1,000,000 to permit the Belle Isle bridge to be built according to the original or commission design be submitted to referendum vote next month were defeated by the Detroit City Council on March 8, and the prospects that the original design may be carried out have thereby been practically destroyed. The council instructed the supervising engineers for the bridge, the firm of Esselstyn-Murphy, to revise the official plans, making such modifications as will bring the cost within the balance of approximately $2,500,000 remaining of the original $3,000,000 approved by popular vote. The principal modifications are a substitution of fill for retained approaches and reduction of width of the carrying elements of the structure, the sidewalks to be cantilevered beyond the outer faces so as to maintain the full deck width. It is expected that the revised plans will be completed early in April.

In connection with the same undertaking a request has been received by the council from W. H. Adams, representing Daniel B. Luten, who prepared the plans of a reinforced-concrete arch bridge recently submitted to the council for the Belle Isle site, that the council act favorably upon a petition laid before it by the Detroit chapter of the American Society of Civil Engineers that the original Belle Isle bridge commission be reappointed and charged with the responsibility of passing upon the arch plans. It is represented that all the criticisms of the arch plan that have been presented to the council have been made without detail knowledge of the plans condemned, and that most of the arguments were directed against a method of securing plans rather than against the designs. Up to the present the council has not taken action on this request.

Plan to Bridge Columbia River

Seattle business men are planning to raise $75,000 toward the $500,000 required in the building of a toll bridge across the Columbia River between Kennewick and Pasco on the Inland Empire highway. The bridge would form a main link between eastern and western Washington, and is expected to provide heavily increased trade for Puget Sound ports, particularly Seattle.

Two Nominations to I. C. C.

On March 11 President Harding nominated former representative John J. Esch and Mark W. Potter to the Interstate Commerce Commission. The nominations were reported favorably by the Senate Interstate Commerce Committee, but final action was not taken. Mr. Potter was one of the three nominated by President Wilson, but not confirmed by the Senate.

Civic Tour to Europe

With Dr. John Nolen, town and city planning specialist, of Cambridge, Mass., as the executive head of the party, a civic tour of Europe is being organized to study business, social and economic conditions. The party to which engineers and their families will be welcomed will leave New York City June 7. Plans have been made for an itinerary to include England, Scotland, Belgium, Germany, Austria, Italy, Switzerland and France. The cost from New York through Paris from June 4 to Aug. 3 will be $940, exclusive of return transatlantic passage, which costs $120 or more.

For further information address J. L. Crane, Jr., Robinson Hall, Harvard University, Cambridge, Mass.

Engineers to Review Los Angeles Sewage Disposal Plan

The proposed new sewage disposal project for Los Angeles, Cal., outlined in *Engineering News-Record*, Feb. 24, p. 331, is to be reviewed by a board of engineers consisting of William Mulholland of Los Angeles, George W. Fuller of New York, and George C. Whipple of Cambridge, Mass., and New York City. As stated in the article cited, the Los Angeles sewage treatment project provided for fine screens of the drum type, with discharge of the effluent into the Pacific Ocean. It has since been reported that it was also proposed to chlorinate the effluent.

A bond election in March of this year was contemplated to vote $12,850,000 for the sewage-works and for a new outfall and branch trunk sewer. The Los Angeles Chamber of Commerce and other local and civic organizations requested the city council to employ a board of engineers to review the plans of John A. Griffin, city engineer, and W. T. Knowlton, engineer of sewers. The city council in turn requested the American Society of Civil Engineers and the American Association of Engineers to suggest the names of ten or twelve qualified engineers from which

the council might select two men to serve with Mr. Mulholland as a third member.

Rivers and Harbors Bill Now Law

The Rivers and Harbors bill authorizing the expenditure of $15,000,000 for maintenance of present works and the prosecution of projects already authorized, under the direction of the Secretary of War and the supervision of the Chief of Engineers, was approved March 1. The bill also makes $250,000 immediately available for examinations, surveys and "contingencies for rivers and harbors for which there may be no special appropriation," but no part of this sum is to be spent on projects not already authorized by law.

Federal Government Withdraws From Barge Canal

President Wilson on Feb. 28 signed the bill directing the discontinuance of operation by the Government of the fleet of barges on the New York State Barge Canal. In accordance with this act the Inland and Coastwise Waterways Service of the War Department, which had control of the operations on the canal, is offering for sale most of the fleet built for the canal, which includes fifteen self-propelled barges, thirty-eight steel cargo barges, sixteen concrete cargo barges, three wooden barges, three small tugs, and ten old wooden barges. About one-quarter of the Government fleet is being retained for operation on other waters still under its jurisdiction. Since early in the war the Government, first under the Railroad Administration and later under the War Department, has operated barges on the canal, but it recently has not had exclusive control of operations.

Coast Survey Head on Boundary Commission

Colonel E. Lester Jones, director of the Coast and Geodetic Survey, has been appointed commissioner of the International Boundary Commission, United States and Canada. He succeeds the late E. C. Barnard. Colonel Jones' appointment was one of the eleventh-hour acts of the outgoing President. The appointment has been challenged by some engineers on the ground that the treaty provides that the commissioner must be an expert geographer or surveyor. The point also is raised that this appointment should be confirmed by the Senate. Mr. Barnard's appointment was not sent to the Senate and the issue never has been raised. It is expected, however, that the Senate will look into the matter in this case.

Colonel Jones points out that little remains to be done by the commission. The work now is largely a compilation of records. The duties are almost entirely administrative and it is understood that the appointment was made largely because of Colonel Jones' record as an administrative officer, and because the Coast and Geodetic Survey virtually was the parent of the original commission. The commissionership does not carry with it compensation, and Colonel Jones is continuing as director of the Coast and Geodetic Survey.

Goethals to Study Port of Shanghai

It has been announced by the Wangpoo Conservancy Board, which has control of the port of Shanghai, China, that Maj.-Gen. G. W. Goethals has been nominated to represent America on the engineers committee which is to report on improvements to the Wangpoo and Yangtse River, including the main port of Shanghai and the adjacent ports of Woosung and Pootung. Studies of this port have been going on for a number of years, and it is expected that work will soon be commenced on projects the cost of which will probably run into millions of dollars.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, Boston; Convention, Cleveland, June 6-10.

The Northeastern Section, Am. Soc. C. E. at its meeting March 5, at Boston, Mass., considered the following questions: 1. Why have a section of the Am. Soc. C.E. in Boston? 2. Should the Northeastern Section confine its meetings simply to American Society matters, or include matters of general engineering interest? A committee was appointed to report on the situation.

The Philadelphia Post, Society of American Military Engineers, at its meeting Jan. 27, was addressed by Col. Mason M. Patrick (formerly major-general, Chief of Air Service, A. E. F. and chief engineer, Line of Communications, in France) on "Duties and Status of the Engineer Reserve Officer." At the Feb. 24 meeting, Col. J. Frank Barber, who was in command of the 304th Engineers in France, spoke on "Experiences of a Regiment of Combatant Engineers in Connection with an Army Offensive."

The North Dakota Society of Engineers, at its annual meeting Feb. 10-11, elected the following officers: President, R. N. Stee; first vice-president, E R. Griffin; second vice-president, W. B. Stevenson; secretary, E. F. Chandler.

The Engineers' Club of Philadelphia, at its March 29 meeting, will consider the subject "City Paving." The advisory committee in charge of the meeting consists of Prof. Milo S. Ketchum, of the University of Pennsylvania; C. W. Pinckney, chief engineer, Borough of Manhattan, New York City and R. Keith Compton, chairman and consulting engineer, Paving Commission, Baltimore, Md.

The Annual Joint Dinner of the engineering societies of Boston, an affair of twelve years' standing, was held at the Boston City Club, March 9. It was participated in, as usual, by members of all of the engineering societies, and sections of national engineering organizations, in the city. Lewis E. Moore, bridge engineer of the Massachusetts State Department of Public Utilities, was toastmaster and the other speakers were E. J. Mehren, editor of *Engineering News-Record*, who discussed economic conditions in Europe, and Rev. McIlyar H. Lichliter, who spoke on "The Vaudeville Mind."

PERSONAL NOTES

FRANK AYDELOTTE, since 1915 professor of English Massachusetts Institute of Technology, Cambridge, Mass., has been made president of Swarthmore College, Swarthmore, Pa. Prof. Aydelotte is the author of "English and Engineering," published in 1917.

CAPT. CHARLES F. HEALEY, engineer of contracts in the city engineer's office, Chicago, has been made assistant city engineer, a position entailing executive duties as assistant to the city engineer. Capt. Healey served in the transportation department of the A. E. F. Before the war he was special investigating engineer in the city engineer's office.

V. S. PETTERSON, assistant city engineer, Chicago, has returned to his old position of chief efficiency engineer in the office of the city comptroller.

F. T. TWITCHELL has resigned from the Arizona Highway Department to engage in a survey for a proposed railroad from Ajo, Ariz., to the Gulf of California.

C. O. THURMAN of Washington, D. C., has been elected borough engineer of Jersey Shore, Pa.

FRANKLIN BAXLEY has been appointed engineer in charge of the municipal plants of Bellefontaine, Ohio.

H. L. MORISETTE, formerly with the Interstate Commerce Commission at San Francisco as junior civil engineer, has been appointed assistant engineer of the U. S. Reclamation Service at Yakima, Wash.

TOSHINAE IKEDA, chief of the civil engineer section, Bureau of Public Works, Taiwan, Japan, is now visiting the United States for the purpose of studying road building methods.

FORREST R. POLK, formerly assistant engineer Division of Highways, Illinois, has resigned to become an instructor in the department of industrial education at the Oshkosh (Wis.) Normal School.

PROF. PHILIP C. NASH, director of engineering practice, Northeastern College, has been granted a leave of absence effective April 13 in order that he may establish the co-operative method of teaching engineering at Antioch College, Yellow Spring, Ohio, under the direction of President Arthur E. Morgan.

PROF. HENRY B. ALVORD has recently been elected professor of civil engineering and will become head of the department of civil engineering of Northeastern College. Prof. Alvord has had several years of experience in civil engineering on the faculties of the Massachusetts Institute of Technology and Bowdoin College, as well as considerable professional practice. He is an ex-secretary of the American Concrete Institute.

D. T. BLACK, for the past three years city engineer of Niagara Falls, Ont., has been appointed city engineer of Galt, Ont., to succeed W. H. Fairchild, resigned.

GEORGE H. MOORE, for some years hydrographer in the city engineer's office of Seattle is now senior electrical engineer to the Public Service Commission of the State of Washington, with headquarters at Olympia.

G. W. ABBOTT, division engineer Boston division Boston & Albany, R.R., has been appointed prinicipal assistant engineer, with headquarters at South Station, Boston, succeeding E. S. Draper, deceased.

MAJOR DANIEL D. PULLEN, Corps of Engineers, U. S. A., has been instructed to report to the commanding general, Panama Canal Department, for assignment to duty with the 11th Engineers.

MAJOR JAMES W. BAGLEY, Corps of Engineers, U. S. A., has been ordered to McCook Field, Dayton, Ohio, as the representative of the Corps of Engineers in the experimental work being done in connection with the adaptation of aerial photography for mapping.

W. B. KNIGHT, division engineer Albany division Boston & Albany R.R., has been transferred to the Boston division, with headquarters at South Station, Boston.

E. K. MENTZER, supervisor of track sub-division 1 Boston & Albany R.R., has been appointed division engineer Albany division, with headquarters at Springfield.

E. L. MILES, formerly assistant chief engineer Toronto & York Roads Commission, with headquarters at Toronto, has been appointed road superintendent of Victoria County, Ont., with headquarters at Lindsay.

FRANK D. HAIN, formerly city engineer of Altoona, Pa., is now engineer for the Altoona & Logan Valley Trolley Co.

GEORGE W. OSGOOD, port engineer for the Port of Tacoma, has been appointed manager as well as chief engineer and will have charge of the operation and construction of the port facilities.

L. F. BOON, recently assistant construction engineer on the malleable foundry of the American Chain Co., York, Pa., has been appointed instructor in the department of civil engineering, University of Minnesota.

E. A. JONES, office engineer South Station, Boston, has been appointed supervisor of track sub-division 1, Boston & Albany R.R., with headquarters at South Station, Boston.

COL. FREDERICK V. ABBOT, Corps of Engineers, U. S. A., retired, has been awarded a distinguished service medal "for exceptionally meritorious and distinguished service in the organization of engineer troops and in the procurement of enlisted men for that service during the war." The citation states that "his zeal was untiring and the success of his effort marked."

JOHN H. CATON 3D, formerly major of the 33d Engineers, has been appointed director general of public works in Santo Domingo, with headquarters at Santo Domingo City, R. D., effective April 1, 1921. At present he is acting director general.

W. S. HENDERSON has resigned as county engineer of Washington County, Kan., to become city engineer of Lawrence, Kan.

V. B. FREDENHAGEN, formerly resident engineer on Federal Aid Projects Nos. 44 and 45 in Saline County, Kan., has been appointed county engineer of Jewell County, Kan., with headquarters at Mankato.

M. L. DEAN, diking engineer of Walla Walla County, Wash., has been named consulting engineer for the new road program to be carried out by the county.

C. K. KOPPERS, formerly superintendent for the A. S. Hecker Co., Toledo, Ohio, is now engineer of construction for the Kellys Creek Colliery Co., with headquarters at Ward, W. Va. During the world war he served with the 17th Engineers in charge of construction of 121 miles of standard-gage track at the Montoir yards, St. Nazaire, France, and later as commanding officer Co. B, 72nd Engineers. After the armistice he was appointed adjutant to the section engineer, Base Section No. 1.

OBITUARY

CALVIN TOMKINS died March 13 in New York City. He was born in East Orange, N. J., 1858, and was graduated from Cornell University in 1879. He was connected as managing director with several New York companies engaged in the manufacture of building materials, among which were the Tomkins Cove Stone Co. and the Bonner Brick Co. From 1910 to 1913 he was commissioner of docks and ferries of the City of New York and was also a member during 1918 of the inland waterways commission of the U. S. Railroad Administration. He was a specialist in port facilities work.

COL. EUGENE W. VAN C. LUCAS, a retired officer of the U. S. Army and formerly commanding officer of the 22d Engineers, N. Y. G., shot and killed himself March 8, in New York. He was born in 1864 and was graduated from the U. S. Military Academy at West Point in 1887. After one year's duty with the First Artillery he was transferred to the Corps of Engineers and after two years at the Engineer School of Application and two years as assistant instructor of military engineering at West Point, he was assigned to river and harbor work. In the Spanish-American War he was chief engineer, 2d Division, 2d Army Corps in camp at Greenville, S. C. He returned to river and harbor duties in 1899, was promoted to rank of major in 1905 and in 1912 he was commissioned lieutenant-colonel and later colonel in the New York National Guard, serving as commanding officer of the 22d Engineers, N. Y. G. Colonel Lucas had complete charge of the construction of Camp Whitman, N. Y., the mobilization camp established in 1916 for the State Guard. An article describing this work appeared in *Engineering Record* July 1, 1916, p. 4. Later Colonel Lucas went to the Mexican border with the 22d Engineers. During the World War he served at Camp Meade, Md., and was retired after the armistice.

WILLIAM H. BRENTON, for the past six years field engineer for the Interstate Commerce Commission in the Pacific district, died at Jerome, Ariz., Feb. 11. He was born near Petersburg, Ind., in 1862 and was graduated from the University of Michigan in 1883. Almost continuously since that time he has been connected with the construction, maintenance, and operation of Western railroads, among which were the Chicago & Alton and the Chicago, Rock Island & Pacific. He located the Pikes Peak cog road. He also served as chief engineer for various railroad contracting firms. From 1910 to 1913 he was engaged in private practice as a consulting engineer and in 1914 was appointed field engineer, Interstate Commerce Commission, division of valuation, Pacific district and had charge of resurveys of 20,000 miles of line.

Cement and Structural Shapes Compared for 21 Years

A Remarkable Chart—1920 Was Cement's Big Year—Production 10 per Cent Above Steel, Based on 1916

Fig. 1 is a comparison of the mill prices of structural shapes and portland cement during the last 21 years. The general similarity of the two curves is striking. Except for the war period 1915-1919 they are out of phase at only one point, 1903.

The sharp rise of steel, 1915-1917, and the more gradual increase in the price of cement during that period is easily explained by the vastly superior demand for steel in war time. The mere fact that cement was able to keep on rising during a war period, when peace consumption was abnormally low, is ample explanation of its continued rise after 1917, when Government regulation of steel prices, followed by the falling demand due to the cessation of the war in 1918 brought the price of steel down rapidly to $2.45 in December, 1919—the lowest point since April, 1916.

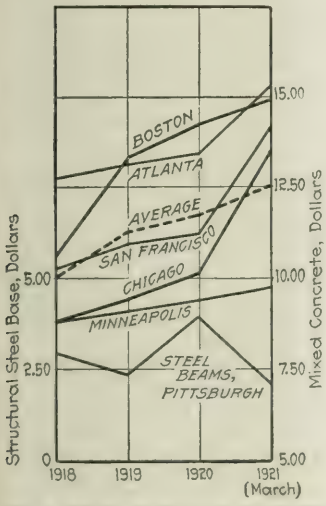


FIG. 2—PRICE TREND OF CONCRETE AND STRUCTURAL SHAPES

The cement curve is plotted from the records of the U. S. Geological Survey and the figures represent the average prices in bulk at factories. According to Ernest F. Burchard of the Geological Survey, the average prices in 1918 ranged between $1.511 per bbl. in Pennsylvania and $1.894 in Washington; with $1.22 in the Lehigh district and $1.69 in Washington in 1917. The average 1918 price for the entire country was $1.596 as compared with $1.71 in 1919 and $2.01 in 1920. The record year both in production and in price was 1920, when 100,302,000 bbl. were manufactured and 96,329,000 bbl. valued at $193,548,000 were shipped.

Spotted on the curve is the current average for the eastern mills.

With return to so-called normal, or peace, conditions, it will be extremely interesting to note whether the base curves of structural steel and cement will resume the agreement in price trend exhibited in 1900-1914.

Fig. 2, constructed from *Engineering News-Record's* monthly quotations, shows the price trend of concrete (including labor) in Boston, Atlanta, San Francisco, Chicago and Minneapolis, and the average or composite curve, as compared with the price movement of structural shapes in Pittsburgh. The same phenomenon is to be observed as in Fig. 1. Steel, the war material, had its ups and downs, whereas cement (or concrete) rose steadily—in some cases rapidly—upward.

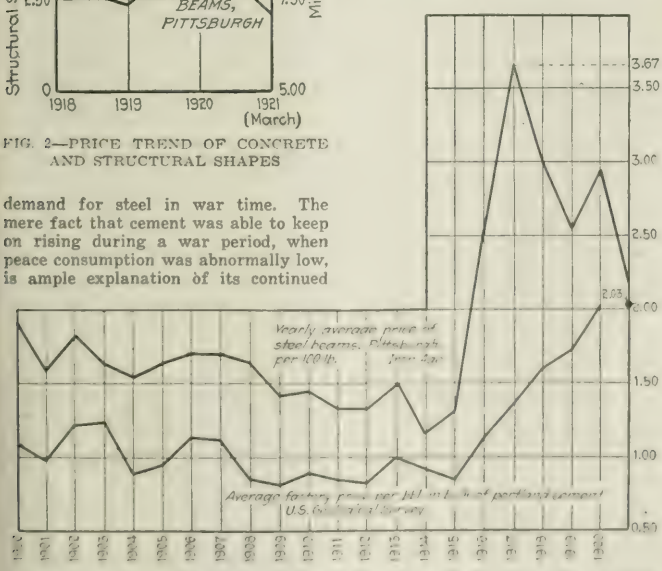


FIG. 1—COMPARISON MILL PRICES OF CEMENT AND STRUCTURAL SHAPES

The steel prices plotted were taken from the *Iron Age* compilation for 1900-1910, and for 1910-1921 from the files of *Engineering News-Record*. The quotations are for delivery in from one to three months and therefore do not take into consideration the extreme prices paid for prompt shipment. The independent steel manufacturers' price rose from September, 1919, returning to the United States Steel Corporation's schedule in December, 1920, and it is at present below the Corporation's level. The independents received as high as 3@4c. per lb. for bars, 3½@4c. for plates and 3@3½c. for structural shapes.

The following tabulation is of interest as showing the production trend of cement and steel since 1916:

	Portland Cement bbl.	Steel Ingots and Castings, gross tons
1916.....	91,521,198	42,773,680
1917.....	92,814,202	45,060,607
1918.....	71,081,663	44,462,432
1919.....	80,769,378	34,671,232
1920.....	100,302,000	41,000,000

These figures only confirm the expected. As for steel, with the war over and the strike on, 1919 showed a slump of more than 9,000,000 tons. Figures for 1920 are not yet available, but it is estimated that they will be within 2,000,000 tons of the 1916 production.

The case of cement is still more interesting. Despite subnormal construction, 1920 showed an increased production of 9.4 per cent over 1916 and 24 per cent over 1919.

Safe Contract Form Sought

In an effort to make contracts safe the National Association of Purchasing Agents is co-operating with various trade, manufacturing, and professional associations in the United States and Canada. The aim is to arrive at a co-operative contract form which can be standardized, and when universally accepted and established will result in a crystallization of business opinion toward living up to contractual obligations. Each of the national commodity committees will work out a contract meeting with its specific needs, which, in turn, will be presented to the particular trade, manufacturing, or professional organization interested, from whom suggestions and revisions will be secured. If necessary, conferences will be held at which time mutual agreements will be arrived at. When these various commodity contracts are worked out they will be turned over to the standardization committee, which will then draw up a basic standard form of contract meeting the need of every industry. Then, in conjunction with the commodity committee, the standardization committee will make provisions for each special commodity requirement.

Miller Charges Antiquated Port Methods in Plea for Treaty

Governor Miller of New York, at a hearing in Albany, March 15, 1921, on the bill providing a port treaty with New Jersey, charged that the city administration of New York City was in a large measure responsible for a lack of progress in improving antiquated port methods and facilities. His charge was contained in a plea for the passage of the Meyer-Adler New York-New Jersey Port Development Bill.

"To my knowledge," said the Governor, "for at least twenty years the port problem has been an acute problem in the City of New York. You who studied this problem know that the terminal facilities of that port are at least fifty years obsolete, if not more."

The group of organizations favoring the treaty bill, who were present, include: The New York Board of Trade and Transportation, the Merchants Association, the Harlem Board of Commerce, the City Club, the Citizens Union, the Broadway Association, the Fifth Avenue Association, the advisory council of the real estate interests, the Central Mercantile Association and several up-state chambers of commerce.

"While piers have been lengthened," said Governor Miller, "the gentlemen who did that did not stop to think that with the immensely more freight that would have to be handled it would even be necessary to make the piers wider.

"Now, I say that twenty years is certainly long enough to wait before the State could step in."

Constitutionality of Donnellly Law Challenged

Counsel for the members of the Association of Dealers in Building Materials and the Builders' Supply Bureau, New York City, defendants in an indictment charging violation of the Donnelly anti-trust law, have demurred to the indictment and have challenged the constitutionality of the law under which their clients were indicted. It is understood that sustention of the demurrer to the indictment would mean the loss by the state of power to control the monopoly of any commodity. The chief counsel's main contention as to the unconstitutionality of the law was based upon the fact that farmers, dairymen and others were exempted, making the law discriminatory class legislation.

Indianapolis Track Elevation Will Proceed

Doubts as to whether track elevation in Indianapolis would begin this year have been dispelled by advices that the railroads' plans for a crossing over Washington St. at Noble St. will be completed in a few days and will be submitted for city approval. Plans of the Lake Erie & Western R.R. for a freight house at the south end of the track elevation are reported to be under study.

Tax Exemption Bill Stimulates Building in New York

Passage of the tax exemption bill by the Board of Estimate, New York City, Feb. 28, has had marked effect on building in the various boroughs of the city, according to reports emanating from the bureaus of building. Little effect of the bill's passage has been noticed in Manhattan, but in the Bronx in the period between Feb. 28 and March 14 permits were issued for the construction of three tenements, housing 157 families, and costing a total of $675,000, and for forty-eight dwellings, housing sixty-one families, costing a total of $274,250.

During the same period of 1920 permits were issued for the construction of one tenement costing $250,000 and housing fifty-eight families, and twenty-five dwellings, costing $308,000 and housing forty families. This represents a substantial increase in the amount of building undertaken during January and February of this year, permits for two tenements and thirty-five dwellings, capable of housing a total of 153 families and costing a total of $685,700 being issued in the latter month, and permits for one tenement and twenty-seven dwellings for sixty-nine families and costing $276,900 being the record for January, 1921.

In the borough of Brooklyn permits aggregating in value $2,169,117 were issued during the week ending March 12, 1921, as compared with $1,372,705 during the week ending March 5, 1921, and $2,024,470 for the week ending March 13, 1920. Though no total figures are available showing what the effect has been in Queens the assertion is made by those in the bureau of buildings that permit applications for residential building have greatly increased.

Detroit Begins Work on 82 Miles of Street Railway Track

The 1921 construction program of the Detroit municipal street railway was started March 1, with a view to completing an organization and acquiring an equipment to construct the 82 miles of the proposed street railway track at the rate of one mile of track per day. The tracks are to be built and equipped, under the provisions of the ordinance passed April 5, 1920, when a bond issue of $15,000,000 was approved by the voters of Detroit for the purpose of acquiring a municipal street-railway system. Present plans call for the carrying out of the construction program by city forces rather than by contract, with a view to materially lessening the first cost of construction. Joseph S. Goodwin, general manager, is in charge of the work.

Twelve steam shovels have been purchased for excavating for track foundations. Other equipment purchased includes eight clamshell buckets, six 6-ton rollers and four arc welding machines for welding rails. Slag and broken granite aggregate for the concrete track foundation has also been purchased. The city is asking for bids on 11,200 tons of steel rails with all the necessary special work, 40,000 twin steel ties, 100 Peter Witt type double-truck single-end trolley cars, and 25 one-man safety cars similar to those now being operated over the municipal lines. A site is being condemned and plans are being completed for a car barn and repair shop estimated to cost approximately $1,000,000.

$179,000,000 for Canadian Government Railways

A total appropriation for the railways of upward of $179,000,000 is included in the estimates of the Canadian government for the fiscal year ending March 31, 1922, which were presented to Parliament by Sir Henry Drayton, Finance Minister, March 8. Of this amount $165,687,633 is for loans to the Canadian Northern, the Grand Trunk, and the Grand Trunk Pacific, to be secured by mortgages. The deficit of government-operated railroads in 1920 is reported as $49,250,000.

Definite information is lacking as to the exact situation of Grand Trunk financing since the property has not passed entirely into the hands of the government, but it is estimated that some $57,000,000 will be required for current and overdue liabilities, operating deficit, payments for sinking fund and refunding purposes and necessary capital expenditure.

Out of a loan of $50,000,000 to the Canadian Northern provision will be made for betterments, new construction on the Western lines and equipment.

During the year the wage bill was considerably increased by the adoption of the McAdoo award. Hon. Dr. J. D. Reid, Minister of Railways, in discussing the estimates said that the high cost of railway operations, caused by the increased wages, had done a great deal of harm and would ruin the railway development of Canada.

American Exhibit for Peruvian Centennial Exposition

American manufacturers and merchants are to be given an opportunity to exhibit at the Peruvian Centennial to be held this year in Lima, in celebration of the hundreth anniversary of Peruvian independence. For the centennial the Peruvian government has voted approximately $3,000,000. Concessions have been granted to the Peruvian Centennial Exhibits Co., 42 Broadway, New York City, and to A. Smeraldi, Lima, Peru, for the allocation of exhibit space.

More Men Taken on by Steel Concern

Owing to improved conditions in the steel industry the Colorado Fuel and Iron Co., Pueblo, Col., employed 1,000 additional men March 14, press reports indicate. Four idle mills reopened, running two eight-hour shifts.

Railroads and Unions Confer in Wage Dispute

Immediately following the individual actions of most of the large carriers looking to curtailment of forces and reduction in existing wage scales members of the executive committee of the Association of Railway Executives met with officials of the four big railroad brotherhoods in Philadelphia March 14, 1921. Although no announcement was made of the proceedings it was stated that "satisfactory progress was made" in discussing "matters of common interest."

In addition to Thomas DeWitt Cuyler, chairman of the Association of Railway Executives the following members of the association were present: W. W. Atterbury, Pennsylvania Railroad; A. H. Smith, N. Y. Central; C. H. Markham, Illinois Central; E. V. Loomis, Lehigh Valley; A. B. Harrahan, Chesapeake & Ohio, and Hale Holden, Chicago, Burlington & Quincy. The brotherhoods were represented by their presidents.

Wages in Montreal Building Trades Drop Ten Per Cent

At a recent general meeting of the Montreal Builders Exchange a revised schedule of wages to be paid employees in the building industry showed a reduction of 10 per cent. The new schedule is as follows: Unskilled labor, 40c. an hour; carpenters, 65c.; bricklayers, 90c.; plasterers, 75c.; painters, 60c.; cement finishers, 60c.; masons, 60c. to 85c.; stone cutters, 75c., and planer men, 60c. The new wages, except those paid stone cutters and planer men, are now in effect, these two classes to suffer a reduction at the expiration of existing contracts—May 1.

Extensive Road and Paving Work Contemplated

Examination of the construction news of this issue of *Engineering News-Record* indicates that many states, besides those undertaking large programs of improvement, are preparing for spring work. Among the larger builders Ohio will receive bids until April 8 for the construction of 45 miles of various types, upon which the engineer's estimate is for the fifteen projects advertised $1,676,437. New York will open bids March 18 for the construction of about 95 miles of highways, divided among twenty-two projects. As noted elsewhere in this section, Pennsylvania will soon open bids for the construction of close to 90 miles.

Among the smaller states Maryland will receive bids until March 22 for the construction of seven miles, most of the work to be concrete. Tennessee advertises that it will receive bids on about 28 miles of modern-type surfaced roads until April 8. Massachusetts has outlined a comprehensive system of bid receiving whereby available funds—close to $7,000,000—are to be spent on contracts awarded at two- or three-week intervals until mid-September.

In addition to proposed and advertised work, scattering street and highway improvements actually put under contract during the week past total approximately $3,000,000. Miscellaneous building continues more or less active, thirty-eight contracts calling for an expenditure of $5,796,382 having been let.

Africa Asks American Bids

Contracts for grain elevators and equipment for railway electrification are offered in this country by the South African Railways and Harbors, a department of the government of South Africa. Material for the Cape Town-Simonstown suburban line and the Durban-Pietermaritzburg section of the main line includes electric passenger, freight and switching locomotives, electric motor cars and car equipment, substation equipment, transformers, boilers and boiler-house equipment, turbo-alternators and condensing plant. Merz & McLellan, London, England, are the consulting engineers for the electrification, which was noted in *Engineering News-Record* of Jan. 29 and Sept. 16, 1920, pp. 227 and 558, respectively.

The elevator contracts include a terminal elevator of 42,000 tons capacity at Durban, a 32,000-ton terminal elevator at Cape Town, 17 country elevators of 3,000 to 5,800 tons and 17 of 1,800 to 2,600 tons capacity. Bids for elevators will be received until May 2 and for electric plant until May 3 by the High Commissioner of the Union of South Africa, 32 Victoria St., London, England.

Pennsylvania to Open Bids on Ninety Miles of Highways

Until April 1 the state highway department of Pennsylvania will receive bids for the construction of approximately 90 miles of highways. The projects number eighteen, and the prevailing type of construction is to be reinforced concrete, though alternate bids will be received upon considerable hillside brick and bituminous macadam. The longest project advertised is 22 miles in length.

Nevada Commission Against State Making Cement

After an exhaustive study a commission authorized by the 1919 legislature of the state of Nevada has reported to the governor of that state the inadvisability of the state erecting and operating a cement manufacturing plant. The commission found that a liberal estimate of the yearly consumption of cement within the portions of the state that would be available as markets would be in the neighborhood of 60,000 bbl. The basis upon which the report was made was the construction and operation of a plant of 200 bbl. per day, though unit costs were estimated on the basis of 200 and 250 working days per year. Exclusive of the money involved in acquiring a site the commission estimated the first cost in the neighborhood of $400,000 and the sum of fixed charges, operating costs and maintenance an additional $300,000. It advised the governor of the state that using as a basis 100,000 barrels per year produced in 200 days, the unit cost would be $2.565 per barrel. Based upon 125,000 barrels or an operation of 250 days the cost would be reduced to $2.406. The commission gave the opinion that a more logical per barrel cost would be in the neighborhood of $3.25 a barrel.

The members of the commission were H. P. Boardman, chairman, college of engineering, University of Nevada; and J. C. Jones and F. M. Cottrell.

Organized Labor of Boston Enters General Contracting Field

The general contracting field in Boston has been invaded by organized labor, the building trades union construction and housing council being recently chartered. The council is incorporated and assumes the legal responsibilities of a corporation. No paid union official can hold office in the council, which is made up of laborers or mechanics in the construction industry. The corporation is capitalized at $100,000 divided into $10 shares. There are nearly 1,000 subscribers already, and leaders point out the fact that because there are 42,000 union men in the building trades in Boston, more money can be easily raised. Ten shares is the maximum shareholders may buy.

The establishment of a co-operative bank is being considered. Materials will be secured on the co-operative basis, and all material sources which can be financed successfully by the council will be co-operatively developed and operated.

Heavy Motor Crane Combines Mobility and Flexibility

Mobility and flexibility are combined in a comparatively new motor crane designed and built by the International Motor Co., Cleveland. The crane itself follows the usual lines and is the product of designers who have had years of experience in crane and derrick construction. It is of full-swinging, self-contained type, rotating through 360 deg. and is driven by a separate, four-cylinder gasoline motor which is built

DEMOUNTABLE CRANE HAS MANY CONSTRUCTION USES

with an extra large flywheel so as to run smoothly in spite of sudden application and release of loads. The capacity of the crane is 8,000 lb.

The particular advantage of this crane unit is its ability to move rapidly from place to place. This makes it especially adaptable for operations which must be undertaken quickly or for work of short duration.

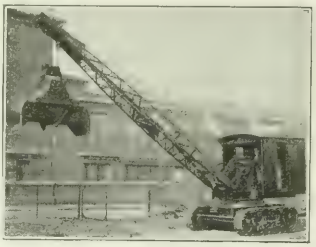
Some of the special uses to which equipment of this type may be put are: Clearing streets of wreckage resulting from fire or collisions; handling trolley rails; and setting up heavy pieces of machinery.

General uses of the crane include setting trolley and telegraph poles, and, fitted with a clamshell, unloading bulk material such as sand, gravel or crushed rock. It is also adaptable to excavating work.

As the entire crane is demountable, the truck chassis may also be used for general transportation purposes.

New Small-Capacity Crane

To fill a need for a small-capacity high-grade crane for use by the general contractor, the Brown Hoisting Machinery Co., Cleveland, Ohio, has developed the Brownhoist No. 2 locomotive crane. The small model is adaptable to a variety of construction uses.



BROWN-HOIST CRANE NO. 2

The machine can be changed in a few minutes' time to handle either a grab bucket, bottom block, or lifting magnet. With these attachments, practically all kinds of material can be handled. All models are self-propelling and when mounted on railroad trucks may be used for switching or loading cars. In order to meet the various working conditions the new cranes are made to operate by steam, electricity or gasoline engine. They are built for use on railroad trucks, traction wheels or creeper trucks, and are built to handle a 1-yd. bucket with loads up to 5 tons, or a 36-in. magnet.

Freight Car Surplus Large

According to an announcement made the middle of February by the car service section of the American Railroad Association a surplus then existed of 358,065 freight cars, this in comparison with an actual shortage of approximately 150,000 cars in the same period of 1920.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Mar. 3.

	New York	Chicago	Atlanta	Minneapolis	Denver	Dallas	San Francisco	Montreal
Steel Products:								
Structural shapes, 100 lb.	$3.58	$3.58	$4.25	$3.86	$5.90	$3.75	$4.70	$5.75
Structural rivets, 100 lb.	5.08	5.08	....	5.50	6.90	8.50	7.05	8.50
Reinforcing bars, ¾ in. and larger, 100 lb.	3.00	3.48	3.75	2.88½	4.37½	3.88	3.75	4.50
Steel pipe, black 2½ to 6 in. lap, discount	39%	53½%	46.65%	46.95%	29@33%	40@45%	36¾@42¾%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	64.10	64.00	67.80	70.00	66.20	87.65	90.00
Concreting Material:								
Cement without bags, bbl.	3.10	2.17	3.00	2.60	3.10	2.85	3.09	4.28
Gravel, ¾ in., cu.yd.	3.00	2.75	2.62½	2.00	2.50	1.75	2.50	1.50
Sand, cu.yd.	1.25	2.75	1.52½	1.75	1.10	1.75	1.65	1.50
Crushed stone, ¾ in., cu.yd.	2.15	2.75	2.50	2.25	3.50	3.20	2.50	2.10
Lime, finished, hydrated, ton	21.00	20.00	18.00	29.00	32.00	25.00	25.40	32.00
Lime, common, lump, 200 lb. bbl.	3.30	1.65	2.00	2.00	3.20	2.50	2.25	1.60
Miscellaneous:								
Pine, 3x12 to 12x12, 20 ft. and under M.ft.	50.00	55.00	37.50	42.00	47.00	45.00	28.00	120.00
Common brick, delivered, 1,000	27.70	15.00	12.50	18.00	16.00	25.00	18.00	18.00
Hollow building tile, 4x12x12, block	not used	.12	.14	.10	.10	.21	.12½	.25
Hollow partition tile, 4x12x12, block	.2444	.108	.15	..	.10	19½	.14½	...
Linseed oil, raw, 5 bbl lots, gal.	.73	.85	.77	.82	.97	89	.79	1.13
Common labor, union, hour	.75@.80	1.00	.35	.50	.50@.63½	.60@1.00	.81¼	..
Common labor, non union, hour	....	.60@.65	.25	.50	37½@.50	.40@.60	.50@.55	.30@.40

EXPLANATION OF PRICES—**New York** quotations are at warehouse, except cement and brick, which are delivered, and tile, which are "on trucks." **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses, except C. I. pipe which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Montreal** quotes sand, stone and gravel per ton, and lump lime by the 100-lb. bbl. No organized common labor in Montreal.

Changes Since Last Week

New York dealers report that they are now figuring their profit on brick at 10 per cent instead of at 15 per cent. The present price to users is cost - plus - cartage - plus - 10 per cent, which, with brick at $18 alongside dock, figures $21.70. Hollow tile is still quoted as in the Mar. 3 price section of *Engineering News-Record*. For small quantities of pine delivered on the job the cost is about $80 for 3 x 12 to 12 x 12, 20 ft. and under, the trucking charge being $2.50 per M ft. b.m.

Chicago contractors' associations have offered building trades new agreements effective May 1, reducing skilled labor from $1.25 per hour to $1, common labor from $1 to 90c. Unions have as yet refused to sign. It is reported that the contractors will entertain no other proposition, which means a fight for the open shop unless the unions surrender.

Denver contractors announced a 20 per cent wage reduction for Mar. 17, but the unions have not yet accepted. About 25 per cent of the building trades are reported working.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN
Editor

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Studying Concrete Plant

THE report of the committee on contractors' plant of the American Concrete Institute, abstracted on another page, is a real step forward both in the business of contracting and in the art of making concrete. Everyone knows how contracting has progressed from the old days of haphazard planning based purely on experience, but the scientific balancing of available plant layouts suggested by the report is plain evidence of the business-like conduct of a modern contracting operation, especially as the report is not the work of a group of theorists but of practical contractors representative of the best in the concrete industry. The report shows, too, that the mixing and placing of concrete is not an established art in which nothing can be learned, but that side by side with the current studies of how to make concrete better are going equally scientific studies of how to make it cheaper.

To the Credit of Engineers

REORGANIZATION of the Government departments at Washington is evidently going to be one of the first orders of business of the new administration. The President has several times advocated it, only last week Secretary of War Weeks said it was the essential preliminary to fiscal stability and Secretary of Commerce Hoover is probably the leading proponent of the idea of departmental reform. If something is done, whether it be a complete realignment of offices and functions or merely the establishment of a Department of Public Works, it will be a point scored for the engineering profession in its effort to prove to the world that it is entitled to have more say in the conduct of the world's affairs. For many years publicists and politicians have seen the waste in the conduct of governmental business and have periodically urged reform, but their efforts were sporadic and easily discouraged. The engineers, on the other hand, were organized and resourceful, with a propaganda backed up by scientific facts. Unquestionably their campaign, favored by the critical financial situation, has forced official recognition of the inefficiencies of Washington.

Machines vs. Manual Labor

A STRIKING example of the substitution of machinery for manual labor is afforded by the grain-car dumping equipment installed by the Pennsylvania R.R. at Baltimore and described in this issue. It is reported that the device has made it possible to eliminate sixty-eight men. This example is unusual only in that the new machine is so large and of such striking design. In all lines engineers are daily following out what the Pennsylvania has so well done at Baltimore—substituting mechanical for human power. But it is only when there is some dramatic step that we recall the developments over a considerable period and realize how rapid the progress has actually been. In construction machinery, for example, we need cite only the development of paving mixers, of sub-graders, of concrete road finishers, of back-fillers and wagon-loading elevators to indicate where we stand today compared to ten years ago. And the end is not yet. With growing scarcity and cost of labor (considering only natural developments and neglecting the war disturbance) this constant increase of mechanical power devices must continue. The possibilities have not yet been exhausted.

Stimulating Self-Analysis

THE REACTION of the industries chosen to be surveyed by the Committee on the Elimination of Waste in Industry promises that the committee's work will result in a reawakening of our industrial leaders to the need of searching analysis of their operations. We had such an awakening of interest approximately ten years ago when the scientific management movement came into prominence. For various reasons that movement has been largely discredited among manufacturers. That its thesis was sound no one will deny; the methods in many cases, and particularly the alleged management specialists, may have been open to criticism. There is reason for hope that the prejudice may in large part be wiped out through the waste survey now in progress. Manufacturers have repeatedly said that they themselves need to know the things about which the committee is inquiring, and which can be learned from analysis of available data. If this sort of self-analysis can be encouraged throughout industry the committee, and consequently the Federated American Engineering Societies, will have made an important contribution to American economic life.

Harbor Terminal Design

THERE is growing recognition of the importance of better harbor terminals to maintain our place in world trade. The normal times that are coming will not see ships tied up for weeks waiting for cargoes. Other things equal, they will go where the best facilities exist for most economical discharge and loading and quickest turn-around. Here, then, the design of the harbor terminal—not only piers and handling equipment, but also railroad layout—plays an important rôle. For heavy tonnage and fast movement the water-front plan is helpless without the land facilities. Track layout, combined with any necessary warehousing, must be adequate for railroad switching operation and storage. If not the whole operation is slowed up. Although this is an obvious truth, lack of co-ordinating land and waterfront facilities has too often been manifest; the pier engineer and the railroad engineer have designed plants without effective liaison, or either the one or the other has designed the whole layout. Without such liaison, or without a directing designer equally familiar

with rail and ship operation, there is always the likelihood of inadequacy in some respect. The plant as a whole must be considered as a freight-handling and transportation machine. Design must be based upon necessities both of rail and of ship operation.

Filtration of Great Lakes' Water

ONE by one the large cities on the Great Lakes are falling into line for water filtration. Cleveland led the way. Its plant has been in use for some time. Detroit is at work on a filtration project. Milwaukee is in what it is hoped will prove to be only a temporary state of hesitancy and debate. A report recommending water filtration for Buffalo is noted in our news section this week. Most of the smaller cities taking water from the Great Lakes adopted filtration before the larger ones did so. Chicago, largest of all the lake cities, stands alone in having made no definite move for filtration. It still depends upon its sewage diverting drainage canal, its long intake tunnels, and chlorination for water safety. Buffalo, with local conditions pointing strongly toward filtration both for safety and general cleanliness of its water supply, has only chlorination as a defence against pollution. Now that Buffalo is reducing its enormous water waste it is in position to build filters without much if any increase in water rates. Even if a material increase in rates would be required Buffalo should have filtered water.

Concrete Road Reinforcement

CONCRETE road reinforcement design is notoriously indeterminate. For years it has been suggested and used as a remedy for the obvious ills of settlement and cracking but analysis of stresses, with consequent accuracy of location and of size, has been lacking. The road as a structure is now receiving the studious attention it deserves but so far research has not offered any definite solution of this reinforcement problem. Meanwhile, the new design for Illinois, made by Clifford Older and outlined on another page, has a rational qualitative, if not quantitative, basis. There is no attempt made to resist cracking but merely to localize it longitudinally, and the rôle of the novel bondless reinforcement along the road edge is merely to prevent vertical movement once cracking has occurred. The danger in a crack being manifestly in the vertical movement of its edge pieces, the idea thus put into the design is promising.

Pavement Design in Illinois

FOLLOWING his statement of principles in *Engineering News-Record*, May 8, 1919, p. 905, and Feb. 3, 1921, p. 210, Clifford Older, state highway engineer of Illinois, in presenting the slab construction noted in the preceding paragraph, rounds out for the moment the record of a notable effort to produce a logically designed rigid pavement. This process of developing the new slab structure deserves especial recognition now when highway engineering thought is turning to research and analysis for a determination of the proper basis for paved road design. Emphasis on the paved road as a problem in design has been notable in Illinois practice. At the beginning this led more particularly to refinement of construction details. Lacking, because of the advent of the motor truck, even approximate knowledge of traffic stresses and wholly without definite information of foundation soil behavior, the only possible engineering means of safeguarding paved road surfaces appeared to be a heavy slab fabricated with care to develop the strength of the material. Further improvement, it was quite as plain to the engineers of the department, required facts regarding subgrade and traffic action on the pavement slab. It has been by its labors to determine these facts that the state highway engineering department in Illinois has established a claim to leadership in pavement design. True appraisal of the pavement design described has seemed to demand the background which has been sketched. This design is admittedly tentative; a tentative design is all that is possible with the present knowledge of paved road behavior. It is, however, true design as this term is understood by engineers, and not the product of trial and failure as have been all pavement slabs hitherto laid down. To this degree at least the development is unique in the actual practice of paved road building.

Ultimate Strength and Pin Stress

WHEN very high strength is displayed by a material or type of member it becomes pertinent to consider whether this strength may safely be utilized. So in the case of the remarkable test values for bridge pins, brought to attention anew by the review on page 502 of this issue. Under former practices in fixing stresses —by referring them to ultimate strength, and applying a factor of safety, as three, or five—there would be no doubt that high test strength would be reflected in high working stresses. But the view held in recent years is that safety should be rated on elastic-limit strength, chiefly because this latter is very often the effective ultimate strength in service. Not only are many structures of such constitution that general failure supervenes when any one element begins to yield, but the general liability of structural metal to sudden fracture due to brittleness, local injury or other interference with plastic distortion has the effect of wiping out the difference between ultimate and elastic strength so far as use is concerned. Pins, however, are outside the scope of these considerations. Unlike all other structural members they appear to be immune against premature fracture. Further, when a pin becomes unserviceable, through either bending or grooving, it does not at once endanger the structure. In sum, pins can be counted on to stay in place and hold the structure together up to ultimate testing-machine load. This lends increased meaning to the high test figures, since they may be interpreted in conformity with old-time practice as the direct gage of working stresses.

How Shall Engineering Practice Be Limited?

MUCH attention is being given in New York State to the proposal to repeal the clause in the engineers' licensing law allowing corporations and partnerships to practice engineering. The question having been raised, it is quite likely that the issue will be made a national one. If so it will have to be opened up in the American Engineering Council, for the New York clause it is proposed to repeal is in accord with the former Engineering Council's model licensing bill. In other words, the council's bill would permit corporations and partnerships to practice engineering provided the engineering work done by the corporation or partnership be under the direction of licensed engineers. In neither

case is the corporation or partnership itself licensed, though that, practically, is the effect of the provision. It is to be noted that those who want the corporations and partnerships excluded from practice are careful to use the term "unrestricted partnership." The term is not clarified in the petition (see page 518), but is explained by those responsible for it to mean partnerships in which non-engineers may be members. They do not object to practice by partnerships in which every member is a licensed engineer. Obviously, this is a logical position, for it restricts the practice of engineering to those who have the proper qualifications. This point not having been brought out strongly in the petition against corporate and partnership practice has not received attention from the opposing side. In the course of future argument, however, this qualification of the type of partnership should be given consideration.

Again, we reiterate the importance of the question. It should have immediate, thoughtful and widespread discussion.

Government's Report on California's Highways

SOME months ago a report was made to two of the large California automobile clubs regarding the condition of the California highway system. This report had a critical air, a fact brought out in our comment thereon in the issue of Feb. 10. Later the California Highway Commission itself made reply to the criticisms, and now we have what may be considered the final evidence in the case—a report by the U. S. Bureau of Public Roads.

The latter report, made by Dr. L. I. Hewes, the bureau's general inspector for the West, was abstracted in the *Engineering News-Record* last week, p. 469. That brief abstract will give the experienced highway engineer confidence in the report, for even the abstract bears evidence of a full grasp of the subject, of remarkable thoroughness, and of impartiality. But the abstract does not do the report justice. It is a remarkable document. Nothing like it has ever been written before, a fact that will come home to engineers when the printed copies are available. It breaks new paths in several directions, and will, we believe, be the groundwork on which investigation of a similar sort will be based for many a day.

With that in mind it is worth while examining the conclusions. The clinching fact is in this finding: that of a total of 1,262 miles of concrete pavement 87.5 per cent is in Class A, B or C condition (which may be described as good or better than good), while only 12.5 per cent is in the inferior classes, D, E and F. This rating is on a *definite quantitative basis*. When it is remembered that this concrete pavement is practically all 4 in. thick, that the use of this thin slab has made it possible to give a large part of the state good highway service, and that the design was determined nearly ten years ago, before the heavy traffic came, there can be no other conclusion than that, measured by results, the California Commission's work has been a success. The bureau's report does not agree with all the commission's policies; in fact it suggests many changes, but back of the results above quoted it is not possible to go. The bureau's view is well summed up in this paragraph of the report:

"It cannot be said in 1920, in the light of the fact that the great usefulness of the highway system is now proved, that the state would have realized its usefulness and provided funds in equal volume had not the system been extended as rapidly as it was and at some sacrifice of either temporary or ultimate durability to increase mileage. There appears, however, to be serious question, in the light of the fact that 70 per cent of the defective pavement of classes D, E and F occur on clay and adobe soils, as to the wisdom of the policy which continued the risk of a thin slab on such soils. It is undeniable, however, that a large mileage of the same thin pavement on adverse soil still remains of classes A, B and C. We find, however, no conclusive final demonstration of the best construction on the adverse soils, and in that respect failure to vary the designs on such soils in the past has postponed the solution of this problem."

As was to be expected, it was found that all was not perfect in the commission's management, that some things should have been done which were not done, and some things should have been done differently, but when all is cast in the scales, the good in the one pan and the shortcomings and mistakes in the other, the result is such as to demand the highest praise for the commission's work.

The critics of some months ago will, indeed, find corroboration in part of the paragraph above quoted and in many other phases of the report, but their lack of sympathetic understanding, to which attention has already been called, stands out all the more clearly by comparison with the temper of the new report.

It was to be expected that the bureau would find the 4-in. slab inadequate (the commission itself has abandoned it in favor of a 5-in. reinforced-concrete design). It advises experimental sections on the unfavorable soils, suggesting that designs of not less than 6 in. in average depth, reinforced, will be necessary in view of the weight of traffic. It states that the famous California ¾-in. carpet coat does not give a service commensurate with its cost, a view largely held by highway engineers outside of California, and urges studies of traffic, fatigue of concrete, soils, and alkali. Finally, there is this important judgment on the California lesson with reference to concrete roads:

"There is nothing presented by the entire California study that indicates that concrete is not a successful pavement."

Only one of the features of the report which breaks new paths in highway study will be mentioned here: the simple, but satisfactory, method developed for classifying the condition of concrete roads. The other path-breaking methods will be discussed in early issues.

Heretofore we have had the qualitative gradings of "excellent, good, fair, poor," with their many variations. Quantitative descriptions seemed impossible. Yet the impossible has been done. The classifications worked out by Dr. Hewes are reasonable, simple and definite. As to the major features which make or mar the value of a concrete pavement, no ground is left for judgment. Such things as pitting and unevenness of original finish are excluded, but these exclusions are of minor importance compared to the covering of the principal features.

If the report, aside from its local significance, had produced nothing but this classification it would properly have merited special commendation.

Foundation of Multiple Concrete Ring Girders For New York Court House

Prevention of Unequal Settlement the Controlling Problem in Supporting Heavy Monumental Building of Hexagonal Ground Plan on Sand

By Carlton S. Proctor
Of Moran, Maurice & Proctor, Consulting Engineers, New York City

In planning the new court house for New York County at Worth and Centre Sts., New York City, Guy Lowell, the architect, found himself confronted by a most unusual foundation problem. Study of this problem by the firm of which the writer is a member led to a foundation design departing sharply from precedent. It is believed that the special requirements of the case, due to the nature of the building and to the ground conditions, are fully met by this type of foundation. It consists of a series of ring girders, each supporting a ring of columns (in one case two parallel rings of columns), and capable of equalizing any tendencies toward irregularity of settlement.

Sand subsoil is found at the site of the court house, to great depth, and it was necessary to support the building on this sand. Because of the nature of the building, it is of large ground plan area. Differences of settlement are therefore a possibility that must be considered, while on the other hand the monumental character of the structure made it imperative to prevent settlement of a kind that might result in cracking of the structure. Groundwater conditions also affected the design, as will appear.

In 1914, after a competition for designs, the Court House Board accepted plans submitted by Mr. Lowell, which contemplated a circular building 400 ft. in diameter, of highly ornamental character. Above ground the proposed structure consisted of a steel-frame masonry building forming in effect six concentric rings, each comprising a series of columns and walls.

Located on an irregular site between Centre, Worth, Baxter and Pearl Sts., the building occupied a portion of the old Collect Pond, shown on early city maps. Under the circumstances it was evident to the architect and to the engineers called in to advise him that unusual precautions should be taken to provide a foundation insuring the least possible inequality of settlement.

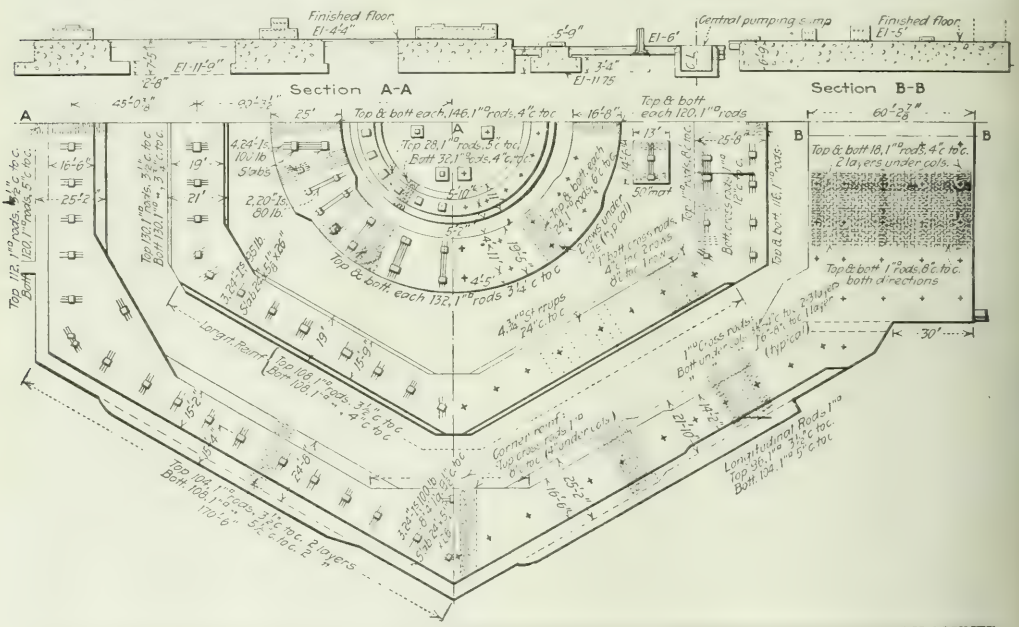


FIG. 1 PLAN AND VERTICAL SECTION OF RING GIRDER FOUNDATION FOR NEW COURT HOUSE, NEW YORK COUNTY

Exploration of the site by borings was conducted in 1914. Seven pipe borings were taken by a method furnishing dry samples; nineteen wash borings were made, and seven test pits were sunk. The results showed that rock occurred in a few places at a depth in the vicinity of 150 ft., but over most of the site was below 210 ft., the limit of the exploration; that the surface material was artificial fill, including at one point the refuse of a tannery, overlying a deposit of fine sand, clay, silt and peat; but that about 33 ft. below curb, or El. —15, sand, or gravel was encountered over the entire area. The borings indicated that this

sand and gravel deposit was continuous and extended down to the limit of the borings.

It was evident that the building would have to be founded in this sand and gravel stratum and that a thoroughly substantial foundation was afforded by it, but that this foundation would inevitably be of somewhat compressible character, when considered in relation to the high demands for prevention of differential settlement of the building.

At this time the depth of water in the soil was 14.5 ft. below mean high water (the latter being datum). Groundwater at the present time is at El. +2. The former low level of the water undoubtedly was caused by long-continued pumping for construction of the Canal St. subway station, two blocks to the north.

Loading tests were made on the sand and gravel subsoil in the exploratory test pits. These confirmed the engineers in their opinion that the material would support the building safely.

Since the very great depth to rock made a rock foundation impossible, and at the same time the character of the material was such as to eliminate consideration of piles, it was evident that spread footings of some form had to be adopted. In view of the monumental and spread-out character of the building, careful consideration had to be given to the question of differential settlement. It was obvious, of course, that the footings should be carried down to the sand or gravel, and not rest in the artificial fill or the silt and mixed strata overlying the sand; but as the material did not vary in character below El. —15, it did not appear that there would be any advantage in going deeper. The importance and monumental character of the building also made it advisable to limit the foundation loading to very moderate values.

It was concluded that isolated footings for the various columns would be almost certain to settle nonuniformly. The material is variable in texture, and this, together with the inevitable differences in the physical condition of the underlying strata, would make even the most careful proportioning of the footing area an insufficient precaution against differences of settlement. The variation in live-loads was a further unfavorable factor. It was concluded that either some arrangement of combined footings or an integral foundation should be used. Grouping a number of adjacent column footings into a single foundation did not appear to allow sufficiently for the probable variations in foundation resistance over the site. A full mat foundation over the whole area, on the other hand, threatened to be of prohibitive cost, the more so as the indeterminate distribution of stresses would require the mat to be made thick enough to give an ample margin of safety. Two special arrangements of combined footings were therefore discussed, each being of a kind to average the physical conditions over a large area. In the one, a radial line of columns would have a common grillage or girder foundation; in the other these girders would be circumferential, or ring shaped, carrying one of the column circles in the framing of the building.

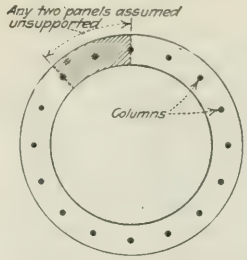


FIG 3. EXTREME LOAD ASSUMPTION

FIG. 2. NEW COURT-HOUSE SITE EXCAVATED TO LEVEL OF BOTTOM OF GIRDERS

As the architectural arrangement of the building was such that the walls and principal partitions ran circumferentially, radial equalization of settlement would be of little effect, whereas circumferential equalization by means of circular foundation girders would safeguard against cracking of walls and would leave no opportunity for harmful differential settlement except that which might occur between consecutive rings of columns, where it could affect at the worst some minor partitions. This circular girder scheme was therefore adopted.

It was not possible nor was it considered necessary to make the circular girders strong enough to carry the load under the extreme condition of support concentrated at two opposite points of the ring. Each girder was designed to transmit the entire load of any one column to the remaining part of that girder, on the assumption (Fig. 3) that the soil under the adjoining two panels had no supporting value. This simple assumption was found to represent a more severe requirement than various other possible inequalities of load distribution.

After a complete design had been made on this basis, a change in policy of the city government resulted not only in temporary suspension of work on the plans but in a subsequent complete modification of the build

ing project. In the fall of 1919 the architect was authorized to proceed on the basis of a revised plan, the revision providing for a building of hexagonal shape and only about 80 per cent as large in plan as the original circular building. The changes naturally called for complete redesign of the foundations, but the same general scheme was used. As will be seen from the plan in Fig. 1, one of the circular girders carries two adjoining circles of columns, while in the earlier project two girders were used here. The foundation is now under construction and is nearly completed. Rodgers & Hagerty, Inc., are the contractors.

In the final planning two comparative designs were worked out for the circular girders, as sketched in Fig. 4. One was of the type contemplated in the earlier planning, comprising a relatively thin concrete base slab and circular steel distributing girders resting on this slab. The other combined the slab and girder functions in a reinforced-concrete T-girder, in which the bearing-slab action was taken care of by the head of the T. The reinforced-concrete girder proved to be more economical as well as more adaptable and flexible in application to the varying conditions of the design, and it was therefore adopted.

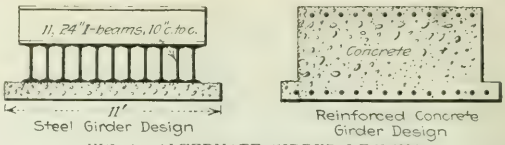


FIG. 4. ALTERNATE GIRDER DESIGNS

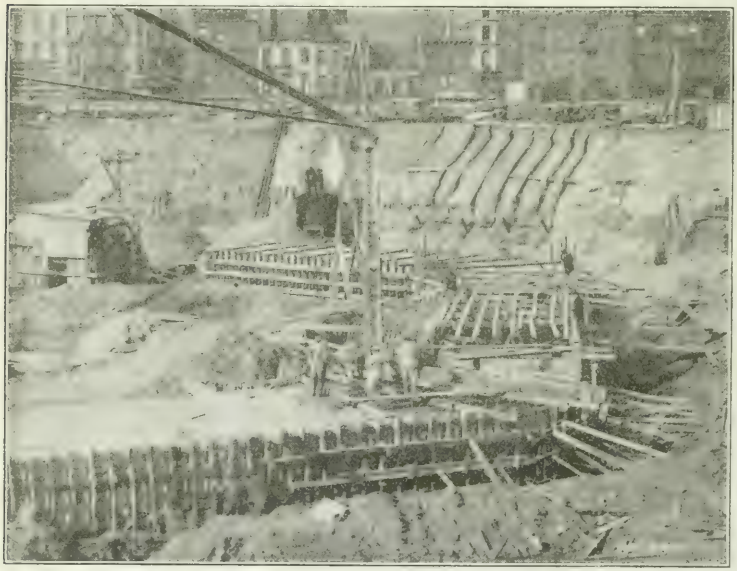


FIG. 5. CONCRETING ONE OF THE FOUNDATION GIRDERS

Uniformity of loading on the soil was obtained by varying the width of the girder base, or head of the T, while the unit stresses in steel and concrete were adjusted by varying the thickness of the stem of the T and the amount of reinforcing.

As designed, all portions of the foundation are subjected to a load of 2 tons per square foot of soil bearing area, under dead load. The proportions being adjusted for uniformity in this way, the design was checked for dead plus probable live-load; the base pressure in this condition does not exceed 3 tons per square foot at the points of highest live-loading.

In the execution of the design care was taken to insure that construction joints separating successive days' work—as it was impossible to cast each ring in a continuous operation—should not establish dangerous shear planes. To this end the construction joints were placed at the points of "minimum average" shear, or halfway between two of the lighter columns, and each joint was formed in a step, so as to give a lap or halved joint between the successive pourings.

In the original design, subgrade was at El. —15. The final design, however, took advantage of modifications made by the architect in the revised plan, and also of the fact that due to a slight change in the location of the building 92 per cent of the area of the footings would encounter the sand and gravel at a higher elevation, namely —11.75. Placing the elevation of bottom of girders at the latter level saved approximately 11,000 cu.yd. of excavation and a very considerable amount of concrete. It also greatly simplified the drainage problem, both during construction and during the life of the building. Under the portico on the Centre St. front, where the top surface of the sand and gravel bed is below El. —11.75, the excavation will be carried slightly deeper, as may be necessary to reach good material.

After the letting of the contract it developed that the groundwater level had risen from El. —14.5 to El. +2, as already mentioned. This was not entirely unexpected, as there was at this time no deep construction in the vicinity and consequently no pumping which would maintain groundwater at an unnaturally low level. A large part of the excavation, therefore, had to be made through water-bearing material. The contractor dealt with this difficulty by establishing a central sump, and reducing the water level as the excavation progressed; by the time footing level had been reached, the groundwater was drawn down sufficiently below this level to permit the casting of all the footings on undisturbed dry material. These means, while simple, were entirely effective in preventing any disturbance of the foundation bed by the large amount of water entering the excavation.

In general the excavation was carried down to a level approximating subgrade over the entire area. In the main part of the work, while the groundwater was being drawn down gradually, between 3,000,000 and 5,000,000 gal. of water per day were handled. When

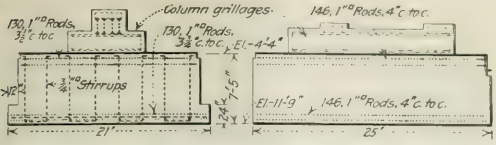


FIG. 6. CROSS-SECTIONS OF SINGLE AND DOUBLE COLUMN RING GIRDERS

the excavation had approached subgrade in any portion of the site, drains were placed below subgrade for collecting the water and preventing its flow upward through the floor into the excavation, thereby preventing the formation of springs and the disturbance of material by water action. In this manner an excavation 2¼ acres in area was carried 30 ft. below curb level and 14 ft. below groundwater level (Fig. 2) through material generally considered unfavorable for such work, and a bed of sand was utilized for the support of the building without permitting any disturbance of its natural compact character.

It should be said, however, that the design would not have been based on the execution of the work in this manner (in open excavation), had it not been that recent experience demonstrated the practicability of reducing the water level in the subsoil by proper drainage and pumping. The fact that the water level at this site had in 1914 been reduced over 15 ft. by adjacent pumping operations made it certain in advance that thorough drainage of the soil in construction was feasible.

In the revised design of 1919 the sub-basement floor was planned to finish at El. —4.33, and provision was made for a complete subsoil drainage system with Hydrolithic waterproofing on all exterior walls and the sub-basement floor. As the excavation progressed, it was found that the material at subgrade at the eastern end of the side was largely composed of gravel, which, while an excellent material for the support of the building, permitted the flow of a considerable amount of water. In view of these conditions and in order to save the city the cost of pumping during the life of the building, the substitution of a pressure-resisting floor for the simple concrete pavement over the spaces between the girder rings was recommended.

The history of the court house to date has been one of changes and delays, and at the present time all contracts except the foundation contract have been cancelled by the city authorities. The foundation work is to a large extent completed. The size of the work can be judged by the following approximate table of quantities involved: Area of excavation, 2¼ acres; volume of excavation, including an unknown amount of ash fill, 93,200 cu.yd.; concrete in footings, retaining walls, floor, etc., 19,970 cu.yd.; reinforcing steel, 1,450 tons.

Population of Japan and Its Cities

The first census of Japan, recently completed, shows a population of 55,961,140 for Japan proper, 17,284,207 for Korea, 3,654,000 for Formosa and 105,765 for Saghalien, or a total of 77,005,112, according to a Washington dispatch to the New York *Times*. The larger cities have populations as follows: Tokio, 2,173,162; Osaka, 1,252,972; Kobe, 608,268; Kioto, 591,305; Nagoya, 429,990; Yokohama, 422,942. Eight other cities have more than 100,000 inhabitants each.

Railway Ballast and Ballasting Methods

Abstract of report of Committee on Ballast, American Railway Engineering Association.

ON ROADBED MATERIAL subject to deformation under live load, the proper depth of ballast under the ties to produce approximately uniform pressure on the roadbed would be not less than the spacing of ties center to center. On material like good sub-ballast, which will not be deformed under live load, the minimum depth of ballast under the ties should be 12 in. These depths are required to give good drainage, to prevent heaving by frost and to form a cushion for the track. A combination of 18 to 14 in. of good sub-ballast and 6 to 10 in. of top ballast, making a total depth of approximately 24 in. under the ties, will produce nearly the same result as an equal depth of the superior material.

Stone ballast should be of such size that the pieces, in any position, will pass through a 2½-in. ring and not through a ¾-in. ring. Bank gravel for first class track should be washed and screened if it contains more than 2 per cent dust or 40 per cent sand; for second class track these proportions would be 3 and 60 per cent respectively. Screened gravel should contain not less than 25 per cent or more than 50 per cent of sand. Stone ballast should be cleaned at intervals of 1 to 3 years in terminals, 3 to 5 years on heavy traffic lines and 5 to 8 years on light traffic lines. From 15 to 25 per cent of new ballast will be required to maintain the standard section.

Hopper cars with a ballast plow or tie drag should be used in distributing ballast for raising track, but for ballasting a parallel track, side dump cars are preferable, especially when operated by air. Convertible cars having sides which swing out and upward, when used with the side plow and unloader engine, are fairly satisfactory when dump cars are not available. Anchoring the train and pulling the plow through it by a cable attached to the locomotive is a poor substitute for the unloader engine, but it is better than unloading by hand. With the spreader car, especially when operated by air, ballast deposited alongside the running track for a new second track can be spread to the outside shoulder and to a grade 2 in. below bottom of ties at a speed of 8 m.p.h. On a grading dump, in wet clay or rock, the spreader will do the work of fifty men and still be idle most of the time.

Ventilation Tests for Vehicle Tunnel

Investigations of ventilation for the Hudson River vehicular tunnel, as announced in the news section of this journal March 4, are being conducted under a co-operative arrangement between the U. S. Bureau of Mines and the New York-New Jersey Bridge and Tunnel Commissions. Flow of air in ducts and bends, such as will be used in the tunnel, is to be tested at the University of Illinois, where the Bureau of Mines has its central district experiment station. An experimental duct 300 ft. long is being constructed at Urbana and special 300-hp. motors and fans are being installed. The final check on the solution of the ventilation problems will be obtained in an experimental tunnel that is now being constructed in the experimental mine of the Bureau of Mines at Bruceton, Pa., just outside of Pittsburgh. An oval-shaped tunnel having similar construction of ducts to those proposed in the Hudson River tunnel and an axel length of 400 ft. is being constructed underground. The cross-section is large enough to carry a single line of automobiles. Studies will be made with respect to the following features: (a) Diffusion of exhaust gases in the cross-section of the tunnel; (b) temperature conditions as affected by the operation of internal-combustion motors; (c) physiological effects of temperature, exhaust gases, and smoke under operating conditions; (d) final check on all previous investigations.

Road Guard Rail Timbers Mounted on Concrete Pipe

System Adopted for Highways at Spokane, Wash., Is Cheap, Strong, Readily Visible and Safe

By A. D. Butler
City Engineer, Spokane, Wash.

In these days when there is an ever increasing number of automobile accidents, the engineer who has to do with the construction of highways, streets or boulevards, every year finds it more necessary to protect the edges of his fills or side-hill work by a suitable guard rail, one which is required to render an entirely different service from the guard rail or handrail of several years ago.

What is the problem of design in such rails? First there is the matter of cost. They must be as cheaply constructed as possible. And in the matter of first cost can be considered the length of time before they must be removed; or, in other words, the cost per year.

Second, the rail must be strong. While it is impracticable to build a structure that will withstand the shock of a heavy automobile driven at a high rate of speed, or that of a heavy truck, yet it should be strong enough so that after it has been run into by an automobile driven at a reckless rate, the repair man can come out

Concrete Pipe Used as Standards for Guard Rail

and haul off the remains of the machine, rather than send for the maintenance crew to repair the guard rail.

Third, it must be borne in mind that, in the vast majority of cases the machine that collides with the rail will do so almost parallel to the direction in which the rail is running; so, if possible, a rail should be used of such height as to have the tendency, when collided with in this manner, to permit the wheel to slide along it and crowd the machine back into the road, rather than to have any projecting posts to catch the wheel or hub and thus wreck the machine or destroy the guard rail.

The fourth requirement is that the rail should be readily seen both in the daytime and at night. With these fundamental requirements in mind, the writer has adopted the following form of guard rail with considerable success.

The posts consist of machine-made concrete pipe, made by the Spokane Concrete Pipe Co. with a Hammond machine. These pipe are 3 ft. long and 10 in. in diameter. A V-shaped templet is used in the bottom of the mold, such that when the pipe is made, an 8 x 8-in.

Guard Rail in Place on Road in Spokane

timber will fit corner wise in this V-shaped notch. These pipes are then filled with concrete and a bolt anchored in the center of the V, extending outward far enough to pass through an 8 x 8-in. timber corner-wise. The holes for the posts are dug, the posts stood in place and the timbers, after having been bored, are fitted into the V of the posts with the bolt extending diagonally through the timber. The posts are then lined up, filled and tamped around. The rail should be of such a height as to be just below the hub of an automobile wheel. In this way it furnishes the maximum protection to the machine with the least danger of catching the hub and wrecking the auto.

On a recent job, 1,600 ft. of this guard rail, constructed by the Street Department under Leonard Funk, commissioner of public works of Spokane, cost a total of $947.77, including the cost of all material and labor in finishing and painting. This made the rail cost 59c. per ft. The items of cost were as follows:

1,600 lin.ft. 8x8-in. timber	$361.12
202 posts	303.00
Cement	20.90
Paint	16.58
Washers	3.10
Paint brushes	6.17
Bolts	34.00
Labor	202.90

The following formula for whitewash has been used and gives very good satisfaction:

Half a bushel of unslacked lime; slack with warm water; cover it during the process to keep the steam; strain the liquid through a fine sieve or strainer; add a peck of salt previously dissolved in warm water; 3 lb. of ground rice, boiled to a thin paste and stir in boiling hot; ½ lb. of Spanish whiting and a pound of glue which has been previously dissolved over a slow fire, and add 5 gal. of hot water to the mixture; stir well and let stand for a few days; cover up from dirt. It should be put on hot. One pint of the mixture properly applied will cover a square yard. Small brushes are best.

Comprehensive Report on Water Supply of Kansas City

A COMPREHENSIVE report on the water-works situation of Kansas City, Mo., in printed form has now become available. In it are recommended a new intake from the Missouri River on the Platte-Clay County line upstream from the city in the State of Missouri, a low-lift and secondary pumping station and purification works, pressure tunnels to connect with the present Turkey Creek station and a proposed high-lift station on the East Bottoms and a new high-service station on the Nicholson Ave. site above flood levels.

Project Outlined

The project outlined is good for 108 m.g.d. and is estimated to cost $18,000,000 at present unit figures, but the engineering Board of Review considers the matter urgent and urges the city officials to push the matter with all possible haste since it will take seven or eight years to construct the works and by that time the present capacity of the existing works, which cannot easily be extended, will have been reached. The personnel of the board is as follows: Wynkoop Kiersted, chairman; C. S. Burns, George A. Johnson, Alexander Maitland and John Prince. The consulting engineers are Fuller & McClintock, New York City. From their report the following notes are taken:

A population of 700,000 expected in 1943 is to be provided for. This will be twenty years after the bulk of the bonds are dated and the state constitution provides that city bonds must be amortized in 20 years and the present generation ought not to be required to provide for works for a much longer period. In 1943 the average consumption is estimated at 104 m.g.d.; maximum for month, 125 m.g.d.; for week, 135 m.g.d.; for day, 145 m.g.d.; for hour, 178 m.g.d.; and for hour including fire draft, 205 m.g.d. If the water is to be sanitary, clear, free from color, tastes and odors and have a reasonably low hardness, filters must be provided.

The Missouri River proved on investigation the most economical and feasible source. The Ozark supply would require filtration, a 140-mile conduit and three pumping stations with an aggregate lift of 1,100 ft. at a cost exceeding $70,000,000. Well supplies are hard and require removal of iron as well as softening Lakes near St Joseph are insufficient in quantity. To take the Missouri water above St. Joseph involves a 70-mile aqueduct. While avoiding the sewage of Leavenworth, Atchison and St. Joseph it is nearer Omaha and analyses indicate at the lower point inappreciable pollution easily removable by filtration. Storage possibilities on the Kansas River are possible but the quality would be little better than the Missouri and conduits and lands for impounding reservoirs much greater, besides which the works would be subject to heavy taxation by Kansas. The site selected for the intake line within the state will be free from taxation, subject to local police protection and where power of condemnation is available for tunnels.

Utilization of the site of the Quindaro works, which lie in Kansas, for a new plant, involves heavy taxes. When the total annual costs are taken into consideration there is practically no advantage in locating new works at Quindaro in Kansas in order to utilize the existing investment there. The fact that it is not feasible to enlarge the Turkey Creek pumping station, together with the growth of the city to the east and south, makes it advisable to construct a complete new high-lift station in the East Bottoms. In connection with this station a covered equalizing reservoir will be required to balance the hourly peaks and to provide for fire drafts.

Estimated costs are as follows: Intake and protection, $1,013,000; river pumping station, low lift to filters and high duty through pressure tunnels to city, $1,300,000; purification plant comprising grit and reaction chambers preliminary settling basins, coagulating basin, rapid sand filters and filtered water reservoir, $4,485,000; concrete-lined pressure tunnels, 80 to 100 ft. below river and solid rock to river (22,000 ft. 7½ ft. diameter) with branches to Turkey Creek station (12,000 ft. 6½ ft. diameter) and to East Bottoms station (14,000 ft. 6 ft. diameter), $4,471,000; East Bottoms station and 20,000,000-gal. equalizing reservoir, $2,714,000; discharge main from East Bottoms station to distribution system, $2,400,000; distribution system and improvement of existing works, $1,600,000.

Filters, settling basin, pumps and boilers should be built with capacity for about ten years, but in general the works should be designed for needs up to 1943.

Immediate improvements of the existing works recommended are as follows: (1) Shut off sewer flush tanks and restrict street flushing, meter all services and continue plumbing inspections with a view to curtailing waste; (2) exercise vigilant and exacting laboratory control; (3) install a 50-m.g.d. pump at Quindaro station and a 30-m.g.d. unit at Turkey Creek station, (4) add valves to discharge headers at Turkey Creek to minimize the danger of throwing several pumps out of service in case of a break; (5) continue to develop gridiron system; (6) cover Turkey Creek reservoir, Holly St. reservoir and Northeast basin to protect them from contamination.

Basic Data

Basic data on which the five river projects were compared are as follows. Structures readily constructed piecemeal are estimated as of 1933, others for 1943. In 1933 the average daily consumption is estimated at 71 m.g.d. and the maximum, 100 m.g.d. In 1943 corresponding figures are 104 and 145 m.g.d.

The intakes have been planned for the maximum 1943 capacity. Of the low-lift and secondary low-lift pumping stations everything except the pumps and boilers have been planned for 1943 maximum capacity, but the first installation is for 1933 conditions. Force mains are planned for 1933 conditions.

In the purification works grit chambers with hopper bottoms are planned for 10-min. flow of 145 m.g.d.; the reaction chambers for 30 min. flow for 145 m.g.d., baffled to produce a velocity of 1 ft. per minute; of four preliminary settling basins having a combined capacity of 39 m.g., equivalent to 9 hours flow of 104 m.g.d., only three are to be built at first; of four coagulating basins having combined capacity of 52 m.g., equivalent to 12 hours' flow for 943 average conditions, three only are to be built, providing for 1933 conditions; eighteen 4 m.g.d. filters for the initial installation having 40 to 50 per cent overload capacity; head houses for average 1943 conditions with 40 to 50 per cent overload capacity in the application of chemicals; 2.9 m.g. filtered water reservoirs planned for 40-min. flow for average 1943 conditions; connecting conduits, gate houses, aerating devices and pressure tunnels for maximum 1943 capacity.

Aeration is to be effected at times by passing the raw water weirs 3 to 5 ft. above the grit chambers. In its fall into the chambers the water would be broken up by riffle boards.

In proportioning tunnels and conduits the Hazen-Williams formula was used, with $c = 120$ for concrete pipe, tunnels and conduits, $c = 100$ for cast-iron pipe, $c = 90$ for steel pipe.

The main tunnel would be driven 16,000 ft. of its 22,000 ft. without intermediate shafts, but for the smaller branch tunnels temporary shafts at 4,000-ft. intervals would be provided.

Road Types on Lincoln Highway

On the 3,305 miles of road forming the Lincoln Highway between New York and San Francisco the mileage of the different types of construction on Jan. 1, 1921, was as follows: Graded gravel, 956; graded earth, 725.67; concrete, 422.34; bituminous macadam, 401.81; macadam, 287.10; brick, 219.68; natural earth, 136.00; asphalt, 78; natural gravel, 62.10; granite block, 7.10; creosote wood block, 5.90; sand, 3.30.

Pneumatic Hand Shovels Hasten Tunnel Excavation

Shovel Blades Attached to Pneumatic Hammers Cut and Loosen Very Stiff Clay Without Picking or Blasting

By George C. D. Lenth
Consulting Engineer, Chicago, Ill.

PHENOMENAL progress in tunneling stiff clay has been made by using pneumatic shovels, in constructing a large sewage conduit in the south part of Chicago. In round figures, a foot an hour of completed tunnel is being averaged. This exceeds any local record and Chicago has built some scores of miles of clay tunnel in the last 25 years.

A three-barreled conduit had to be constructed, extending from the Calumet pumping station of the Sanitary District of Chicago, located near 125th St. and Indiana Ave., to the site of the proposed Calumet sewage treatment works now under contract, located just north of 125th St. and east of the right of way of the Chicago & Western Indiana R.R., a distance of 2,300

FIG. 1. COMPACT PLANT LAYOUT CONCENTRATED SURFACE OPERATIONS

ft. The three sections are constructed of reinforced concrete, the sizes being respectively 5½ ft., 7½ ft. and 9 ft., and the cross-sections, semi-elliptical. The purpose of the three-barrelled section is, first, to convey sewage from the pumping station through the 5½- ft. and 7½-ft. conduits under pressure, at a velocity sufficiently high to prevent sedimentation, to the sewage treatment plant, and, second, to convey the treated effluent back by gravity through the 9-ft. section into a large outlet conduit already constructed under the sewage pumping station. Thence the treated sewage is carried by gravity into the Sag channel, which carries it to the main drainage channel and the Illinois River.

Between the pumping station and the westerly main track of the Illinois Central R.R., a distance of 500 ft. there were a number of obstacles, such as a 5-ft. brick sewer, switch tracks, building material and the footings of the new power plant building, all of which had to be taken into account before the work started. From the west line of the Illinois Central right of way to the east line of the Western Indiana R.R. right of way, a distance of approximately 1,150 ft., the Illinois Central has more than 50 tracks, and the Western Indiana, 3 tracks. In accordance with the terms of the easements granted by the railroad companies, all work on their respective properties had to be carried on in tunnel. The contractor for the work located the shaft about 100 ft. west of the Illinois Central R.R., Fig. 1, and sunk a 30-ft. square shaft 29 ft. deep, installing a hoist, a concrete mixing plant, an air compressor plant, material track, cement shed, storehouse, blacksmith shop and office. Over the concrete mixing plant is a large heated

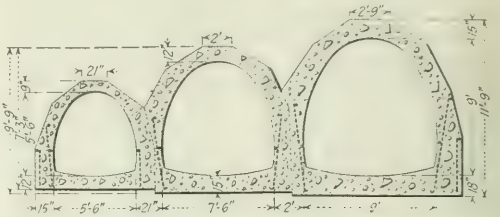


FIG. 2. THREE-BARRELED SEWER TUNNEL LINING

locker room for the use of the men, thus giving them a safe place for their clothes and a warm place for dressing.

The peculiar shape of the tunnel, as shown in Fig. 2, and the closeness of the railroad tracks to the roof (the distance from the top of the rail to the outside of concrete being approximately 16 ft.) made it apparent that the entire section could not be economically tunnelled in one operation. The outside width of the completed conduit is approximately 30 ft., and the maximum height, 12 ft. The soil is a blue glacial clay, tenacious, dry and difficult to pick. The amount of excavation on the 7½-ft. section is 3½ cu.yd. per foot, and on the whole section is approximately 9½ cu.yd. The amount of concrete per foot for the whole section is approximately 4.2 cu.yd., with 80 lb. of reinforcing steel. Considerable discussion was had between the contractor, his superintendent, and his engineer as to the method and plan to pursue, and after analyses of the earth stresses were made, the decision was reached to excavate and concrete the central, or 7½-ft. section, first, and after the concrete had received a set of at least 48 hours to follow up with the 5½-ft. section on the north and the 9-ft. section on the south.

Work on the shaft was started early in November, 1920, and on account of the critical freight car situation, especial effort was made to store sand, gravel and cement, so that when excavating and concreting started no delay from lack of materials would be experienced. About 50 per cent of the materials for the whole job were on the site before tunneling was started on Nov. 28. The disposal of the excavated material, amounting to approximately 22,000 cu.yd., was solved by purchasing eight acres of low land south of and adjoining 125th St. Two headings were started, one to the west toward the pumping station and the other to the east, and, on account of the delay in getting air tools, tunnelling was carried on in the usual manner without the use of compressed air.

Under ordinary tunnelling methods, progress is determined by the amount of material which can be mined in each shift. A foreman, five miners, two muckers and one car pusher are considered a working unit, and in tunnel work in soil of this character and degree of hardness the rate for each miner has been 3 to 4 cu.yd. for each 8-hr. shift. The introduction of the compressed air shovel and pick has revolutionized progress. Instead of the miners setting the pace, the problem is to remove the muck so that the miners can be kept reasonably busy. A foreman, four miners, six muckers

FIG. 3. TUNNEL HEADING SHOWING MATERIAL AND PNEUMATIC SHOVEL GANG

and two car pushers are the working unit in one heading, with a rate of output of from 8 to 10 cu.yd. per miner per 8-hr. shift. In two 8-hr. shifts 18 miners excavated as high as 196 cu.yd. The muck is removed in standard half-yard tunnel cars. The view, Fig. 3, shows the crew and the air tools in the heading for the 7½-ft. section, the outside dimensions of which are approximately 10 x 10 ft.

From the start, the progress of the work has been phenomenal. Two 8-hr. shifts mining and one 8-hr. shift concreting, have completed between 20 and 25 lin.ft. of tunnel. This exceeds by far any of the records heretofore made on work of this character in this locality. The progress in excavation during the first 58 days of tunnelling was: 764 ft. of 9-ft. section, 883 ft. of 7½-ft. section and 864 ft. of 5½-ft. section, which is equivalent to 822 ft. of the entire section, or a rate of 14.2 ft. per day. The progress during the two weeks prior to Feb. 1 has greatly exceeded the average, so that the slogan on the job is now "Get at least one foot of completed tunnel every hour" for six working days. The recent daily reports indicate this to be the performance. This progress is due not only to the introduction of the compressed air pick and shovel, but also to the efficiency of the contractor's organization. The air picks and shovels are operated by Little David hammers made by the Ingersoll-Rand Co. The actual cost of excavation from the heading in the tunnel to its final disposal on the dump was slightly less than $5 per cubic yard. The rate of pay for miners is $1.25 per hour; muckers, $1.12½ per hour, and other labor, $1 per hour.

The digging blades were specially designed for this job, and a considerable amount of money was expended in getting the proper shape commensurate with ease of handling. The most satisfactory size is 5 x 9 in. and the best weight is 7½ lb. The character of the steel for the blades was a problem which was difficult of solution. The repeated stress and strain within the steel due to air gun, caused the cutting tools to break at the most unexpected times, so that a large supply of these had to be kept on hand. Fig. 4 shows the details of this shovel. Considerable saving in the construction cost was possible because of the character of the ground which is such that even with the railroad traffic over the roof of the tunnel it is unnecessary to place any cants or timbers. The tunnel work is now carried on without compressed air except as it is used to operate the digging tools.

A 1:2½:4½ concrete is mixed on the surface in a 14-cu.ft. capacity batch mixer and spouted down into the tunnel into half-yard tunnel cars. Segmental steel tunnel forms of the Blaw type are used. As the concreting on the 7½-ft. section progresses, openings 5 ft. high by 7 ft. long are left in the north and south walls at frequent intervals, which are of great help in constructing the 9-ft. and 5½-ft. sections. By means of these openings the tracks of the lateral tunnels are connected to those in the 7½-ft. section.

The entire plant is operated by electricity, the hoist, the concrete mixers and the air compressors. Coal is used for heating aggregate and water in severe weather. The air compressor is of the two-stage belt-driven Ingersoll-Rand type XB having a capacity of 600 cu.ft. per minute and giving an air pressure of 100 lb. which is capable of handling 15 to 18 air picks. The installation of the compressed air plant for the

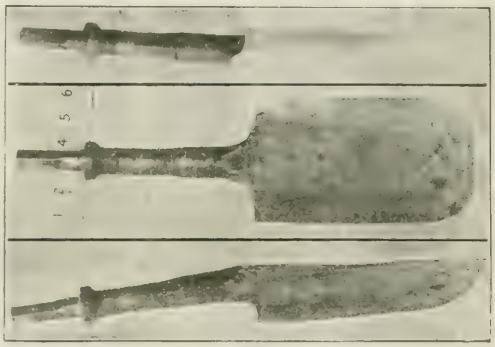


FIG. 4. PNEUMATIC SHOVEL BLADE

operation of the picks and shovels made unnecessary the installation of fans and blowers for ventilation purposes. While excavation is in progress, there is an abundance of air from the hammer exhausts. During the concreting shift, the air valves are opened into the tunnel and the compressor operated at a pressure of 30 lb. Excellent ventilation is obtained in this way.

The contract requires the completion of all of the work before May 1, 1922. On Feb. 1, 1921, 40 per cent had been completed, and unless unforeseen conditions arise, the entire contract will be completed before June 1, 1921. The contractor is the American Sewer & Drain Construction Co., Chicago, with Dan O'Conner as superintendent. The work is being paid for by the Sanitary District of Chicago on the basis of lineal feet of completed tunnel, with the usual clauses regarding additional payment for excavation, concrete, etc., outside of the specified dimensions or quantities. A. W. Dilling is chief engineer and Langdon Pearse is sanitary engineer, of the District, and L. D. Barker is resident engineer in charge of construction.

Road-Making Machinery Exports

Exports of road-making machinery during January, 1921, were valued at $77,875. This compares with $51,411, the value of the exports during January, 1920. The figures are those of the Bureau of Foreign and Domestic Commerce.

Higher Stresses for Bridge Pins

Tests of Iron and Steel Pins Show Usual Flexure Theory Inapplicable—Formulas for Practical Use

By D. B. Steinman
Robinson & Steinman, Consulting Engineers, New York

STRESS conditions in bridge pins have received scant attention in the past. From a study of available data the writer is led to propose a material increase in allowable bending stress over values permitted in present specifications, and to suggest the use of a straight-line formula for that stress so as to take into account the span ratio l/d.

Although of minor importance in new designs, the question of proper working stress for pins assumes economic importance in the rating of existing bridges. In consequence of initial unscientific packing or of subsequent increase in bridge loading pins are often found to have critical bending stresses; and a knowledge that these stresses are safe would relieve the engineer of the alternative of restricting traffic or of ordering expensive and difficult repairs.

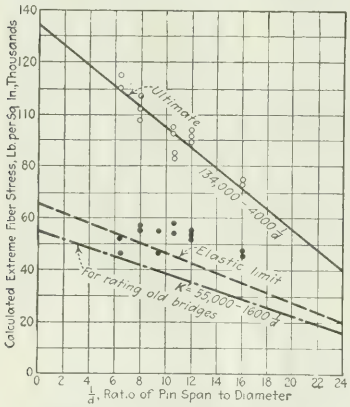


Fig. 1. Wrought-iron pins.

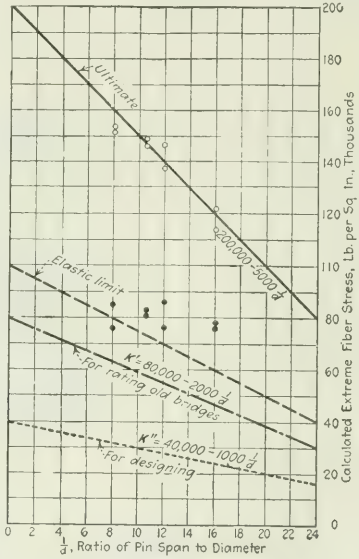


Fig. 2. Steel pins.

FIGS. 1 AND 2. RENSSELAER TESTS OF WROUGHT-IRON AND STEEL PINS

The writer has found, in old railway and highway bridges, calculated pin stresses far in excess of those usually regarded as safe, without any visible signs of overstress. A reassuring interpretation of such conditions is disclosed in the results of experiment.

The only pin tests of which any record could be found by the writer were made nearly forty years ago. Burr, in his "Elasticity and Resistance of the Materials of Engineering," 1915 e.c.d., pp. 557, 559, reports a series of tests made in 1882 at Rensselaer Polytechnic Institute on comparatively short cylindrical beams of wrought iron and steel. Tests on wrought-iron bridge pins made at the Watertown Arsenal in 1881 are reported in Executive Document 12, 47th Congress, 1st Session, pp. 171 to 195 (see Lanza's "Applied Mechanics," 1897 ed., p. 525). The fiber stresses and span ratios calculated from those records are plotted in Figs. 1, 2 and 3, respectively.

The wrought iron pins tested by Burr were ¾ in., 1 in. and 1¼ in. in diameter and were tested with spans of 8 and 12 in. The calculated fiber stress (K) at the ultimate load ranged from 74,000 lb. per sq.in. for a span-length of 16 diameters to 115,000 for a span length of 6 diameters, or from 1.3 to 2.1 times the direct tensile strength of the material, which was 55,000. The inverse variation of ultimate fiber stress with slenderness ratio was consistent throughout, as shown by the plotted values. The points lie very close to a straight line yielding the formula,

$$\left.\begin{array}{r}\text{Ultimate } K\\ \text{for wrought-iron pins}\end{array}\right\} = 134{,}000 - 4{,}000\, l/d \qquad (1)$$

In the same experiments, the calculated fiber stress at the elastic limit of the beams under test ranged from 46,000 to 58,000, or about twice the value in direct tension, which was about 28,000 lb. per sq.in. The elastic-limit stresses are also plotted in the diagram, and are seen to be more than one-half of the ultimate.

The steel pins tested by Burr were ¾ in. and 1 in. in diameter and were tested with spans of 8 and 12 in. The calculated fiber stress K at the ultimate loads ranged from 114,000 for a span of 16 diameters to 153,000 for a span of 8 diameters, or from 1.7 to 2.3 times the direct tensile strength of the material which was about 67,000 pounds per square inch. Plotting the individual tests, Fig. 2, the points are found to lie approximately along a straight line yielding the formula,

$$\left.\begin{array}{r}\text{Ultimate } K\\ \text{for steel pins}\end{array}\right\} = 200{,}000 - 5{,}000\, l/d \qquad (2)$$

In the same experiments, the calculated fiber stress at the elastic limit (also plotted) ranged from 76,000 to 86,000, or over twice the value in direct tension (37,000 lb. per sq.in. and higher than one-half of the ultimate.

The Watertown Arsenal tests were made on wrought-iron pins 2½, 3, 3½, 4 and 4.88 in. in diameter, with spans of 6, 12, 18 and 24 in. The maximum loads applied (*without producing failure*) corresponded to calculated fiber stresses of 92,000 for a span of 6 diameters to 141,000 for a span of 2 diameters, or from 1.8 to 2.8 times the direct tensile strength (50,000 lb. per sq.in.). These values are plotted in Fig. 3, together with the straight line representing formula (1), deduced from the Rensselaer tests, in order to show that the straight-line formula may safely be extended to slenderness ratios as low as 2 diameters.

The foregoing analysis of tests serves to emphasize two conclusions:

1. The modulus of rupture (K) for pins is far beyond the ultimate resistance to tension, even two or three times as great.

2. The modulus of rupture of pins increases in a marked degree with diminishing ratio of pin-span to diameter (l/d).

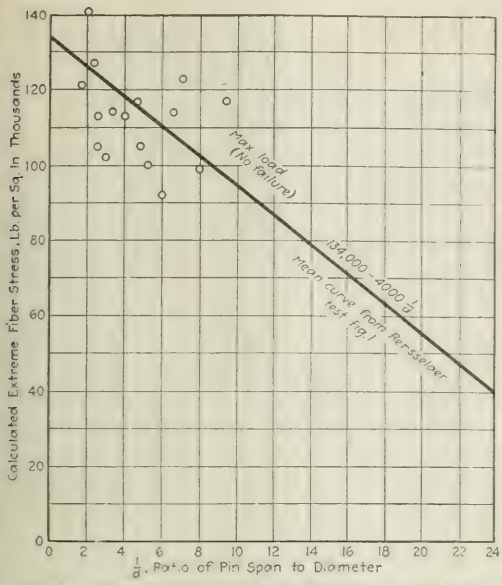


FIG. 3. WATERTOWN TESTS OF WROUGHT-IRON PINS
These tests were not carried to failure.

To account for these observed effects, different explanations may be advanced:

(a) In pins, more than in other beams (on account of the circular section), the extreme fibers are supported or assisted in sustaining their maximum stress by a large mass of adjoining fibers having a lower stress.

(b) In all beams, because of the disproportionate increase of stress with strain after the elastic limit is passed, the modulus of rupture calculated by the common theory of flexure is greater than the actual extreme-fiber stress at failure.

(c) The assumption that the loads and reactions are concentrated at their centers instead of distributed over the widths of bearings gives higher values than the true moments.

(d) Any slight bending of the pin results in some readjustment of the applied forces which tends to reduce the moments below the values calculated.

(e) A pin is a *short beam* in which the loads are carried across largely by transverse shear and compression, to the relief of ordinary flexure. Stresses calculated by the common theory will be correspondingly higher than the actual stresses. (This is essentially the explanation suggested by Burr).

(f) The loads applied on the outer fibers are distributed approximately along 45 deg. lines before reaching the neutral axis. This effect alone would explain an excess of calculated over actual stress amounting to 11 per cent for $l/d = 10$, 25 per cent for $l/d = 5$, and 100 per cent for $l/d = 2$.

A combination of some or all of the hypotheses just enumerated ought to account for the phenomenally high stresses observed in the pins, and for the variation of ultimate strength with slenderness ratio.

In applying the formulas above derived from the tests cited, a low factor of safety is justified, as there is no danger of the bending moments being greater than calculated and there is a practical certainty that they are somewhat less.

For rating old bridges, with the moments calculated as usual by assuming the loads applied at the centers of their bearings on the pins, a factor of safety of 2½ should be ample. This will give

$$\left.\begin{array}{r}\text{Allowable } K' \\ \text{for steel pins}\end{array}\right\} = 80{,}000 - 2{,}000\, l/d \qquad (3)$$

$$\left.\begin{array}{r}\text{Allowable } K' \\ \text{for wrought-iron pins}\end{array}\right\} = 55{,}000 - 1{,}600\, l/d \qquad (4)$$

According to the values plotted in Figs. 1 and 2, pins figured for these stresses (K') will be stressed about 20 per cent below the elastic limit.

For *designing,* a factor of safety of 5 is certainly generous. This will give a working stress

$$\left.\begin{array}{r}\text{Allowable } K'' \\ \text{for steel pins}\end{array}\right\} = 40{,}000 - 1{,}000\, l/d \qquad (5)$$

instead of 24,000 as at present specified. Eq. 5 is also plotted in Fig. 2, in order to exhibit its safety in comparison with the ultimate fiber stresses.

A confirmation of the safety of the above formulas for figuring pins is found in the Watertown Arsenal reports, in the record of a wrought-iron pin stressed in the testing of a latticed channel column (previous reference, pp. 161, 171). The pin, 14 in. long and 3 in. in diameter, loaded at two points and supported at three, safely withstood a load of 388,500 lb., at which the column failed. The extreme-fiber stress in the pin calculated for this loading was 102,000 lb. per sq.in., or more than double the maximum permissible stress proposed in eq. (4), above.

Further Tests Desirable

The tests plotted in Figs. 1, 2 and 3 seem to afford convincing proof that very high bending stresses may safely be permitted in bridge pins. Additional experiments, however, are highly desirable, in order to confirm the conclusions and to make the information on the subject more complete. In the light of present knowledge, the tests can be more comprehensively planned; and the strain-gage can be applied to ascertain the actual fiber stresses in the pins. The data thus secured will not only be a contribution to the science of stresses, but will also be of economic significance in questions concerning the rating or reinforcement of existing bridges.

Railway Mileage in 1920

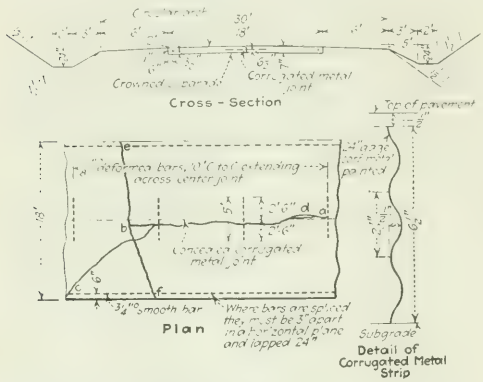
Railway construction reduced nearly to the zero point and more than balanced by mileage of line abandoned, resulting in a net decrease in the total railway mileage of the United States for the year 1920, is shown in statistics compiled by the *Railway Age*. Only 314 miles of new line were built, the longest stretch being 37 miles on the Alaska Government Railway. This is the lowest record for many years and it is only in the past few years that the record has been below 1,000 miles: 979 miles in 1917, 721 in 1918 and 686 in 1919. On the other hand, there were 713 miles of line abandoned in 1920 (on which 240 miles of track were taken up), giving a net loss of nearly 400 miles in the total railway system. From 1,420 miles of line built in 1895 the record rose to 6,026 miles in 1902 and then declined to about 3,000 miles for each of the years 1911, 1912 and 1913, followed by a sudden drop to 1,582 miles in 1914 and 933 in 1915, with a slight rise to 1,098 miles in 1916.

Illinois Has New Concrete Road Slab Design

Corrugated Iron Strip Down Center of Slab and Smooth Rod Reinforcement at Sides To Localize Cracking

CONTROL of longitudinal cracks and reduction of corner-crushing at transverse cracks, are sought in the new slab design for concrete roads in Illinois. Details of the new design are given by the accompanying drawing. All concrete roads on which bids are asked this year are of the design shown. This is the only change in the specifications except that stockpiling of aggregates on the subgrade is prohibited.

It is not practicable completely to prevent longitudinal cracks. In general they will occur on a very



NEW DESIGN OF CONCRETE ROAD TO CONTROL CRACKS

considerable portion of the mileage of any long-completed concrete road. With a monolithic slab they will be irregular as at *ab;* sometimes they will run off the slab as at *c*, and sometimes they will bifurcate, forming a weak spot, as at *d*. By providing the concealed corrugated metal joint, the theory is that the forces which form longitudinal cracks of irregular alignment will find relief in opening up the concealed joint. There will be a longitudinal crack, but it will be controlled in alignment. In this manner the appearance of the road will be improved and longitudinal cracks will be prevented from running to the edge of the pavement, thereby creating weak corners which tend to break down under traffic as described in *Engineering News-Record,* Feb. 3, 1921, p. 210.

The corrugated metal strip used to form this longitudinal joint is ½ in. less in width than the depth of the slab, and therefore does not interfere with tamping and finishing operations. The corrugations form an interlocking joint which prevents separate movement of the adjacent edges. These corrugations are held in mesh, and the joint prevented from opening, by the deformed bar dowels or ties extending across the joint as illustrated.

In specifying the construction of the joint, the corrugated metal is No. 24 gage painted metal, having a width of corrugation of 2½ in. and a depth of corrugation of ½ in. This is the standard commercial article which is obtainable universally from mills and warehouses. The painted metal is specified since it is the standard commercial article and to emphasize the fact that galvanized metal is not required. In case contractors desire to use old stock, or corrugated metal which is not painted, or metal which is heavier than 24 gage, such practice will be permitted. The metal may be used in strips of any length which the contractor desires. The joints may be butt joints or lap joints, at the contractor's option. The corrugated metal shall be held in place prior to and during the depositing and finishing of the concrete, by any method which the contractor may choose, provided the metal is not displaced during these operations. Small iron stakes, which may be removed or left in place at the contractor's option, will probably afford the most economical method of supporting this joint.

In order that the ⅝-in. round bars, which extend across the longitudinal joint at 10 ft. centers, may be easily placed, it will be acceptable either to punch the corrugated strips or to make vertical open slots to receive the bars. These bars must be deformed or rough-surfaced bars, which will bond with the concrete, as they are used for tie bars to hold the two 9-ft. slabs in place. No paint, grease, nor asphalt shall be placed on these bars. The use of any deformed or rough-surfaced bar, the area of which is equal to or greater than a ⅝-in. round bar, will be permitted.

In addition to the longitudinal joint, the new slab design, as illustrated, calls for ¾-in. round, smooth, painted longitudinal bars located 6 in. inside the edge of the slab and on the neutral axis. These are not, properly, reinforcing bars; they are designed to bridge across a transverse crack as *ef*, so that the adjacent corner slabs will act together under load and thus tend to reduce the corner breakage described in *Engineering News-Record,* Feb. 3, 1921, p. 210. It is intended that these bars shall not bond with the concrete. To this end they are smooth, round bars painted with one coat of red lead and then coated with hot asphalt. The paint coat is also designed to resist rusting action.

Incidentally, in specifying the construction of this improved slab, corrugated transverse construction joints are required. At all such points corrugated metal strips similar to those specified for the longitudinal joint are to be placed against the header board before concrete is deposited. The ¾-in. round smooth bars at the edges of the pavement are required to project at least 24 in. beyond the construction joint. In order to facilitate the removal of the wood header and the placing of the bars, it will be permissible to place a vertical open slot in both the corrugated metal strips and the wood header.

The revised concrete slab design has been worked out under the direction of Clifford Older, chief highway engineer of Illinois.

Repeated Reversal Stress Tests in Concrete Beams

In a recently issued Technologic Paper (No. 182) of the Bureau of Standards W. A. Slater, G. A. Smith and H. B. Mueller report on the tests made for the Concrete Ship Section of the United States Emergency Fleet Corporation during the war on the effect of repeated reversals of stress on doubly reinforced concrete beams. The intended scope of the test program was cut down by the end of the war so that the information available is nowhere near as complete as was originally expected. The record of tests is given very completely in the bulletin and serves as a reference for future investigations of this sort.

Plant Layout Studied by Concrete Institute Committee

Report Submitted at Annual Convention Embodies Description of, and Comparative Costs Upon Seven Fundamental Types

IN ORDER to guide the contractor in his choice of equipment for average concrete building construction, the special committee on contractors' plant of the American Concrete Institute reported at its annual convention in Chicago, Feb. 14-16, upon fundamental types of equipment for receiving materials, and mixing, hoisting and placing concrete, and accompanied the report with certain data concerning the cost, per cubic yard, of concrete, including the cost of plant installation and operation. After studying numerous concrete plants in successful operation, the committee came to the conclusion that no recommendations could be made for a standard plant layout to meet all conditions. However, it did report that under ordinary circumstances there was no justification for the installation of an elaborate plant, unless an analysis showed the saving in labor cost to operate to be greater than the cost of the plant required to save that labor.

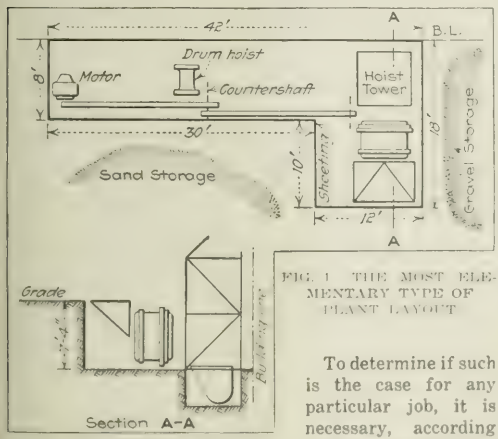


FIG. 1 THE MOST ELEMENTARY TYPE OF PLANT LAYOUT

To determine if such is the case for any particular job, it is necessary, according to the committee's report, to make for each layout under consideration a careful estimate of the cost of plant installation and operation, per yard of concrete. This process of estimating could be simplified by the use of charts to be drawn up by the contractor, based on the contractor's own records of cost for installation and operation, and his depreciation or rental charges. With these analyses in hand, the committee considered it possible to make a comparison that would weigh the merits of each scheme from an operating standpoint and at the same time tell whether the proposed outlay for plant required under it would be justified by the saving it offered.

So the committee found that, owing to local conditions or peculiar requirements as to speed, labor saving, winter weather, etc., anything approaching a single standard arrangement of plant was out of the question. Most of the layouts visited, however, were found capable of being grouped into seven fundamental arrangements, developing from a very elementary form by the addition of equipment intended to conserve labor, thus making

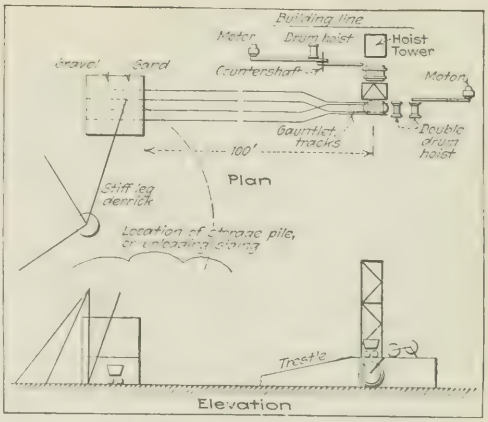


FIG. 2 THE TYPE OF PLANT LAYOUT WHICH EMBODIES THE GREATEST EQUIPMENT EXPENSE

possible a comparison between the additional money expended for plants and the saving in labor costs as a result of its use. The most elementary form of plant layout is indicated in Fig. 1 and the most pretentious layout, which corresponds to No. 7 in the committee's report, is indicated in Fig. 2.

A survey of the individual operations of unloading, transporting and receiving, as well as the combination function of mixing, hoisting and placing concrete, showed the advisability to the committee of separating from the others the unloading and transporting operations. As these two operations were considered in themselves subject to such a large number of possible combinations of methods, they were omitted entirely by the committee, plant layout as affecting the receiving of materials and the mixing, hoisting and placing of concrete being alone considered. These seven plant layouts, described as to the fundamental methods of operation, are as follows:

1—(Shown in Fig. 1) Mixer in a pit. Sand and gravel is dumped on the ground on each side of the mixer pit. The mixer is charged by hand, using 6-cu.ft. carryalls.

2—Sand and gravel are unloaded from back-dump motor trucks against a bulkhead at the charging hopper. Laborers are required to trim material in the bulk head, but wheeling is not required.

3—Sand and gravel are delivered to a storage pile, and rehandled from the storage pile to the mixer bulkhead by a stiff-leg derrick with a clam-shell bucket. The derrick may also be used for unloading cars or scows and handling to storage.

4—The mixer is above ground. Sand and gravel are delivered to the storage piles and rehandled to a 100-cu.yd. bin over the mixer by a stiff-leg derrick. The derrick may also be used for unloading cars or scows and handling to storage.

5—The mixer is on the ground. A material bin is above the mixer. Sand and gravel are delivered in back-dump trucks and unloaded into a conveyor boot built into the ground. A chain belt bucket elevator conveys the sand and gravel from the hopper to the bin.

6—The mixer is in a 3 ft. pit to avoid sheeting. There is a bulkhead against the charging hopper. Sand and gravel are piled against this bulkhead by a 24-in. belt conveyor from a conveyor boot in the street.

7—(As shown in Fig. 2). The mixer is above the ground. Sand and gravel are received by car or scow and unloaded

into a 100-cu.yd. bin by a stiff-leg derrick. The material is handled from the bin to the mixer in 1-yd. side-tip cars drawn by an endless cable from a double-drum hoist.

In determining the cost, per cubic yard of concrete, of plant installation and operation of the seven fundamental types of layout, several assumptions were made. It was taken for granted that on jobs of less than 3,000 yd., a ¾-yd. plant would be used, a 50-ft. wooden tower, eight carryalls for placing concrete, and 300 ft. of run panels. Jobs over 3,000 yd. would have a 1-yd. plant, a wooden tower averaging 125 ft., twelve carryalls for placing concrete, and 400 ft. of run panels. These factors were assumed as average equipment, went on

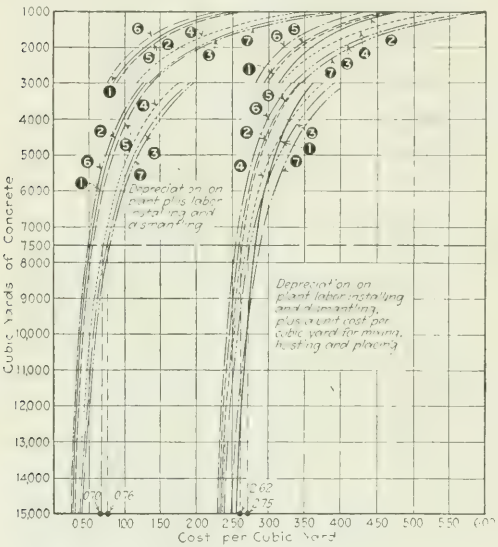


FIG. 3. COST COMPARISON OF THE SEVEN PLANT LAYOUTS

the committee's report, and as many contractors standardize on 1-yd. chuting equipment, this was used for both ¾ and 1-yd. mixer plants, but with a 100-ft. steel tower for the ¾-yd., and a 180-ft. steel tower for the 1-yd. plant. Variations from this average, in a case of any job of medium size, would involve only a slight difference in cost per yard when pro-rated over the entire yardage. On extensive operations a slight difference in cost per yard between several plants would naturally warrant a careful individual estimate of each.

The committee pointed out that any contractor might plot for himself a set of curves as are indicated on accompanying charts, based upon his own layout, by keeping a record of the cost of installing and dismantling each arrangement and adding thereto his allowance for plant depreciation. As plant obtained by a contractor on a rental basis costs more than the depreciation allowances made by the committee, such conditions should be taken into consideration in plotting similar curves and in estimating for jobs where it will be necessary to rent part of the equipment.

In plotting the curves shown in Fig. 3, which is a comparison of costs of the various plants, depreciation was figured on jobs running from nine months to a year. For jobs of shorter duration, the depreciation allowances herein stated would be slightly high. For the

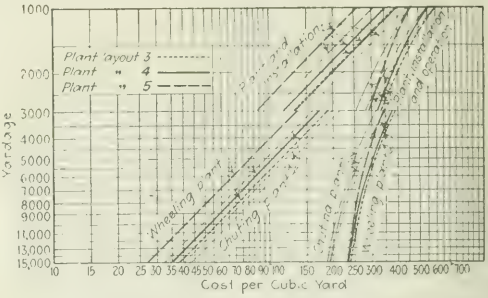


FIG. 4. COMPARISON OF WHEELING CHUTING COSTS ON PLANT LAYOUTS 3, 4 AND 5

¾-yd. plant the depreciation has been taken at 60 per cent of that for the larger plant. This yearly depreciation was figured as 40 per cent in the case of a bucket elevator; 33 per cent for carryalls; and 20 per cent for concrete buckets, hoists, mixers, motors, side-tip cars, steel-hoist towers, and stiff-leg derricks. Frame structures, such as bins, bulkheads, wooden towers, etc., were considered a complete loss, owing to the uncertain salvage value of such material and the widely varying practices in regard to selling, storing, etc. The committee found that labor to dismantle would, in general, be found to offset any salvage.

An estimate of the labor required for the operation of each plant, that is, mixing, hoisting and placing, has as a basis a labor rate of $6.50 per 8-hr. day. This unit cost per cubic yard for mixing, hoisting and placing was estimated for the seven fundamental types of layout as follows: Plant No. 1, $2.30 per cubic yard; No. 2, $2.10; No. 3, $2; No. 4, $2; No. 5, $2.05; No. 6, $2.05, and No. 7, $2.10. These figures assume the placing of concrete by wheeling. The right-hand curves in Fig. 3 show the depreciation on a plant of the seven types, including the labor of installing and dismantling the plant, plus this unit cost per cubic yard for mixing, hoisting and placing, whereas the left-hand curves show the depreciation on the plant, plus the labor of installing and dismantling the plant.

To analyze further each arrangement, seven additional charts were prepared by the committee on which comparison was made between wheeling as a means of placing and chuting, using steel-hoist tower, 50-ft. boom and counter weight truss, to eliminate wheeling on the floor. The charts were drawn indicating yardages per mixer.

In Fig. 4 are shown these differences in cost of plant installation and operation between the chuting and wheeling methods. The curves in Fig. 4 are based upon plant Nos. 3, 4 and 5. In explanation of the use to which the curves in Fig. 4 may be placed, the following illustration is taken from the report of the special committee:

A building containing 15,000 yd. of concrete, for which it is desirable to use two mixing plants, is taken as an example. Choice lies between plants of the type of No. 3 and No. 4 where the contractor unloads the material, and a plant similar to No. 5. for which the material is delivered by a dealer. It will be assumed that yardages handled by the two plants are approximately equal. Comparison will then be made on the basis of 7,500 yd. per mixer. Comparing first plant Nos. 3 and 4. it is found that the cost per yard for plant and installation are respectively 76 cents and 70 cents. The combined cost for plant installation and opera-

tion is $2.81 and $2.75 respectively. Choice is therefore between No. 4 and No. 5, which shows a total of $2.62, 13 cents per yard less than No. 4.

To these figures, however, must be added unloading for No. 4, and unloading and trucking for No. 5. These figures will ordinarily run about 20 cents for No. 4 and 50 cents for No. 5, assuming a mile haul and disregarding the dealer's profit on the transaction. The revised figures now stand:

No. 4—Plant installation and operation, $2.75 + $0.20 = $2.95.

No. 5—Plant installation and operation, $2.63 + $0.50 =$3.12,

If the contractor has chuting equipment he will refer to chart marked plant No. 4, which is a comparison between placing by wheeling and chuting. At 7,500 yd. he will find the chuting equipment will cost him 11 cents more per yard in plant charges, it will save him 40 cents net on the combined total of plant installation and operation. The additional plant charge for chuting equipment is therefore justified by the saving in labor charges.

Effect of Train Speeds on Increasing Track Maintenance Costs

Abstract of subcommittee report, Committee on Economics of Railway Operation, American Railway Engineering Association. Prepared by C. C. Williams and J. M. Burt.

DISCUSSION of the effect of increased speed on the cost of track maintenance requires recognition of two distinct points: (1) Necessarily higher maintenance standards under higher speeds, and (2) increased costs from actual damage by trains due to increased speed. Confining the study to the second point, experience has shown that greater increases in maintenance costs arise from increasing freight train speeds than from increasing passenger train speeds. Observations also indicate that such increases in maintenance costs are not as pronounced on tangent track as on curves.

Force exerted by track in deflecting the mass of locomotive or car, in interference with the natural period of oscillation due to high speeds, will vary as the first power of the velocity of the train. As indicated by tests of behavior of track under traffic the variation is a direct one. The equations for the maintenance of way and structure expenses may therefore be written in the following form:

Ties	Cost = A + $K_t V$
Rails	Cost = B + $K_r V$
Ordinary track maintenance	Cost = C + $K_m V$
Ballast	Cost = D + $K_b V$
Track laying and surfacing	Cost = E + $K_s V$
Superintendence	Cost = F + $K_s V$
Bridges, trestles and culverts	Cost = G + $K_y V$

The factors A, B, C, etc., are the costs of various tiems at any given speed of operation and the co-efficients K_t, K_r, etc., are the factors indicating the increase per mile per hour increase in speed. From calculations based on previous investigations the value of K_t, K_r, etc., are as follows:

	For Passenger Trains —		For Freight Trains —	
Coefficient	Tangent Track	Curved Track	Tangent Track	Curved Track
K_t	0.0011	0.0150	0.0014	0.0150
K_r	0.0010	0.0082	0.0031	[illegible]
K_m	0.0008	0.0038	0.0008	[illegible]
K_b	0.0010	0.0038	0.0012	[illegible]
K_s	0.0022	0.0190	0.0027	[illegible]
K_s	0.0022	0.0190	0.0029	[illegible]
K_y	0.00067	0.00067	0.0009	[illegible]

In illustration of application of the above analysis: It is proposed to increase average speed of freight trains from 20 to 25 m.p.h. over a road of 75 per cent tangent, 25 per cent curves. If the road is one carrying both passenger and freight traffic, the passenger traffic will establish the standard of maintenance necessary. Therefore, the question of a higher standard of maintenance will not be involved and the increase in maintenance expense will be attributable only to increased speed of freight operation as follows:

Tie expense	100 (0.0014 × 0.75 + [illegible]) = [illegible]
Rail [illegible]	100 (0.0031 × 0.75 + [illegible]) = [illegible]
Ordinary track [illegible]	100 (0.0008 × 0.75 + [illegible]) = [illegible]
Ballast [illegible]	100 (0.0012 × 0.75 + [illegible]) = [illegible]
Track laying and surfacing	100 (0.0029 × 0.75 + [illegible]) = [illegible]
Superintendence	100 (0.0029 × 0.75 + [illegible]) = [illegible]
Bridges, trestles and culverts	100 × 0.0009 × 0.5 per cent

Thus the increase in maintenance expenses, in this case, would be about 2.4 per cent, or approximately 0.5 per cent increase per mile-per-hour increase in speed of freight trains.

Manifestly, the effect of speed in increasing the damage done to track will be dependent upon the character of equipment and rolling stock and it is, therefore, necessary to consider the effect of increased speed of freight trains and the passenger trains separately due to different standards of maintenance in the two classes of equipment.

New Emergency Contract Devised

PAYMENT to the contractor of a designated fee, the furnishing by the contractor of all equipment and tools, the furnishing by the city of all materials, and the payment by the city of all labor costs exclusive of the wages paid a general superintendent, are the features of a new emergency contract devised by the City of Cleveland and applied in the construction of new units to the city hospital. By the terms of the contract the city becomes virtually the employer, doing the work by day labor and hiring a supervisor of labor and materials. The contract is being executed by the Central States Engineering & Construction Co.

The contractor is to furnish and deliver on the site at his sole expense, all the necessary power equipment, such as steam shovels, locomotives, dump cars, hoisting engines, motor trucks, concrete mixers and like equipment; and all necessary small tools, such as picks, shovels, crowbars, wheelbarrows, concrete buggies, etc. The contractor is also to furnish such parts as are necessary to keep the equipment in good repair.

The power equipment estimated as necessary for the construction of the buildings contemplated, and the time required for each item of equipment, is tabulated in the contract. In the event this equipment is not used for the entire length of time estimated, allowances for the release of any of it from the work are to be deducted by the city from the sum stipulated to be paid the contractor—$109,000. The monthly rate which is to be conducted in case certain items of equipment are released is as follows:

Steam shovel	$600	Power cases	50
Locomotives	300	Stiff-leg derricks	55
Dump cars	30	Guy derricks...	250
Concrete mixers	100	Pumps	50
Hoisting engines	100	Boilers.....	25
Motor trucks	50		

The $109,000 is to be paid the contractor in installments as the work progresses, 10 per cent of the installments to be deducted and retained by the city until sixty days after the completion of the contract.

The city is to purchase all materials necessary for the construction through its purchasing department, upon estimates furnished by the company and approved by the city architect. Material deliveries are to be made by the city. Necessary supplies, such as fuel, light, oils, and water are also to be furnished by the city. Payment for labor is to be assumed by the city, the payroll for each week to be prepared by the company and approved by the city architect and director of parks and public property, the company, or contractor, being only designated as a deputy of the city in distributing to the employees the wages earned. Inasmuch as payment of labor is undertaken by the city, the contractor is held free from liability of the payment of compensation insurance, except in those cases where the contractor contributes the negligence causing accidents.

Car Dumpers for Quick Unloading at Grain Elevator

Speed Up Operation of Entire Plant and Cut Labor Force Required—Automatic Equipment Opens Grain Doors

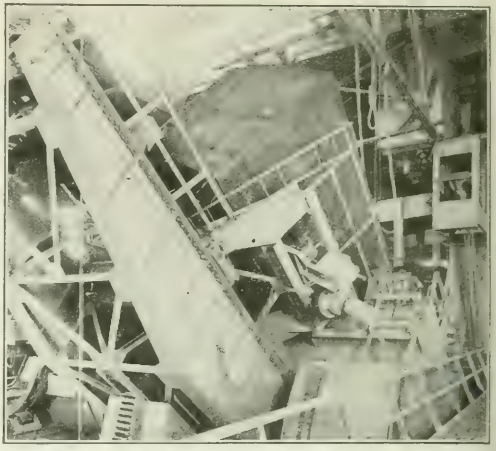
SPECIALLY DESIGNED car-dumper units, combining an automatic device for opening grain doors, have led to increased speed of operation of the entire plant and materially reduced the labor force required at the Northern Central grain elevator of the Pennsylvania R.R. recently completed and put in operation at Baltimore. This is the first time that the car-dumper principle has been applied for the unloading of grain at elevators and heretofore it has been at this point that speed of operation has been impeded through the necessity of employing manually and mechanically operated shovel boards and hand shoveling for unloading into the sink.

A dumper serves each of the four unloading tracks and the total time required for emptying a car, including spotting and removing, is about 7 min. At the same time it is estimated that the four unloaders replace the labor of about sixty-eight men that would otherwise have been required.

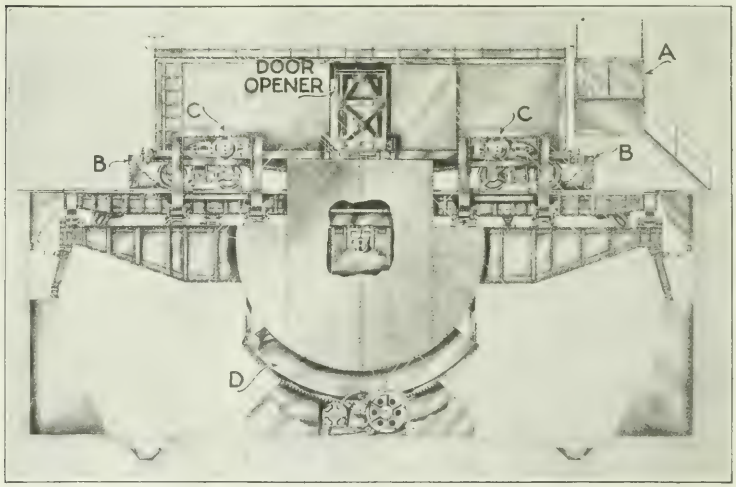
The location of the unloaders is indicated in the accompanying drawing, cars being received on four tracks from the Pennsylvania R.R., crossing the tracks of the Canton R.R. immediately in front of the elevator site. This restriction imposed the necessity of extending the elevator yards from the Canton tracks to the end of the pier carrying the unloading gallery. The dumper units are located midway between the Canton tracks and the end of the pier so that sixteen loaded cars can be spotted on each of the four unloading tracks and handled without a switch engine.

A disappearing "barney" on each of the unloading tracks handles the cars to and from the dumpers, each controlled by heavy endless cables. The operator's cage on each dumper is stationed just beside the car to be unloaded, for easy observation. After the operator has spotted the foremost car on the middle of his unloader he first anchors it by the endwise and side clamps (engaging couplers and holding against the frame). The grain door is then automatically pushed in and raised, and the car slowly tipped to different positions so that its entire contents of grain is discharged into the receiving sink. Electrical connections with motors controlling the entire operation are so arranged that when the first operation is started the motors furnishing power for each succeeding operation are automatically actuated in sequence, each stopping when the cycle of operation is complete and then reversing the entire cycle of operation. As quickly as a car is spotted on the dumper, motor No. 1 is started, controlling the end clamps, which firmly engage the couplers of cars of any length. As quickly as a certain pressure is exerted by the end clamps, designated by the letter *B* in the accompanying working drawing, the power is automatically thrown out and current turned into the motors controlling the side supports marked *C*, which move up against the sill of the car, where pressure is automatically limited, with the throwing off of the current and setting in operation motor No. 3 controlling the grain door opener.

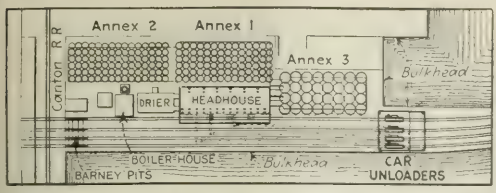
The automatic grain door opener is considered a



EXTREME POSITION OF BOX CAR DURING UNLOADING
Tipped lengthwise through 45 deg. and sidewise, 30 deg. Top of concrete counterweight partially balancing lengthwise movement is shown in foreground. Side clamp mechanism prominent at center of photograph.



SIDE ELEVATION OF GRAIN CAR DUMPING EQUIPMENT SHOWS DEEP PIT AND HEAVY CONSTRUCTION
(A) Operator's cage. (B) End coupler clamps. (C) Side support clamp mechanism. (D) Concrete counter weight partially to balance car when tipped endwise.



CAR UNLOADERS SERVE FOUR RECEIVING TRACKS

principal feature of the equipment, since it is not necessary to batter in the bottom boards and then hammer the rest of the door loose from the door posts of the car. After the bottom of the opener drops on the floor in the doorway the grain door is quickly pushed in about 6 in. and raised about the same distance from the floor of the car, sharp-pointed pins carried on upright bars on the face of the opener engaging the grain door and holding it until all grain is run out and the car has been swept. Then the opener, or pusher, is withdrawn and the temporary grain door dropped.

As soon as the grain door is pushed in, current is automatically turned into the next motor, which tips the car sidewise to an angle of 30 deg., starting the grain to flow into the hopper. Then the current is automatically transferred into the fifth motor, which tips the car endwise to an angle of 45 deg., at the same time tipping it sidewise 30 deg. The endwise tipping is then reversed so that all the grain from both ends of the car will be discharged.

Upon completion of this cycle of operation the entire cycle is automatically reversed, withdrawing the grain door pusher after the car is returned to normal position and then withdrawing the side and coupler clamps.

The dumping equipment is known as the Stewart Link-Belt Grain Car Unloader. The installation was designed and built by James Stewart & Co., contractors, Chicago, who erected the grain elevator.

Drainage of Large Railway Cuts

Abstract of report of Committee on Roadway, American Railway Engineering Association.

LONG LOW-GRADE CUTS should be avoided wherever reasonably possible in railway location, and where they are necessary the engineer should give careful study to providing adequate drainage. Such cuts should be taken out to a width that will permit of wide and deep side ditches, and the slopes should be flat enough to avoid danger of the banks sloughing. Surface ditches should be provided wherever required, and should be kept back far enough to avoid seepage or sloughing into the cuts.

Where it is not possible to accomplish drainage by open ditches, various more or less desirable schemes have been used for draining cuts, such as vitrified tiling or trenches filled with large or small rock, both tile and trench drains being used with or without lateral weepers. More drastic methods have had to be resorted to where springs have been encountered and the water seeps upward and outward from subterranean veins, these sometimes occurring directly beneath the track. Where it is necessary to put in longitudinal tile subdrains, they should be placed below the frost line and below any saturated material, laid to a true bed, and covered with cinders or other suitable material.

All water possible should be kept from reaching the roadbed. Side ditches should be provided in cuts in all or any class of material in order to hold storm water down and to convey the water away as rapidly as possible. If tile drains are still necessary, they should be placed at satisfactory depth, and the side ditches of the cut should be kept open at all times.

Heavy Timber Framing Used for Seattle Transit Shed

Latest Part of Pier B in Smith Cove Section Has Main Floor Members of 14 x 32 In. Sticks 40 Ft. Long

ON PIER B of the new Smith Cove development of the Port of Seattle there are two transit sheds each 128 ft. wide, separated by a 54-ft. track space and with marginal track spaces each 28 ft. 6 in., making up the total 367 ft. width. Both of these sheds are of timber framing of extremely rugged design, as shown in the accompanying drawing. A special feature is the use of twin 14 x 32 in. Oregon fir sticks, 30 and 40 ft. long, for the floor beams of the second floor. The east shed,

INTERIOR OF FIRST FLOOR OF EAST SHED, PIER B, SMITH COVE DEVELOPMENT, PORT OF SEATTLE

which is shown in the view, has been in use for some time, but the west shed, the details of which are given, is now under construction.

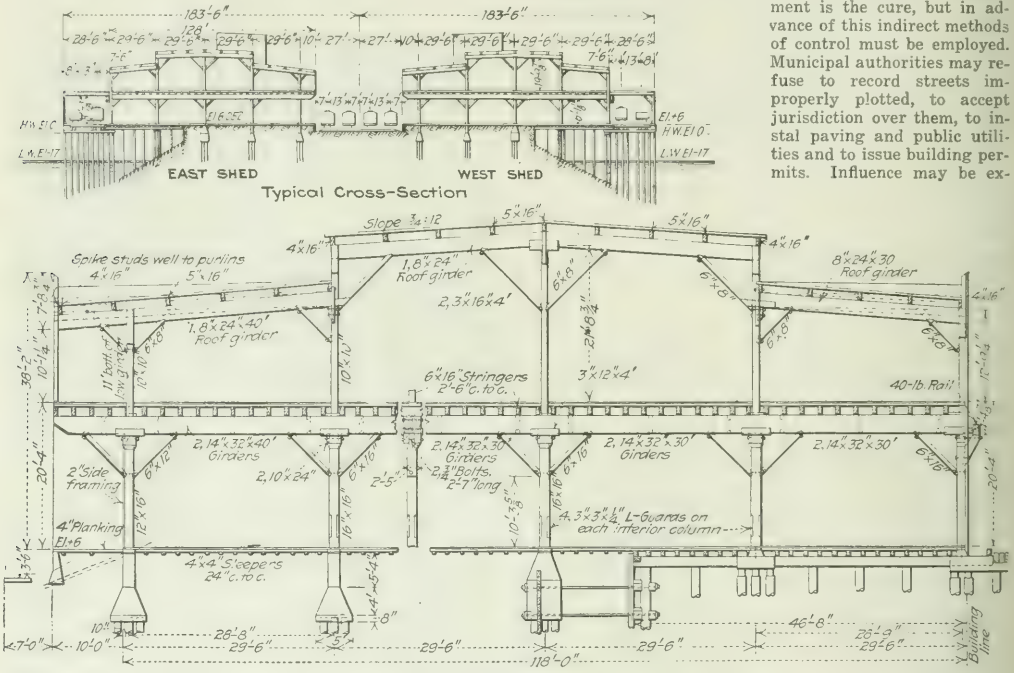
The sheds were built on a central fill with pile carried extensions on the sides. They are 1,060 ft. long, extending from the bulkhead line, where they connect with the marginal way and where the second story is connected with a marginal viaduct. The second floor girders extend beyond the wall of the first story on the track side of the building a distance of 10 ft., forming an additional 10 ft. for the second story enclosure, and providing on the first floor a sheltered loading and unloading platform the full length of the building. By thus cantilevering the second floor the necessity for columns at the outer edge of the platform on the first floor has been obviated, thereby leaving the platform entirely clear of obstructions.

Each second floor girder consists of two timbers 14 x 32 in. by 30 ft. and 40 ft. long, bolted together with an air space between. They are used because they are low in cost and can be obtained on short notice, are easily and cheaply worked into shape, and offer no difficulties to the direct attachment of connecting wooden members. Being made up of two sticks each, the members can be mated up so as to obtain for each girder greater uniformity of material and strength than is possible with single sticks, and being of wood painting as a protection against the corrosive effects of salt air is not required.

The first story column caps in the west shed are of

wood, notched into the column tops and bolted through in both directions for securing to the column and to prevent seasoning cracks. The grain of the caps is vertical. The column tops are mortised into the second floor girders to prevent collision displacements, dowels not offering equal advantages. In the east shed precast concrete column caps, as shown in the view, were used.

Columns resting on wooden pile caps, where space is available, are constructed of a rich concrete without reinforcement. Columns resting on concrete footings, which were cast at the time the pier was constructed, over one year previously, where vertical and horizontal spaces are limited and where intensities of pressure are high, have spirally reinforced concrete base plates.



DETAILS OF TIMBER PIER SHEDS OF PIER B AT SMITH COVE

Freight may also be handled from or to the ship at the second floor of the shed. To facilitate this a traveling freight platform has been provided to run on a track on the ship side of the building. The platform is constructed at the second floor level and travels the entire length of the shed. Passengers use the second story only, passing to and from ships by means of a traveling, adjustable gangway, which travels on the same rails as the freight handling platform. This gangway is usable at any point in the length of the shed for any size of ship or height of tide.

The piers were designed and built by the Port of Seattle Commission, George F. Nicholson, chief engineer.

Indiana Public Utilities and Water-Works

Of 1,400 public utilities of all kinds in Indiana 286 are water-works. Their value is $30,000,000 compared with $800,000,000, the value of all public utilities.

City Planning and Subdivision Plans

REGULATION of the acceptance of plans for new subdivisions is one of the difficulties in city planning work, such regulation being desirable in order to secure conformity with the adopted city plan. The purpose of such conformity is to avoid awkward and uneconomical cutting of real estate in making future street extensions or connections. The following notes on this subject are from a paper read at the recent meeting of the American City Planning Institute by Ernest P. Goodrich, consulting engineer, New York:

Except in Pennsylvania there seems to be no direct local power to prevent large or small obstructions to future development along adopted plans. Constitutional amendment is the cure, but in advance of this indirect methods of control must be employed. Municipal authorities may refuse to record streets improperly plotted, to accept jurisdiction over them, to instal paving and public utilities and to issue building permits. Influence may be exerted to induce companies to refuse loans or insure titles of lands for such obstructions.

Replotting was successsfully carried out in Portland, Ore., where all the property owners of a poorly plotted district agreed to turn over their deeds to a trust company selected jointly by the municipality and the owners, which company handled the redistribution of the area. This method not only gave back to each property owner an equivalent area but also resulted in an improved street system and in additional plotted real estate sufficient to pay for the costs of the proceeding.

In minor instances the established city plan can and should be modified to obviate such difficulties. Diagonal streets, for instance, need not be carried in absolutely straight lines. Small angles can often be introduced advantageously to reduce real estate costs and to add interest to the vista. Street extensions can be made with slight jogs, but the offset should never be so great as to produce angular crossings of other thoroughfares greater than 30 deg., because of the difficulties of traffic regulation which would be likely to follow.

Failure and Proposed Repair of Third St. Arch Bridge

Shallow Pier Foundations and Scour Blamed—Fallen Portion to Be Replaced by Reinforced Arch Ring Sections

REPORTS on the failure of the Third St. Arch Bridge in Dayton on Jan. 21, made available now by Charles H. Paul, assistant chief engineer of the Miami Conservancy District, and George F. Baker, city engineer of Dayton, agree in attributing the collapse to the shallowness of the pier foundations. In the report of Arthur E. Morgan, chief engineer to the Board of Directors of the Miami Conservancy District, the river improvement work of the district is described, so far as it lay in the immediate neighborhood of the pier that failed, and this work is declared not responsible for contributing to the failure. John L. Harrington, consulting engineer, Kansas City, reporting on the failure to the city, states that it is impossible to determine whether the river improvement operations were or were not a factor in the matter.

Mr. Harrington describes the general procedure to be adopted for repairs, which is at present about to be put under contract. He points out certain essential cautions to be observed in this work, of rather unusual engineering character. He also describes the structural conditions of the bridge arches, in which signs of deterioration are noticeable. The two reports are reproduced below in slightly condensed form.

Conservancy District Report

An examination of the pier between the spans, which is the second pier from the east side of the river, showed that a crack had occurred a little to the north of the center of the pier, that the broken part had shifted about a foot to the west and had listed to the north. The movement of this pier in all probability preceded and caused the failure of the arches.

Examination of the pier which failed showed that there had been scour around it, and that at the north point of the pier this scour had reached to about one foot greater depth than the bottom of the pier.

The Miami Conservancy District had made no excavation on either side of this pier. The nearest excavation was a shallow trench about 40 ft. to the north for the purpose of laying a water main, which was done about a year ago. The trench for this water main did not reach to a depth as great as the depth of the pier which failed and could have had no effect upon it. The work of cleaning the channel at this end of the bridge has not yet been done. This is to be done next spring.

The failure is plainly due to the shallow foundations and absence of piling under them. On all new bridges constructed on the river since the organization of the Miami Conservancy District, we have required more than twice the depth of foundation of the older bridges, and pile support in addition.

The Miami Conservancy District is in no way responsible for the failure of the bridge.

Report of John L. Harrington

The Third Street Bridge consists of seven reinforced-concrete arch spans of the Melan type, designed by Concrete Steel Engineering Co. and built by Hogland & Kline Construction Co. in 1904. It carries a roadway 42 ft. wide having two street-railway tracks in the middle, and a 10-ft. walk at each side, making a total width of 62 ft. between handrails. The spans vary in clear length from 80 ft. at the ends to 110 ft. at the middle of the bridge, with a rise of approximately one-twelfth of the span. Each is reinforced by 21 steel ribs, spaced 34 in. center to center transversely to the roadway; those in spans 2 and 3 are composed of four 2 x 3 x $\frac{3}{16}$-in. angles. According to the plans and specifications, the concrete in the arch barrels is composed of a 1:2:4 mix; that of the piers of a 1:3:7 mix.

Pier 2 is 10 ft. wide under coping and has a footing 20 ft. wide by 80 ft. long. According to both the plans and your soundings, the pier footings are at elevation 713.13, which is 9.04 ft. below low water. The bed of the river commonly varies from nothing to 6 or 8 ft. below low water, for at this point the river bed has not yet been dredged to conform to the plans of the conservancy district.

Your soundings, made after the failure, showed the bed of the river to be washed out at the upstream end of pier 2 to elevation 711.6, approximately 1½ ft. below the pier footings. The pier broke in two approximately 31½ ft. from the upstream end and canted upstream so as to leave a crack about 9 in. in width at the coping, and toward the middle of the river about 11 in., measured at the coping. This was undoubtedly caused by the undermining of he upper end of the pier, which resulted in its failure.

The failure of the pier caused a portion of span 2, varying in width from about 24½ ft. at pier 2 to substanially nothing at pier 1, to fall almost vertically to the river bed, carrying a motor truck and a motor car with it. The fall was so direct that a considerable portion of the brick paving lay substantially intact on top of the debris. A section of span 3, varying in width from about 24½ ft. at pier 2 to substantially nothing at about three-quarters of its length from pier 2, also fell into the river. The barrels of both arches split cleanly along the third Melan arch rib, measured from the center of the bridge, for a considerable distance from pier 2, and then zig-zagged to the handrail, generally breaking longitudinally for some distance along each rib, as the break crossed it.

Each span was, during construction, divided into three parts by two longitudinal construction joints; one of these joints was crossed by the line of failure but manifestly had nothing to do with the failure itself, for the break did not follow it. Both the arch barrels and the pier show good concrete at the fractures.

The steel arch ribs are decidedly rusty. I estimate, from examination of the exposed steel, that the concrete adhered firmly to about 15 per cent of the area of the lattice bars and angles composing the ribs, thus leaving 85 per cent of the steel unprotected. Examination of all of the structure shows that this is a general condition, for from the river, the situation of each rib is clearly marked, sometimes by dripping water, always by streaks or rust, and sometimes by the scaling off of the concrete beneath the steel ribs. Each arch barrel is thus composed of alternate latticed steel girders and free and unreinforced concrete ribs.

Reconstruction Method.—The failed portion of Pier 2 should be replaced by a new portion of corresponding section supported on piles, and after it is completed the failed portion of spans 2 and 3 should be trimmed off to piers 1 and 3 and replaced with properly reinforced concrete arch barrels. The new portions of both pier and arch barrels should be well doweled to the portions remaining in place. The unbalanced thrust now on piers 1 and 3 should be reduced by removing the paving and spandrel filling from spans 1 and 4, and further by inserting struts under pressure from the renewed portion of pier 2, thus permitting the reconstruction of the failed portions of spans 2 and 3 under normal conditions.

In rebuilding the failed portion of the structure care must be taken to relieve so far as possible the stresses in the remaining portions of spans 2 and 3, for they are now carrying all of the thrust from spans 1 and 4, and care must also be taken to avoid unduly heavy blasting in the removal of the failed portion of pier 2.

Failure Conditions.—Pier 2 failed because its foundation was not carried down to a safe depth and because the water at a stage but little above extreme low water cut away the small amount of sand and gravel surrounding it and washed out a portion of the readily removable sand from beneath it. All of the piers of this bridge are similarly

liable to failure; therefore all of the piers should be properly protected from erosion of the river bed below the elevation fixed by the conservancy district, which is only approximately 4½ ft. above the base of pier in each case.

The Miami Conservancy District surveyed the river before beginning its operations, and the results of these surveys, shown on their plans, make it clear that at the Third St. bridge the river then frequently scoured much below the elevation of river bed to which the district is dredging. It is therefore impossible to determine whether the scour at pier 2 resulted from their operations, above and below the bridge, or from some local cause of scour, for very little erosion was necessary to cause the failure, and it may have resulted from either cause.

The failure of the concrete to adhere to the arch ribs, and the consequent failure of the concrete and the steel to act as a unit, have no bearing upon the present failure, but the gradual destruction of the steel ribs by corrosion, for which I see no remedy, will limit the life of the bridge to comparatively few years. Yet the remaining years it will safely serve make it advisable to repair the present damage and to protect all the piers from scour, which may at any time cause failure of a pier or of the whole structure.

It is difficult to estimate closely the cost of repairing spans 2 and 3 and Pier 2, because the amount of work is small in proportion to the equipment required, but I estimate that $60,000 will probably cover the cost of this work.

I have carefully considered the various methods of protecting the piers against scour, and have concluded that the most economical and satisfactory will be to surround them with riprap to a width of about 15 ft. The sand and gravel must be removed so that the rip rap will have its surface at elevation of river bed fixed by the conservancy district, leaving a clear channel in accordance with their plans, yet be adequate in depth and arrangement to constitute a reliable protection. I estimate that this will cost between $20,000 and $25,000 for the Third St. bridge piers. An accurate estimate is not possible because I have not available the price of rock delivered.

Design of Railway Car Repair Shops

Abstract of report of committee on Shops and Locomotive Terminals, American Railway Engineering Association.

MANY railroad companies find it desirable to provide shops for handling repairs to freight cars either on account of climatic conditions, legal requirements or the belief that the provision of such shops will result in a higher degree of efficiency. Each railroad company must determine in accordance with its own operating methods and conditions whether a shop is justified and what expenditure is warranted, so that the fixed charges per car, due to this expenditure, may not exceed the advantages secured by better workmanship, lower unit cost and less delay in conducting repairs. The layout of many plants has been governed by existing property and trackage limits, and this condition will probably be encountered even more seriously in the future, except where very extensive plants in new localities are contemplated.

Sheds or shops are not to be recommended for light repair work, because of the frequent switching necessary and of the fact that many hundreds of cars in this class are worked upon each day. In the case of heavy repairs, however, shops may be desirable at certain points, especially when considered in conjunction with the power, tool and handling equipment necessary for intensive production.

Heavy repairs may be classed as follows: (1) Medium repairs, consisting of moderate attention to trucks, underframes and superstructure, with entire repainting; (2) heavy repairs occasioned by severe wreck damage or extreme deterioration; (3) rebuilding, where cars are strengthened and made modern in construction through the application of steel underframes, ends, roof, etc. Most railroads prefer to do heavy repair work on their own cars, due to having suitable standard material and to the fact that cars can be segregated by series and the work standardized. Where a railroad owns a sufficient number of steel cars to justify the expense, a special shop should be given consideration.

Tracks should be spaced 24 ft. c. to c. where material tracks are employed and 18 ft. as a minimum where material tracks are not used. For such spacing it is desirable to allow 60 ft. per car. Railroads using wider track centers, such as 30 ft. with material tracks and 22 ft. without, usually employ only 50 ft. per car.

For supply tracks, standard gage seems to be preferred throughout the country, due to the ease in handling wheels and the usual design of section push car upon which material can be carried. Further, erecting shops can be supplied with freight car loads of underframes, sills and other heavy material, which is not possible with narrow-gage tracks.

There should be a minimum clearance of 10 ft. from center of track to face of pilasters and 12 ft. from center of track to face of wall. Overhead clearance above top of rail where cranes are not employed should be 20 ft. minimum, 22 ft. being desirable. Where cranes are used, the clearance should be not less than 25 ft., unless careful study of local operating conditions should dictate a smaller dimension advisable. Clearance defines the exact headroom possible either from the crane hook or crane cage or girder, whichever forms the farthest downward projection. Shops designed with cranes should be limited to include bays not exceeding four repair tracks.

End doors in car shops should be not less than 13 ft. wide and 17 ft. high, obtaining as large a door on supply tracks as clearance and general construction will permit. Separate paint shop accommodation should be provided in line with the normal movement of cars through shops, being so installed that equipment can be handled expeditiously and prevent blocking repair tracks.

Full consideration should be given to expected increases in demand and to future extensions which can be foreseen. Where shops are constructed with traveling cranes, the runways should be advanced beyond the covered space to provide for flexibility of operation to permit men to work either out-doors or in-doors as local conditions may govern. This plan will assist also in the handling of material and the adjustment of loads in cars. For a prompt and ecomonic handling of material there should be cranes, hoists, monorails, supply tracks, runways and storage space, all located with a view to concentrating work and materials into definite groups.

Ample lighting is essential. Roof and walls should be so constructed as to admit the maximum amount of natural light and ample artificial light should be provided, equivalent to that required in locomotive shops. Interior walls and ceilings should be painted and maintained as nearly white as possible. A temperature of between 40 and 50 deg. F. should be maintained in the shop, but 60 to 70 deg. is preferable in adjacent machine sections and other points requiring operators to remain stationary at tools. The expense permissible in providing a heating plant will be governed largely by the form of construction to be employed. It should be remembered that during cold weather equipment has to be thawed out when brought into the shop in order to facilitate repairs, so that the heat should be delivered as near the floor as practicable and well distributed so as to avoid drafts.

New Tests on Bond Resistance

Results of the investigations made for the Emergency Fleet Corporation during the war on the possible corrosion of embedded steel and the effect on bond resistance of various methods of treatment are reported upon in Technologic Paper No. 173 of the Bureau of Standards by W. A. Slater, F. E. Richart and G. E. Scofield. The outline of these tests has been reported at various other times. The full statement has nowhere before been made available. The tests comprise tests with bars treated to prevent corrosion, investigation of individual protective coatings in their relation to bond, effect of variations and conditions of storage, comparison of plain and deformed bars, effect of the manner of applying coatings, and effect of lap.

Antioch Wins Injunction in Suit Over Brackish Water

THE town of Antioch, Cal., which is located on the tidal reaches of the San Joaquin River, has been granted a temporary injunction by the superior court of Alameda County, forbidding irrigators to divert water from the Sacramento River above Antioch on the grounds (1) that Antioch has unquestionable right to take 500,000 gal. of fresh water per day from the river for municipal uses, and (2) that water drawn from the upper river for irrigation uses was at least a contributing cause in rendering the Antioch supply unfit for domestic use in 1920. However, the court warned all concerned that the issue of the temporary injunction to protect rights which seemed to be endangered must not be construed as in any way indicating the action of the court when the suit came to be tried on its merits. The prayer for the injunction named specifically irrigation districts, companies and individuals owning about 450,000 acres of agricultural land in the upper Sacramento Valley. The case is reported to foreshadow still more important suits that may be filed by owners of large areas of irrigable delta lands who claim that the use of brackish water for irrigation will damage their land. Throughout the controversy the current question has been, "Can up-river irrigators be held responsible for the brackish condition of river water?" A summary of local conditions and of the testimony follows:

WATER NETWORK IN THE VICINITY OF ANTIOCH, CAL.

Antioch, which has a population of 1,940, pumps its water supply from the San Joaquin River. The Sacramento River, supplying 80 per cent of the combined flow of the two rivers, affects conditions at Antioch through sloughs connecting the two streams in the delta lands above the town (see map). In the lower reaches of both rivers the tidal effect is strong. In the upper end of Suisun Bay there is at times a tidal range of 7 ft. At a 6-ft. range about 80,000 acre-ft. of bay water flows upstream into the mouths of the rivers and it is the salt in this bay water that causes the complaint.

Upper Suisun Bay is fresh through winter and spring when the rivers are high. In the summer the water grows brackish, the salt content increasing up to the end of the low-water season. There is a wide variation in the annual discharge of these two streams. In 58 years it has ranged from 40 to about 265 per cent of the normal. The maximum salt content at Antioch, as determined by the State Water Commission during the latter part of August and September, 1920, ranged from 0.75 to 0.9 parts per hundred at low tide up to 1 to 1.2 parts per hundred at high tide.

Court Proceedings

In the court proceedings Antioch attempted to establish its riparian rights and to show that these took precedence over the rights of all appropriators on the Sacramento or San Joaquin rivers; that it is entitled to a certain amount of pure water and that upstream appropriators by diverting fresh water and causing salt water to flow in are as guilty of polluting the water as though they placed salt in the river.

The defense claimed (1) that the taking of water out of the river did not constitute pollution; (2) that the riparian rights of Antioch were dependent on its ownership of 0.46 acres of land which could not be irrigated because of its use as a site for pumping and filtration plants; (3) that a town in its corporate capacity cannot function as a riparian owner; (4) that water pumped from the river by a pumping plant located on riparian land cannot be taken and used for domestic or other purposes on land which is non-riparian to the river, except as an appropriation of the water; (5) that Antioch, as an appropriator, has no rights in excess of 500,000 gal. of water per day and cannot claim the entire low-water flow of the Sacramento River to keep the water fresh at its pumping plant; (6) that the maintenance of the entire low-water flow of the Sacramento River to supply that amount of water to Antioch would not be the highest use to which this water could be put.

By its expert testimony, Antioch attempted to show that the salinity of water at its intake depended directly on the flow in the Sacramento River at Sacramento and that a continuous flow of 3,500 sec.-ft. at Sacramento would be necessary to keep the water fresh at Antioch.

Experts for the defense essayed to show that several causes had contributed to salinity at Antioch in recent years. These were (1) the succession of dry years from 1916 to 1920; (2) government dredging in the river between 1913 and 1920, which had modified the tidal flow in the lower rivers, increased the circulation of water around Sherman Island and hence contributed to salinity of water flowing through three-mile slough; (3) the withdrawal of large overflow basins on Sacramento River through reclamation, thereby reducing the retarding effect on river flow and causing the river to reach its lowest stage earlier than under original conditions.

The defense admitted that the use of water for irrigation purposes was a contributing cause but contended that for the other reasons cited the conditions in the low-water season of 1919-1920 were such that even if the injunction sought had been made operative in July, and a flow of 3,500 sec.-ft. had been maintained at Sacramento, the water would not have been fresh at Antioch until winter rains came, and meantime the defendants would have suffered the loss of their crops.

A Modernized Plant to Handle Asphaltic Oils for Road Use

THE equipment for handling asphaltic oil in the San Jose yard of the California Highway Commission has recently been entirely rebuilt in order to make radical changes in the design and method of operation. The old plant was up to date when built, presumably, because it was designed by a company whose business was the handling of asphaltic materials. However, in the light of the commission's experience in recent years in handling oil for road use, it was possible to improve practically every important feature of the old plant. The time of both heating and pumping was greatly reduced, the fuel cost was cut 50 per cent, the necessary labor force was cut about 90 per cent, the very serious danger of fire was largely eliminated and it is now said to be almost impossible for the oil to "freeze up" in the pipe and pumps.

Fire Hazard in Old Plant

In the old plant, oil was pumped from the tank cars to vats. Before the pumping could commence, however, a car had to be steamed sometimes as much as sixteen hours, and not infrequently five days were required to complete the unloading. Wood fires were built under the vats to heat the oil before delivery and these fires had to be watched carefully to prevent the oil from boiling over, which was liable to set the plant on fire, as the hot oil overflowed directly into the fire pit. The pipes were often drained to prevent the "freezing," but there was no place to drain the piping system except onto the surface of the yard. This meant waste, nuisance and fire danger.

In laying out the new system provision was made for a gravity flow from tank cars on a spur track in the yard to underground concrete tanks. Three underground tanks, each with a capacity equal to that of two tank cars, were built. The pipes through which the oil flows from the tank cars each contain a small steam pipe for heating purposes so that as soon as steam is turned on, the valve in the tank car is opened and oil begins to flow almost immediately. With this arrangement it ordinarily takes only about 7½ hours to steam and empty a car. The pipes through which oil is delivered from the underground tanks were run on an upgrade so that as soon as the pumps are stopped the hot oil in the piping system drains back into the tanks. These pipes were insulated with asbestos to conserve the heat.

Underground Tanks

The underground tanks each have two small and two large compartments. By means of interconnecting gates, all the compartments can be utilized as a single container, or the gates in the partitions may be closed and the separate compartments used independently. Steam coils are provided in the smaller tanks and when the oil is to be drawn out they are heated first. As soon as the steam coils have brought the oil to a temperature at which it can be pumped, it is drawn out and circulated through a small retort. For a while the hot oil is returned to the small compartment until all the oil in this compartment is brought to a high temperature. The hot oil is then turned into the larger compartment whence it is circulated through the retort until the temperature throughout this compartment reaches the desired point and the oil is ready for delivery.

Thus, the only equipment required, in addition to tanks and piping systems, is a steam-driven, centrifugal pump for drawing oil out of the underground tanks, and an oil-burning retort for heating it. The retort is of the standard type and has a circulating system of 3-in. pipes, which is the same size as the delivery line for the underground tanks. The retort has a brick setting and is located alongside the underground tanks. The pump, protected by a galvanized-iron housing, is set on the pipe line between tanks and retort. Steam for the pump is provided from the central boiler plant built to supply the heat and power requirements of the yard.

Instead of a crew of four men, which was formerly necessary to handle the pumping system, the work now required is easily done by the fireman and the plant engineer. This consists chiefly of making the pipe connections to the tank car, starting the oil fire in the retort, starting up the oil pump, etc. With the new system, oil in the underground tanks can be brought to a temperature ready for delivery within four hours, or approximately one-sixth the time required with the old plant.

An Estimate of Hoover

THERE have been thousands of estimates of Herbert Hoover published in American and foreign newspapers and magazines, but the following, from the *New Republic* of March 9, indicates a grasp of Hoover's engineering characteristics that is not often found in the general press:

In the way he accepted his post in the cabinet, Mr. Hoover again displayed a hint of that quality which makes him easily the most constructive man in American public life. For no sooner was it admitted that Mr. Harding had invited Mr. Hoover than the evidences of Mr. Hoover thinking of what could be made of the job were seen. Of all the cabinet choices he alone, and he immediately, did the thing which is both remarkable and obvious: he showed that he was studying his opportunity and using his imagination upon it.

In our time there has been no one with quite such an appetite and such digestion for concrete fact joined to quite such a faculty for using knowledge as the basis of power. Contrast him with the man who always starts with a moral maxim; contrast him with the man who starts in some corner of the facts and ends among the wishes of interested friends. The contrast supplies a notion of the type of man who in the complicated novelties of modern civilization is needed to administer great affairs.

There seems to have gone into the making of Hoover several strains often enough found in different men, but rarely in the same one. The first of these, and the least common, is a habit of scientific estimate, an ability to think quantitatively, an ability, not only to let the facts speak for themselves, but to make them speak. A second strain, common enough by itself, but rare in a scientifically trained man, is that of the shrewd and daring trader. The story of Mr. Hoover's dealings with suspicious governments before we entered the war, and since the armistice, is a record of incredible resource and ingenuity. He plays his whole hand for all that it is worth.

But all of this would not alone have given Mr. Hoover his extraordinary place in modern life. Back of it is a gift for seeing the human reality in a true order of values. In 1914 there were plenty of people who wanted to save Belgium, yet without the Belgian relief it is possible that Belgium would have been torn to tatters in the process. The idea of saving the people that you are out to save by saving them, feeding them, sustaining them, holding them together, even though they are on the other side of the battle-line was one of those direct and unheard of performances that are a mark of genius.

American Railway Engineering Association Convention

Rail Situation Explained—Improvement in Track Labor Conditions Needed—Capacity of Old Bridges—Electrification—Wider Use of Standards

RAIL SPECIFICATIONS, the track labor problem and proposed rules for rating the capacity of existing bridges were the high points of discussion at the 22d annual convention of the American Railway Engineering Association, held at Chicago March 15-17. The interesting feature of the rail situation was a statement explaining the present deadlock due to the refusal of the mills to accept the new A. R. E. A. specifications. The other two subjects developed extensive and controversial discussion. Apart from these subjects the proceedings were largely uneventful, characterized by limited discussion in adopting specifications and other material for revision of the *Manual*, together with the acceptance of a large amount of information on a variety of subjects. This result may have been due in part to the overpowering effect of the mass of material submitted by 25 committees, nearly all of which dealt with four or five subjects, the reports for the convention covering approximately 1,000 printed pages. A news report of the convention appears in the news section of this issue. A summary of the technical discussions follows.

Deadlock in Rail Specifications

An important development of the meeting was a letter sent by the chairman of the committee on Rail, G. J. Ray (D., L. & W. R. R.) supplementing the committee's report. Mr. Ray, who was unable to be present, stated that no rails have yet been rolled to the specifications adopted in 1920 owing to the action of the manufacturers, who will not accept these specifications for rails of more than 110 lb. per yard and will only meet them for rails of less weight subject to certain modifications and an extra price. Mr. Ray believes that some of the claims of the manufacturers are reasonable, but on the other hand they have offered no constructive criticism of the specification. Their general attitude is that their own specifications and the 1915 specifications of the Association are satisfactory, that the 1920 changes will prove costly without improving the quality of the rail and that railways are not sufficiently interested in furnishing better rails to pay the extra cost of production. No action was taken or requested, but the committee this year will consider whether to adopt two specifications (for different grades of rail) or to adopt a single specification which will not require extra cost but will be accompanied by a list of specific requirements and their probable cost, for the benefit of railways requiring rails of higher grade.

As to the specifications in use, C. W. Gennett, Jr., (R. W. Hunt & Co.) estimated that those of the manufacturers represented the largest proportion of the 1920 tonnage, with the A. R. E. A. specifications of 1915 ranking second. In 1920 mills were slow to adopt special means of securing sounder ingots. Rails from the tops of ingots average 15 per cent of the production. They are all under suspicion but their price is the same as that of the others. Increase of distance between supports in the cold straightening press from 42 in. to 60 in. at some mills has given favorable results, due to reducing the punishment of the rails in this process.

The relation of shattered steel in fissured rails to the mill end of the rail was discussed by M. H. Wickhorst, and there was a report by P. H. Dudley (N. Y. Central) showing good ductility in the heads of old rails. Forms for reports of rail fractures were submitted by the committee and were adopted after some discussion as to making them clear to section foremen.

Supplementing a progress report on stresses in track Prof. A. N. Talbot outlined some later results obtained on curves. There is a high bending stress in the inner rail at the third or fourth driving wheel, though this decreases as speed increases. Lateral bending in the outer rail is found at the leading truck and first driver and at the last driver and trailing wheel, which stress increases with the speed. Tests are now being made to determine the transmission of stresses through the splice bars at rail joints.

Economics of Track Labor

It is thought that the committee on Economics of Railway Track Labor lost an opportunity when it made a good report but failed to present any definite conclusion for adoption, as evidenced by the prolonged and vigorous discussion of the subject. In the committee's opinion the railways and the engineers have not observed the lessons of the past few years and have taken no action towards overcoming the economic conditions which result in serious labor shortage each year. Intermittent work with alternate hiring and firing of forces and the continual training of green men is still common practice. Little has been done in the direction of permanent employment for skilled men over the entire year.

Standard methods of maintenance-of-way work should be considered first, in the opinion of Earl Stimson (Baltimore & Ohio). He thought that the committee had put the cart before the horse in leaving this subject for the future. This view was controverted at once and with emphasis, the general opinion being that the committee was right in first studying how to get and keep the men. It was stated by C. H. Stein (Central of New Jersey) that the labor question in these days is a psychological as well as a financial and an economic problem. Stress was laid upon the necessity of permanent employment. How can loyalty or interest be expected from men who know that they are engaged only for seasonal work and that they are likely to be discharged at any time. C. A. Morse (Rock Island Lines) showed that some part of track work requires skilled labor, although the railroads have never gotten beyond the point of considering that every man who works on a section gang is a common laborer. The skilled track labor at least should be retained permanently. Further, Mr. Morse suggested that foremen of track, water service, signal and bridge and building gangs should be trained in the habit of planning their work in advance.

In this connection the committee on Track reported that little maintenance-of-way work is now handled under contract or piecework. The Pennsylvania R.R. and Baltimore & Ohio R.R. had track work systems which included the establishment of unit performance

for piecework schedules, but these systems were abandoned by the U. S. Railroad Administration and have not been re-established. Many roads have employed a cost-plus form of contract in handling maintenance work during the past year, but in effect this was little more than the recognition of the contractor as a labor agent, the work being, as usual, under the direction of the regular railway officers. Published comparisons of the effective work of individuals or groups were suggested by the committee on Economics of Railway Operation as a means of stimulating friendly rivalry and thus increasing the efficiency of maintenance-of-way employees.

Other economic subjects were passed with little attention after the labor discussion noted above. The committee on Economics of Railway Location reported on train resistance and a comparison of electric and steam locomotives. The committee on Economics of Railway Operation discussed the subject of determining and increasing the traffic capacity of a railway and the effect of speed of trains on cost of operation. The latter subject was divided into three parts, dealing with track maintenance work, maintenance cost and transportation cost. All were progress reports and no conclusions were presented.

Capacity Rating of Old Bridges

Rules and unit stresses for the rating of existing bridges were presented as the principal subject of the report of the committee on Iron and Steel Structures. In the prolonged discussion several speakers objected to the rating stress of 20,000 lb. permitted for structures of wrought iron and bessemer steel as being too high for old structures. Although supporting this objection C. F. Loweth (C., M. & St. P.) stated that in many cases he had been obliged to carry old bridges in service where the stresses were fully as high as those permitted by this report. In such cases the type and weight of locomotives has been restricted, but there is always the tendency to assume that the structure is safe and then to forget about it. Owing to the time which elapses between the decision to renew a bridge and the actual construction of the new bridge the old structure may be kept in service without proper regard to the margin of safety decided upon at the time of inspection.

Mr. Loweth proposed that a lower stress be specified, with the provision that a higher figure might be allowed in structures which can be kept under close supervision. Such action was opposed by G. H. Tinker (N. Y. Central), who urged understanding that the unit stress specified is a limit which may not be exceeded. It was pointed out by B. R. Leffler (N. Y. Central) that the proposed rules are not intended to give the idea that any bridge is safe if its stresses do not exceed those specified. They are for the guidance of experienced bridge engineers who will keep watch of the structures in accordance with the conditions discovered. Mr. Loweth also agreed that the rules should make it plain that the bridges are under suspicion and require frequent examination, and that the relatively high stresses permitted are for structures intended for early renewal. As to the final action in ordering renewal P. B. Motley (Canadian Pacific) stated that this responsibility must fall upon some one man of sufficiently strong personality to compel renewals, where proper, in spite of objections on the score of cost.

Use of the extensometer in determining the stresses in old bridges was endorsed both by Mr. Motley and Mr. Robbins (Interstate Commerce Commission). Mr. Robbins has found that in many members actual stresses exceeded those determined by computation. Professor Wilson (University of Illinois) considered that weakening of bridges is due to the working loose of connections rather than to the deterioration of metal in the members. Tests have shown that repetition of stresses will loosen the rivets in connections where the stress is only half that permitted by the A. R. E. A. specifications for bridge design. In reply to this Mr. Tinker remarked that reversal of stress is not likely to occur except at points where it has been provided for. Where the stress is always in one direction it may be repeated so many times without causing loosening of the rivets that it may be allowed to approach closer to the full elastic limit.

Railway Electrification

The subject of steam railway electrification was dealt with directly and indirectly in two or three reports. The committee on Electricity suggested that steam auxiliaries may be necessary with hydro-electric plants, as thirty-three out of fifty-three large hydro-electric installations east of the Mississippi River are thus augmented, mainly to care for the dry season. Electric interference with telephone and other lines was also discussed. On the basis of experience with electric traction on the Norfolk & Western R.R. the committee concludes that 44,000 volt current for transmission and 11,000 volt single-phase current for the trolley line are practicable for lines having heavy grades and heavy traffic, and that probably this system will effect a saving of at least 12 per cent of the total annual expense as compared with steam operation.

Electrification cannot be undertaken wholesale, according to the committee on Economics of Railway Location, partly because of the enormous capital outlay and partly because each road or even each subdivision is a problem in itself. On the other hand, within the past few years the efficiency of the modern steam locomotive has been increased about 50 per cent by improvements which have increased the tractive power and the sustained hauling power, as well as the economy in fuel and water. Profits from electrification must be realized indirectly in a majority of cases, as in increased track capacity or the postponing of second track.

Earthwork Shrinkage

For shrinkage of earth removed from excavation to embankment an allowance of 10 per cent of quantities measured in excavation was adopted. The words "measured in excavation" were added to the conclusion as presented by the committee on Roadway, as it was shown in the discussion that the embankment quantity is sometimes taken as the basis. For swell of rock it was concluded that local conditions must be used as a guide, no general figure being applicable. According to a new definition adopted shrinkage is "the difference in volume between the material excavated and the ultimate volume of the same material in the embankment after it has reached a state of equilibrium."

Settlement is denoted as "the reduction in height of an embankment caused by shrinkage or subsidence." The committee's report supported the comparatively recent idea that subsidence occurs under all embankments except those on rock, but stated that serious subsidence is local, so that no rule can be given for estimating it.

With the adoption of standard specifications for ties, submitted by the committee on Ties in form practically identical with those adopted in January by the National Tie Producers' Association, it is considered that a long step has been taken in the efficient use of timber for this purpose. Investigation has shown, however, that no railways are using the earlier A. R. E. A. specifications. The need for supervision of committees to prevent overlapping work, with perhaps conflicting results, was evident when it was pointed out in the discussion that the committee on Wooden Bridges had also submitted independent specifications for ties. In regard to the economic values of different sizes the tie committee has found varying opinions but little definite knowledge. It considers that the difficult factor of traffic must receive more attention before comparisons or conclusions can be made. The report concluded with the usual review of substitute ties and urged that railways should provide adequate facilities for extensive tests of such ties. In the report of the committee on Wood Preservation it was stated that ties treated with water-gas tar have given good results and that further trial is advisable. Tests with sodium chloride are also desirable, in view of the possibility of this material being obtainable at a price very nearly that of zinc chloride.

Plans and specifications for switches and frogs, submitted by the committee on Track, were adopted after brief discussion. The design for a clamped frog was specially commended by J. L. Campbell (El Paso & Southwestern). The value of a lengthy report on gages and flangeway widths for curved crossings was disputed, as locomotives have such extreme variations in length of wheelbase and gage of driving wheels that no reliable conclusions can be drawn. It was suggested that the mechanical section of the American Railway Association should be asked to try to effect some uniformity in this matter. It was remarked also that curved crossings are bad in practice, but to this it was replied that frogs on curved track introduced the same conditions. It appears that the Association's standards on flangeways and curve gage are not followed in practice.

Track Tool Standards

Standardization of ballasting tools was proposed by the committee on Ballast, which submitted drawings and specifications for tamping bars, tamping picks, forks and shovels. No action was taken. The introduction of these designs depends upon both the railways and the manufacturers, but the latter have shown little interest as none of them replied to the committee's request for discussion of the proposed designs. Standard designs for track tools were adopted several years ago by the Roadmasters Association but they were used only to a very limited extent.

Other subjects covered in the report are specifications for stone and ground ballast, instructions for ballasting operated lines and the organization of a ballast raising gang of 77 men. According to the report opinion generally is strongly opposed to ballasting by contract in normal times, and especially on operated work. Concrete slabs under the ballast on soft roadbed are considered to prove successful at reasonable expense. The specifications were adopted with little discussion. For washed gravel they limited the sand to 15 to 20 per cent. J. E. Willoughby (Atlantic Coast Line) thought that a higher proportion of sand might be used, but the committee considered 20 per cent sufficient for average conditions. It would be inclined rather to lower the minimum than to raise the maximum.

Temporary signal protection for track work or emergency conditions was outlined by the committee on Signals and Interlocking. Present specifications for galvanized wire fencing are to be omitted from the *Manual*, on recommendation of the committee on Signs, Fences and Crossings, on the ground that they are inconsistent. Several roadway signs were adopted, having sheet iron targets on boiler tube posts set in concrete, but why a sign of the same type for valuation sections should have a cast-iron target the committee could not explain in the absence of one of its members. It was suggested, however, that it might be considered of a more permanent character than the others. Designs for concrete mile posts (triangular section) and property posts (rectangular) were adopted. A summary of legislative requirements as to highway grade crossings and separation of grades was submitted with the report.

Bridges and Masonry

As a preliminary to preparing standard designs for timber trestles the committee on Wooden Bridges and Trestles suggested that the E-45 loading is a minimum, E-55 generally sufficient and E-65 the maximum for which a practicable trestle can be designed with the kinds of wood generally available. A 12-ft. span or panel length was recommended, as 16-in. stringers will be available without undue cost as long as yellow pine timber lasts, but 18-in. stringers for longer spans are doubtful. The proposed loadings were objected to by E. A. Frink (Seaboard Air Line), who considered that they should conform to those of specifications for steel bridges. He also questioned the economy of 16-in. stringers. Specifications and classification and grading rules for lumber were adopted after a discussion which related to the advisability of adoption rather than to any specific criticisms.

Slump tests for concrete noted by the committee on masonry were objected to by A. F. Robinson (A., T. & S. F.), who thought they would be unsatisfactory unless made by an expert. What is needed is a set of rules that can be carried out by any intelligent foreman. Further, more attention needs to be given to the time of mixing. Another important matter is the care of fresh concrete after it has been placed. In arid districts concrete dries out rapidly and is usually not so good as that in more humid districts. Mr. Robinson proposes to try coating the concrete with some waterproofing material which will retain the moisture and permit complete hydration of the cement. According to the report of the committee concrete exposed to moisture will continue to increase in strength for some years, but if exposed to dry air there will be little gain. It was announced by the chairman, J. J. Yates (Central of New Jersey) that the joint committee on specifications for concrete and reinforced concrete expects to issue a draft of its specifications in May.

Electrolytic effect on reinforced concrete was discussed briefly by the committee on Electricity, which reported in favor of a waterproof shell, as this will not only exclude moisture but also prevent abrasion of the concrete. A waterproof pitch which will remain flexible is the best lining for the shell and samples of such material have been found elastic after twelve years' experience.

Intensive use of freight house sites on costly land or in congested districts by placing tracks on two floors and providing upper floors for warehouse purposes was recommended by the committee on Yards and Terminals. Improved handling of freight at freight houses has been mainly in the use of tractors as conveyors. Trolley hoists, having fixed paths, are better adapted to warehouse than to freight house service. Plans were submitted, and adopted, for typical track layouts and ladder tracks at passenger stations.

Methods of ascertaining the cost of new construction for buildings of different types were presented by the committee on Buildings, the price per cubic foot being considered satisfactory for estimating for a number of buildings of similar type. Standard specifications for railway buildings were submitted but no action was taken. The new committee on Shops and Terminals submitted a progress report on the design of car shops, with plans of existing shops. It presented also an illustrated classification of railway ashpits.

Standards, Records and Organization

In a progress report the committee on Standardization, which is composed of the chairmen of the several committees, pointed out that an important phase of its work is to secure the more general use of the standards, specifications and recommendations of the Association. It suggested that each committee should be requested to recommend subjects for standards. As a preliminary to a study of the presentation of engineering data in diagram or graphic form the committee on Records and Accounts submitted a 12-page bibliography. Rules for the guidance of engineering field parties and instructions for maintenance-of-way employees, submitted by the committee on Rules and Organization were adopted after some dispute over individual rules. As to organization, mention may be made of figures given by the committee on Economics of Track Labor for 60 railways aggregating 152,000 miles of main track. Although 75 per cent of these have the divisional system 72 per cent make an engineer or the engineering department responsible for maintenance-of-way and 65 per cent give preference to engineers in selecting division officers in charge of maintenance. Further, 50 per cent of the roadmasters and track supervisors have had engineering training.

Expanded Metal Showed Up Well in Slab Test

In the note describing the comparative tests of two slabs, one reinforced with rods, the other with expanded metal, in *Engineering News-Record,* March 10, 1921, p. 417, the data on the behavior of the slabs were transposed so as to make it appear that the expanded metal did not act as well as it actually did. The correct statement as to the behavior of the slabs is as follows: In the rod reinforced slab the first cracks were observed at 661 lb. per square foot, when the center deflection was 0.19 in.; the total load sustained was 1,245 lb. at which load the deflection was 1.055 in., and as the previous readings indicated rapidly increasing deflections it was decided not to continue the loading to complete failure. In the expanded metal slab the first cracks were observed at 713 lb. per square foot, at which point the center deflection was 0.15 in.; the total load sustained was 1,153 lb. and the deflection taken on the next to last load was 1.09 in.

Shall Corporations and Partnerships Practice Engineering?

Arguments Advanced for and Against Such Practice in Petitions Presented to the New York Legislature

(Details as to the status of this case will be found in the News Section of this issue, page 524.)

As set forth in the News Section petitions have been sent to the members of the New York Legislature for and against the provision in the present law which allows corporations and partnerships to practice engineering. The provision in question follows that of Engineering Council's model bill, and requires that the persons in such corporations and partnerships who are "in charge of the designing or supervision which constitutes such practice" must be licensed engineers.

Opposing Argument

The petition, sent by the American Institute of Consulting Engineers, but containing also the names of non-members of the institute, opposes practice by corporations and partnerships, and was sent to the Legislature first. The body of it, containing the reasons for the petitioners' position, is as follows:

(a) It [permission to corporations, partnerships and joint stock associations to practice] nullifies the intent of the law, in permitting groups of non-engineers, under the guise of corporations, unrestricted partnerships and joint stock associations, indirectly to do those very things that the individual non-engineer is prohibited from doing;

(b) It sanctions a practice that easily may be made an immoral one, in permitting an aggregation of individuals, in whole or part non-engineers, to serve in the dual capacity of supposedly disinterested professional advisers to a client and at the same time as self-interested financiers, sellers or contractors in the execution and supervision of the work in connection with which such professional advice is given, such sanction being diametrically opposed to the universally recognized rule that the engineer shall not be personally interested, directly or indirectly, in a company with which he has relations on behalf of his employer or client;

(c) It permits the relegation of the professional engineer in the employ of an engineering corporation or unrestricted partnership, made up in whole or part of non-engineers, to a position of anonymity or to that of the servant, relieving him of all professional responsibility to the client and placing him under the direction of those whose primary interest is a banker's or contractor's profit;

(d) It permits conditions under which a group constituted in whole or part of non-engineers, with impunity may violate the codes of ethics that have been adopted by various professional societies for the guidance of their members and for the protection of the public;

(e) It places the holder of a license issued by this state on a plane inferior to that existing in seven of the ten other states of the Union, in which licenses to practice the profession are now required and on a plane inferior to that existing in Canada;

(f) It lowers the dignity and standing of the profession of engineering by legalizing that which, in the penal law and other laws of the state, is stamped as illegal in the case of the professions of law, medicine, dentistry, veterinary surgery and nursing; and

(g) It is detrimental to the public interest in that it tends to force engineers in independent practice to abandon their purely professional work and affiliate with contracting or banking organizations, thus depriving the public of the disinterested and effective service of the men who hitherto have been chiefly responsible for the progress of the engineering art.

Favoring Argument

The petition of those favoring practice by corporations, partnerships and joint stock associations, forwarded to the Legislature by a group of representatives of corporations and partnerships, presents the following arguments in support of its position:

There has come to the attention of the undersigned members of the engineering profession practicing in this state in the form of an appeal to each member of the Senate and Assembly the March 16 petition of forty-three consulting engineers communicated by the American Institute of Consulting Engineers (whose membership is about 110) urging favorable action on Senate bill No. 147, and adverse action on Senate bill No. 147,716 recently reported out by the Judiciary Committee.

In the opinion of the deputy attorney general, asked and given at one of the hearings, the former bill would, if reported and passed, so profoundly modify the existing law as to require putting into the hands of receivers and liquidating the assets of all engineering partnerships and corporations in the state.

* * * * * *

In respect to the clauses affecting partnerships, etc., the unreported Senate bill No. 147 would reverse the "model bill" of Engineering Council, the organization consisting of representatives from the great national engineering societies comprising not less than 40,000 professional engineers of all branches throughout the United States and recently merged into the American Engineering Council of the Federated American Engineering Societies.

On Feb. 14, 1921, the executive board of the American Engineering Council, Herbert Hoover presiding, unanimously voted "that this board endorses the 'uniform law for registration of architects, engineers and land surveyors' prepared by old Engineering Council's committee."

The "model bill," after which the existing statute now on the books of this state was in general patterned, and which the petitioners would reverse, has behind it the preponderating and representative professional constituency to which we have referred, and constitutes the broadest consensus of professional opinion respecting engineering corporations and partnerships, as distinguished from the opinion represented by the small group of consulting engineers who have addressed you.

Senate bill 147,716, which we endorse and which has been reported by the committee, accords with the "model bill" in safeguarding professional engineering by expressly providing that "the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint stock corporations shall be licensed engineers."

Comparison With Law and Medicine—It is an error to assume, as the consulting engineers appear to do, that the profession of engineering is like the professions of law and medicine (including dentistry and nursing). If it were their conclusions and their point of view would to a certain extent apply.

Looked at in the large, law deals with rights, medicine with life, engineering with materials. The lawyer is an officer of the court and involved in the functions of government. A breach of legal ethics robs of justice, perhaps irretrievably, and may often be concealed. The physician is the highly confidential and intimate bedside agent upon whom health and life depend. A breach of medical ethics may cost even life and be covered by the grave. The engineer, as distinguished from the pure scientist not here involved, is invariably the servant of economics or business, and is submitted invariably to the test and the involvements of commercial cost. A breach of engineering ethics affects the purse and is extraordinarily difficult long to conceal, particularly from the criticism of fellow engineers, for the engineer's structures, machines and combinations are tangible evidences before the eyes of the world. They represent a field to a high degree less personal than the fields of law and medicine.

The ethics of engineering revolves about a different axis from the ethics of law or medicine.

Reason for Group Organization—These are reasons why engineering would receive a heavy blow if professional engineers were deprived of the right of doing their work in groups either through corporations or partnerships and forced to split up into individual practitioners.

The engineering profession has been growing by leaps and bounds. It started about 150 years ago with civil engineering. Ten years ago the number of officially recognized branches was twenty-seven. Today the Department of Education of the State of New York recognizes forty-two, among them being civil, mining, mechanical, electrical, metallurgical, illuminating, insurance, heating and ventilating, chemical, aëronautical, hydraulic, marine, refrigerating, automotive, industrial, structural—not to mention more.

A single engineer cannot in justice to the public today profess to be an expert in more than two or three of these branches at once, yet the increasing magnitude and diversity of engineering projects often involves many and sometimes a majority of the branches mentioned.

If bill No. 147 should become law, which the consulting engineers urge, the individual could not with his fellows form an engineering partnership better to cover the engineering field. If he hired professional engineers as his employees he would be committing the evil the petition cites against corporations and partnerships; namely, relegating the professional engineer "to a position of anonymity or to that of the servant."

If it be once recognized that the art of engineering has grown broader than the capacity of an individual personal practice then both in respect to technical equipment and to working capital, it will be seen that the engineering partnership and the engineering corporation, far from being evils, are necessities—opportunities enabling many thousands of engineers to co-operate with each other and with the public in a way otherwise closed to them.

The increasing number and success of the groups does not lead but follows the trend of the day. The public demands service in larger units under greater concentration of responsibility at greater efficiency of direction and accompanied by greater pecuniary responsibility than a number of separate consulting engineers could supply.

Construction Work—To cite certain abuses of engineering partnerships and corporations as possible without reference to certain abuses in individual practice as also possible does not give a balanced picture.

The individual consulting engineers further say "(g) It is detrimental to the public interest in that it tends to force engineers in independent practice to abandon their purely professional work and affiliate with contractor or banking organizations, thus depriving the public of the disinterested and effective services of the men who have hitherto been chiefly responsible for the progress of the engineering art."

The progress of the engineering art is a big thing. It is tending to rank construction a part of engineering fully as much as design. The definition written on the walls of the great national Engineering Library begins, "Engineering is the art of organizing and directing men and of * * *."

If we understand them right the individual consulting engineers regard performance of the function of construction as incompatible with "purely professional work," and a certain type of lump-sum contractor who loses business when the functions of design and construction are combined agrees with them.

But the advantages to the client (the public) in combining engineering and construction through the saving of time, of cost, and through the greater control permitted him over his project are so great that in recent years constantly increasing numbers of clients prefer to have their work thus carried out.

Where design and construction are simultaneously performed by the same engineer, partnership or corporation a much larger capital is necessary than for design alone and the affording of this capital is an additional reason for the growth of engineering partnerships and corporations.

These, for stipulated and relatively small fees, put themselves in the position of trusted agent for the client (the

public), as which agent they perform for him exactly the same services in design and construction as he would perform for himself if all the engineers and constructors were his own employees.

This comprehensive service often involves the purchase and installation for the client's account of many millions of dollars worth annually of machinery, apparatus and supplies and these purchases are business dealings requiring specialists of a very high order of commercial ability and integrity to protect the client's interest. While the client reimburses the engineer for expenditures for purchases, for payroll, etc., the working capital required to carry on the business prior to reimbursement, to furnish plant and other equipment, and to be absorbed as working capital in the form of accounts and bills receivable in the same fashion that any other business absorbs it, is large, usually reaching figures beyond the capacity of individuals and especially of professional individuals to furnish.

The possession of larger capital renders the engineering partnership or corporation much more responsible at law than the individual consulting engineer for any malpractice it may perform, or culpable error it may commit and the fact that engineering partnerships and corporations can be sued with advantage for breaches of trust, for violations of law, for carelessness and other acts render dealings with them more satsifactory than dealings with individuals of less pecuniary responsibility, while it makes for acute consciousness of liabilities.

These are reasons why industrial corporations, banks and syndicates of capitalists and investors which furnish work for the engineer are tending more and more to deal with the groups rather than with the less pecuniarily responsible although no less professionally responsible individual engineers, and we repeat that the present law, together with the reported bill which we endorse, requires of partnerships and corporations that the persons carrying on the actual practice of enginereing on their behalf must be licensed engineers.

In simultaneously performing the functions of design and of construction or in performing the function of design for one client and of construction for another, whether in the latter case the work be carried out by lump sum contract or otherwise, it is impossible to discover any serving "in the dual capacity of supposedly disinterested professional advisors to a client and at the same time as self-interested financiers, sellers or contractors in the execution and supervision of the work."

There is no impropriety in receiving a stipulated fee for construction or a stipulated fee for design, or in receiving a larger stipulated fee for a combination of both.

When doing both, the interest of the engineer, partnership or corporation is wholly identified with the interest of the client and is not opposite.

There is a skill in designing that only experience in construction can give and there is a skill in construction that only experience in designing can give, and the consulting engineer who would suppress engineering partnerships and engineering corporations and thereby withdraw the possibility of group action and of capital for a larger scale and more progressive engineering business, instead of being "chiefly responsible for the progress of the engineering art" aims a blow at one of the rapidly growing and successfully developing functions of that art—the function of construction.

Student Chapters, American Society of Civil Engineers

Student chapters of the American Society of Civil Engineers number fifteen according to the February issue of the society's *Proceedings*. The chapters are located at the following institutions: Cincinnati, Rensselaer, Drexel, Iowa State, Pennsylvania State, Rutgers, Stanford, University of Iowa, Colorado, Kentucky, Pennsylvania, Pittsburgh, Texas, Wisconsin and Washington.

Tuning Up the East Chicago Filters

DIATOMS in the supply and overload in capacity combined to make runs of the filters exceedingly short in the early operation of the filter plant at East Chicago, Ind. H. E. Jordan, superintendent of filtration, Indianapolis Water Co., in a paper presented recently to the Indiana Sanitary & Water Supply Association outlined some of the "tuning up" difficulties at this new plant put into operation Nov. 11, 1920. The plant has a nominal capacity of 8 m.g.d., operating at the rate of 125 m.g.d. per acre. The 36,000 people served had been using 300 to 360 gal. each per 24 hours of the unfiltered water. Filters were built with the understanding that meters would be set on every service. As soon as the consumers have been educated to the direct relation between waste and payment the rates will drop below the nominal capacity. In fact a drop has already been noted from 10.4 m.g.d. in December and January to 9.9 m.g.d. during the first 12 days of February.

Essential features of the plant are six 24 x 20-ft. 3-in. filters, a four-compartment sedimentation basin of 4 hours' detention period, mixing tanks comprising two units of four tanks each with horizontal baffles to give a velocity 1 to 2 sec.-ft. and nominal detention period of 4 min., a 75,000-gal. wash-water tank on the third floor of the chemical house, duplicate dry-feed chemical apparatus and three filtered water basins, two being under the filter tanks. The perforated pipe underdrains in the filters consist of 2½-in. wrought-iron laterals spaced 6 in. c. to c., with two rows of ⅜-in. perforations on the underside spaced 3 in. c. to c. The gravel depth is 16 in. and the water is maintained 4.9 ft. above the 30-in. sand layer, the surface of which when at rest is 30 in. below the wash-water gutters.

The sand size originally specified was 0.3 m.m. but was increased to 0.4 m.m. before delivery. Less than 5 per cent is of the 0.3-m.m. size. The uniformity coefficient ranges from 1.35 to 1.66. Operation has stratified the sand and several inches of 0.3-m.m. size has been scraped from the surface.

The turbidity of the water is low, less than 25 p.p.m., but diatoms, mostly asterionella, range in the daily counts from 1,000 to 2,000 standard units per cubic centimeter. To reduce the number of diatoms a gradually increased amount of aluminum sulphate has been used until it appears that not less than 200 lb. per million gallons is required to reduce the microscopic content of the effluent from the sedimentation basin to less than 300 standard units.

The average length of run has ranged from 3 hours in December to 5.2 hours in February, the corresponding overload being 30 and 23 per cent. Wash water has ranged from 16.7 to 8.2 per cent.

A more serious question, however, arises in this plant, as at others on the lower end of Lake Michigan, in that steel mill quench waters and discharges from oil refineries produce unusual and disagreeable tastes. These tastes are charged up to the chlorine or to the alum treatment by the consumer. Mr. Jordan feels that it is not the duty of the water-works company or departments of these cities to extend their purification systems, even if it were possible, to meet the peculiarities of all industrial wastes but that the industries should keep these noxious materials out of the lake.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

On Corporations Practicing Engineering

Sir—A petition has been sent to the Legislature of the State of New York protesting against an amendment of the state licensing law which would permit the practicing of engineering by corporations. [The petition appears on another page of this issue.—*Editor.*] It appears to me that the profession has arrived at the parting of the ways. Either it should courageously abandon the practices which in other professions and among common carriers are forbidden by law; or else it should cease to claim a single-minded devotion to the interests of the client or employer and frankly and without cavil acknowledge itself to be a trade or business.

On this decision would seem to rest our future attitude toward the extension of engineer license laws throughout the country. If we are to assume the obligations that attach to the other professions and bar the practice of engineering by corporations, partnerships made up in whole or part of non-engineers, and joint stock associations, then the requirement that individual engineers shall be licensed, in my judgment, is logical and proper,—otherwise not.

The professional standing of the signers to the petition would seem to entitle their opinion to the earnest consideration of your readers.

New York, Mar. 17, 1921. W. J. WILGUS.

Automatic Recorder for Stream Discharge

Sir—The use of a cam to produce a float-gage record directly indicating stream discharge, described in *Engineering News-Record,* Dec. 9, 1920, p. 1124, under the heading "An Automatic Recording Apparatus for Stream Discharge" and independently invented by Prof. Irving P. Church (*Engineering News-Record,* Dec. 30, 1920, p. 1297), is antedated by a similar device which the writer saw in use at the Barking Outfall of the London Main Drainage Works in 1913. In this discharge of effluent from the precipitation tanks passed over a weir and the volume, as determined by the Francis formula, was recorded directly on the chart. KENNETH ALLEN,

New York City, Jan. 4. Sanitary Engineer Board of Estimate.

Sir—Referring to the description of Moore's attachment described as an "Automatic Recording Apparatus for Stream Discharge" in your issue of Dec. 9, 1920, p. 1124, and to Prof. Church's letter to you concerning the same appearing in your issue of Dec. 30, 1920, p. 1297, attention is directed to U. S. patents 938,850, 946,128 and 1,103,410 covering self-registering water meters, issued to the writer in 1909, 1910 and 1914.

In all of these patents the idea of using a cam with radii proportional to the discharges of any given stream for varying gage heights to control a registering device is used. The patents cover the flow of water over weirs, through orifices and in open channels. The application of this cam control to a recording as well as to a registering device is simple and was considered by me at the time of working up my patents over ten years ago. So far as I can learn my application of the idea of using a cam for determining the flow of water is the first use of the kind.

Several instruments have been made in accordance with the patents and have been reliable and reasonably accurate.

Another interesting application of the principle involved in the discharge cam was worked out by the writer in 1914 and 1915 and submitted to the U. S. Geological Survey for test. The design consisted of a device for automatically integrating the discharge of streams in acre-feet from the graphic records of automatic gage height recorders by using the integrating apparatus from one of the instruments above referred to. In this device, hand propulsion was substituted for the usual clock-drive of the water meter and a cam based on a rating curve for the stream was cut from card-board and used to establish the relation between gage and discharge. As the gage height record was run past the integrator by means of a speed drive connected with the hand drive of the integrator so geared as to co-ordinate the time elements of the integrator and the gage record, a tracer attached to the float wheel of the integrator by means of a fine flexible wire was made to trace the gage height graph and thus through the rotation of the float wheel the corresponding discharge effects were simultaneously transmitted to the integrator arm through the cam. This device converted the long and tedious computations of stream discharge into a brief operation of only a few minutes time. The machine was used in experimental demonstrations with success in the general hydrographic conference of the Geological Survey in the winter of 1915, competition with other devices having the same purpose. F. W. HANNA,

Ankeny, Iowa, Jan. 4. Consulting Engineer.

[After seeing copies of the letters from Prof. Church and Messrs. Allen and Hanna, Mr. Moore submitted the following.—EDITOR.]

Sir—My position is unchanged as to the declaration that the Stevens recorder, as equipped with the Moore discharge plotting attachment and working on the Moore special hydrographic cross section paper, is the first automatic stream discharge recorder so far developed that is satisfactory from both scientific and commercial standpoints, and is moreover quickly adaptable to any cross-section and to any stream. It is not merely a weir-discharge measuring device, as have been most of the discharge-measurers so far developed, although it can record weir-discharge of any dimension with the utmost ease, once the weir rating curve has been developed.

Although due deference is paid to the device of Prof. Church, as developed for weirs, my invention was independently developed without any knowledge of the work of Church, Hanna, Allen et al. The claim that mine is the first universally adaptable *recorder* of stream discharge is here reiterated. It is not claimed to be an *integrator,* although no doubt this feature can be easily added when desired, or if desired, which, from his experience, the author is inclined to doubt. GEORGE HOLMES MOORE.

Olympia, Wash., Feb. 14.

[To go further in clarifying the situation, *Engineering News-Record* requested Mr. Stevens to review the subject from his viewpoint. Mr. Stevens' letter follows.—EDITOR.]

Sir—The use of a cam for converting height of water into discharge was probably first used in connection with the development of recording devices for the Venturi tube, for which latter device patent 381,373 was granted to Clemens Herschel April 17, 1888.

In 1905 patent 790,693 was granted to J. W. Ledoux of Swarthmore, Pa., for a liquid-meter applicable to the Venturi tube, in which the spiral cam is used, to cause the recorder "to show the rate of flow at any instant." It is my impression that this is antedated by other patents of recording devices for the Venturi tube.

Engineering Record, Sept. 21, 1912, p. 334, describes a device for weirs and flumes designed and used by R. G. Hosea, assistant engineer Colorado Fuel & Iron Co., wherein a spiral cam somewhat similar to that shown by Mr. Moore is interposed between the float and recording pencil to cause the pencil to record rate of flow directly instead of water levels. There is no mention of a patent. The article closes with the following: "The writer noticed an illustration of a similar device said to be in use at the Hanley, England, sewage purification plant . . ." Perhaps this is similar to the recorder mentioned as having been seen by Kenneth Allan at the Barking Outfall of the London Main Drainage Works, as noted in his letter above.

On Dec. 24, 1907, patent 874,529 was granted to H. Neibuhr, "a subject of the King of Prussia, German Empire, and a resident of Hanover, Germany," covering a "device for transforming a motion variably according to any mathematical law into a uniform motion and registering the latter, [which] can be employed in connection with gas- and water-meters." This device uses a combination of cam and link and is applicable to open channels, weirs, etc., causing the pencil to record rate of flow directly.

Mr. Hanna in his letter above makes a distinction between "recording" and "registering," according to which it appears that the Moore attachment, the Ledoux patent and the Hosea and Church devices, as well as the sewage recorder in England, would be classed as "recording" devices in that they record rates of flow. The Hanna meter and the Stevens type L recorder and flow meter would be "registering" devices in that they register total volume, not rates of flow. (The Stevens recorder and meter, described on p. 531 of this issue, is covered by patent 1,356,322, for which application was filed on July 23, 1917.)

In all such recording devices the height (or pressure) of the liquid is the independent variable h to which the rate of flow q is connected by some functional relation, for example $q = kh^n$. The transformation from h to q is therefore effected by some form of cam, one co-ordinate of which is proportional to h, while the other co-ordinate is proportional to kh^n. In the case of registering devices the total volume v is obtained by some integrating mechanism involving the element of time, such that there is produced graphically or indicated by dials the integral of q with respect to the time t or $v = \int kh^n dt$.

The use of the Hanna meter for obtaining volume in acre-feet from graphic records of gage heights is ingenious and practical, but on account of the necessity of tabulating mean daily discharge has been superseded in the offices of the U. S. Geological Survey by an instrument known as the Fuller Integrator. This instrument shows on a dial the mean discharge in second-feet when the tracing point is passed over the graphic record of gage heights for one or more days. It was first designed by Edwin S. Fuller, formerly of the U. S. Geological Survey, and has been perfected by the Water Resources Branch of that Service. It is of the registering type, but automatically divides the volume integral by the time so that mean rate of flow is obtained.

It is doubtless true and not unusual that these devices should have been perfected in various parts of the world entirely independent of each other. Mr. Moore's attachment is novel in its mechanical details but the fundamental principle has been recognized many years—in fact, it is not at all unlikely that a more exhaustive research would disclose the use of the principles involved many years prior to any citation I have made.

J. C. STEVENS,
Consulting Engineer.

Portland, Ore., Feb. 19.

Getting Rid of the Bark Beetle

Sir—Your paragraph under the title, "Insects Destroy More Timber Than Do Fires," on p. 1279 of *Engineering News-Record*. Dec. 30, 1920, should be given serious attention by engineers. Conservation of forest resources, reforestation and afforestation are problems of vital interest to the nation, and engineers must give their best efforts to the solution of these problems or be victims of their own lack of foresight.

The science of forestry is in its infancy. Even in regard to the natural phenomenon of fire in the forest there is a division of opinion as to whether fire in its normal and natural operation is detrimental or beneficial to the forest. In some types of forests, fire is admittedly a natural silvicultural agent. The yellow pine forest of Klamath and Lake Counties, Ore., mentioned in your article, is one of these. Fire is caused there mostly by lightning. Suppression of these natural fires for a long period of years, however, creates an abnormal amount of forest litter and prevents the normal and natural operation of fire as a silvicultural agent. It is also claimed that suppression of fire increases the crop of beetles, the "insects which destroy more timber than do fires."

It is said that state and federal funds are insufficient for the eradication of the beetles. As now practiced, the method of eradication is a very costly one. It consists in felling and peeling the infested tree and burning the bark. It is very questionable whether this is the best and most economical method. The cost of present practice is about $3 per tree. The cost of the proposed operation of surface firing would be less than $1 per acre and, if properly engineered, should be less than five cents per acre.

The presence of the beetle is indicated by pinkish-colored pitch tubes protruding from the tree. The color is due to the particles of bark mixed in the white pitch. The mass of pitch, about 2 in. in diameter, has a tube through it, this tube extending through the bark forming an entrance or opening through which the mature beetle may pass. The larva develop in reservoirs of pitch between the wood and the bark and new galleries are cut in the soft formative tissue largely by the grubs.

When a pitch tube is set afire, it will continue to burn until the galleries are drained of the reservoirs of pitch. The bark which has been separated from the wood by the galleries will burn off to some extent; and, undoubtedly, the insect in its various stages of development is destroyed. This may be an effective and economical method of eradication of the beetle.

The California Forestry Committee, organized in 1920 to study and experiment with controlled burning and other forest problems, is giving close attention to the effect of fire upon the bar beetle. Engineers having any data on this subject should furnish this committee with same.

JOSEPH A. KITTS,
Civil Engineer, California Highway Commission.

Santa Monica, Cal., Jan. 22.

Foundation Difficulties in Plan of the New York-New Jersey Port Commission

Sir—The plans of the New York-New Jersey Port and Harbor Development Commission show a large transfer station in Jersey City where the freight is to be transferred across platforms, reloaded into small cars and taken to Manhattan over two tracks in tunnels. These tunnels form thereby a belt line railroad, reaching Manhattan at 47th St., and returning to New Jersey at or near the Battery.

Various routes are shown through Manhattan. One running along West St. with warehouses covering four, six and eight city blocks each, or sixty-eight city blocks in all. While this route is probably the least objectionable one after completion, it will be enormously expensive because this route lies almost entirely on made land, formerly reclaimed from the North River, and experience shows that foundations in this location encounter a mass of old piles, timber grillage and stone riprap, etc., making the work very slow and expensive to say the least.

The other plans show routes across the city to the East River and back again, and it is stated in the report that these tunnels would be put so far below the surface that they would not interfere with the future subways. But such tunnels crossing the lower part of Manhattan would probably wreck a great many buildings which are now resting on the surface of quicksand.

The routes along the East River would encounter much of the same material as along West St., as Pearl St. used to be the East River shore line, and as Greenwich St. was the North River shore line.

Another point in the commission's report is that these tunnels would be so far below the street level that they would not interfere with the subways running over them. But apparently the fact was overlooked that the warehouses, in the aggregate covering sixty-eight city blocks on one plan and forty-five city blocks on another would take one mass of very expensive column foundations and elevator foundations which would have to be carried down to the rock and would seriously interfere with any system of subways above it.

T. KENNARD THOMSON,
Consulting Engineer.

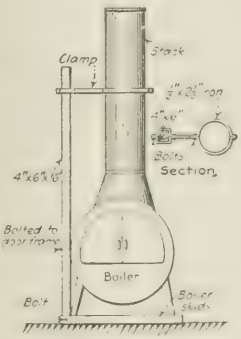
New York, March 15.

HINTS FOR THE CONTRACTOR

Timber Boiler-Stack Support for Temporary Set-Ups

By George W. McAlpin
Point Pleasant, West Virginia

FOR holding stacks on temporary boiler set-ups, such as are usually found on construction jobs, the support shown in the accompanying sketch has been found of great service.



The support is composed of a vertical 4 x 6-in. or 6 x 8-in. post, bolted to the boiler base and having, at its upper end, an iron clamp encircling and holding the stack. The clamp is quickly and easily adjusted by bolts and fastened around the stack as it is set up in position. The support is rigid, does not obstruct as do guy wires, is cheaply constructed and easily erected.

Closed-Drain Excavation in Irrigation Work Done by Dragline

By James D. Hays
Hays, Sloan & Lewis, Inc., Engineers, Boise, Idaho

MANY drainage districts in the irrigated sections are small and have combined open and closed systems. The only machine to use for the open drain is, of course, the dragline. However, we have found that for trenching in tile work the dragline compares favorably with the trenching machine, and it eliminates the additional expense incurred in the use of a second machine, for the dragline as well can be used in back filling.

On a job on which this system was used near Payette, Idaho, during 1920 the tile crew, working nine hours, could lay as many lineal feet of tile as the small dragline could dig in three 8-hr. shifts. The banks were sloped in accordance with tile conditions, so that working conditions were made safe for the men.

TRENCHING AND BACKFILLING DONE BY DRAGLINE

In backfilling a regular bucket was used, but the dump line was detached, as is indicated in the accompanying photograph. Backfilling was accomplished at about twice the speed of excavation, cutting cost in half.

Five men constituted the tile gang, and two men handled the dragline, with a general superintendent over all. Team work was intermittent. From 500 ft. to 700 ft. of trench could be opened and tile laid in a day. M. R. Lewis was in charge for the firm.

Bridge Sway Reduced by New Flooring

REPLACING a 3-in. plank floor by wood block on 4-in. tongue-and-grooved plank resulted in remarkable stiffening of the intercounty bridge over the Monongahela River connecting Webster and Donora, Pa. The bridge, built in 1908, comprises five pin-connected spans (one of 515 ft., among the longest highway truss spans in the United States), totaling 1,288 ft., with 258½ ft. additional of deck girder approaches, and has a 24-ft. roadway carrying two street-car tracks. It was floored with 3-in. oak decking on 6 x 6-in. ties, 2 ft. on centers, carried by four longitudinal joists. Autotruck traffic and heavy coal haulage from adjoining mines made the maintenance cost of this floor very heavy, there being almost daily floor failures and the cost for lumber alone amounting to $3,200 per year during the last four years. The floor of the truss spans has therefore been replaced with a 3¾-in. creosoted wood block pavement on a 4-in. base of tongue-and-grooved planks, supported by ties spaced 18 in. on centers and that of the approach spans by hillside brick on concrete arches sprung between transverse 6-in. I-beams spaced 2 ft. on centers. William G. Muse, road engineer for Westmoreland County, under whose plans and specifications the work was done, says of the work that it has "entirely remedied the excessive vibration and side swaying so marked in both the trusses and girders with the old oak decking carrying the traffic.

In connection with the floor repair the roller nests of the five truss spans were cleaned and packed in grease to insure their free working, as an additional remedy to the vibration under traffic. This called for a special expedient in the case of the 515-ft. span, where the weight per shoe amounted to 300 tons and there was no possibility of making an inside connection to the 6-in. end pin. A 9-in. machined collar was run onto either end of the pin, and inserted in two 15½ x 2 in. plate hangers engaging a 15 x 6-in. steel packing beam above, which was lifted by two 300-ton hydraulic jacks. All lifting contact surfaces were lined with sheet lead. Lifting a shoe, removing the roller nests and putting in blocking, took less than 8 min. This work as well as the floor renewal was done by the Lamm Engineering Co., Pittsburgh. The total cost of the bridge improvement amounted to about $60,000, of which $6,200 was the cost of jacking up the spans and cleaning and replacing the rollers.

NEWS OF THE WEEK

New York, March 24, 1921

Railway Engineers Meet in Annual Convention

Members Act on 18 of 25 Committee Reports Presented — Attendance Largest in Association's History

All previous records of attendance were broken at the twenty-second annual convention of the American Railway Engineering Association in Chicago, March 15-17, when 650 members, or 16 per cent more than last year's record, and 160 guests registered. At practically every one of the six sessions the convention hall was filled to capacity, beginning with the opening meeting to hear the annual address of the president, H. R. Safford. Reports of 25 committees were submitted and action was taken on 18 of them. Everything had been printed in advance, permitting the chairman or some member of the committee, all of whom sit with him on the "witness stand," to present the findings in the briefest time. Almost without exception the committees gained approval for material which they recommended for the *Manual*. A report of the technical discussions appears elsewhere in this issue.

Discussions were not voluminous, that on allowable stresses in the rating of old bridges being the most spirited. Some objection was raised to the slump test for concrete consistency and a report on comparative advantages and disadvantages of electrification of steam roads brought out opposing opinion as to the operating difficulties in bad weather. Neither was there a unanimity of opinion on the proposal to take membership in the American Engineering Standards Committee. Prominent among the recommendations adopted were specifications, classification and grading rules for timber and conclusions as to disintegration of concrete and the corrosion of reinforcing steel in sea water.

PRESIDENT'S ADDRESS

In the presidential address, Mr. Safford called attention to a better era which he believes has arrived for the railroads coincident with the passage of the new Transportation Act, closing a period of excessive regulation and failure of the public to realize the interdependence and joint responsibility of the railroad and user to create, support and maintain what the public most desires—good transportation. To committee personnel problems, said Mr. Safford, much time has been given. He recommended a joint conference between the committee of the board on personnel and the various committee chairmen at the beginning and end of the year to perfect the committee or-

 (Continued on p. 526)

Engineering Practice by Corporations and Partnerships at Issue in New York

Societies Pass Resolutions and Both Sides Address Statements to Members of Legislature

(For arguments on the merits of this controversy see page 518 of this issue)

A protest against permitting corporations, unrestricted partnerships and joint stock associations to practice engineering in New York State was made by the New York Section of the American Society of Civil Engineers at its meeting March 16, when it adopted without a dissenting vote a resolution offered by Colonel William J. Wilgus calling on the Governor and the Legislature to act favorably on Senate bill 147, amending the existing licensing law passed last May. This action followed the reading of a petition, signed by a number of prominent New York engineers, objecting to the practice of engineering by corporations and unrestricted partnerships. Bill 147 would repeal the clause in the existing law permitting corporations and partnerships to practice engineering.

The New York Chapter of the American Association of Engineers passed resolutions of similar purport March 8, as did the Council of the American Institute of Consulting Engineers March 9. The former organization explained in forwarding its resolution to the Senate Judiciary Committee that its representatives at hearings Feb. 21 and 22 (referred to below) had taken a contrary position, in the belief that the fate of the licensing act was at stake. This delegation, however, had gone to Albany to support the repealing amendment.

Since the hearings of Feb. 21 and 22 both the opponents and the advocates of practice by corporations have addressed petitions to the members of the Legislature supporting their respective views, the petition of those who oppose corporate and partnership practice, forwarded by the American Institute of Consulting Engineers, contains the names of forty-one (originally forty-three) signers, most of them being prominent consulting engineers. This petition dated March 16, was sent first. The second petition aiming to offset that of the consulting engineers, was handled by representatives of corporations and partnerships and was forwarded to the Legislature this week. Count of the total number of signers was not available as this issue went to press, but on Tuesday morning had passed the 400 mark.

DEVELOPMENT OF CONTROVERSY

The present situation was brought about by the introduction in the Senate Jan. 24 of an amendment to the licensing law which would repeal the clause permitting corporations and partnerships to practice. Under the law that permission is granted "provided the person or persons connected with such corporation or partnership in charge of the designing or supervision which constitutes such practice is or are licensed." This clause is in accord with the bill recommended by Engineering Council.

Hearing on the proposed amending bill was held before the examining board and the Department of Education, which administers the law, on Feb. 21, at which were present representatives of the American Association of Engineers, of several other engineering societies and of engineering corporations and partnerships. As a result of discussion it was agreed to abandon the

Another Dayton Bridge in Danger

Reporting on an inspection of the Dayton View bridge over the Miami River at Dayton, O., J. L. Harrington has advised the city commission that one pier of the bridge is being slowly undermined and is in danger of washing out at any time. Closing the bridge to traffic is being considered. One pier of the Main St. bridge is also said by Mr. Harrington to be in unsatisfactory condition.

Two Legislative Houses Pass New York Port Treaty Bills

The Senate of New Jersey and the Assembly of New York have passed bills authorizing the negotiation of a treaty between the two states looking to a program for developing the Port of New York and providing for the creation of a port authority of six members, as recommended by the New York-New Jersey Port and Harbor Development Commission. The measure is favored by Governor Miller of New York and opposed by Governor Edwards of New Jersey.

At this writing the New York State bill is "on general orders" in the Senate, from which it will pass to a vote after a third reading. Early passage and approval by the Governor are looked for at Albany. At Trenton the measure has largely become a party issue, opposed by the Democratic Governor. Since Republican members predominate in both houses, passage of the bill over the Governor's veto is now expected.

request for repeal, but to substitute for the clause permitting corporations and partnerships to practice one that the attorney-general's representative believed would be in better legal form. The original amending bill is known as No. 147, and the substitute bill, which would allow the existing law in substance to remain unchanged, is known as No. 147,716. Consulting engineers practicing as individuals are the chief advocates of the former bill, while representatives of corporations and partnerships are leading in the support of the latter.

The following day, Feb. 22, a hearing on the amending bill was held before the Senate Judiciary Committee, and a spokesman, selected by the preceding day's meeting, urged upon the committee the passage of bill 147,716, which, as above stated, would, in effect, leave the law unchanged. It is alleged in the petition favoring bill 147 that the time of the hearing on Feb. 22 was advanced from 2 p.m. to 12 noon, and that therefore those favoring it arrived after the hearing adjourned. The petition advocating No. 147,716, however, submits copy of the original call for the hearing as evidence that the hour originally set was noon, while against their opponents' claim that only "those favoring the corporate interests" were heard they cite a list of engineers not connected with corporations or partnerships who were present at the hearings.

The petition supporting No. 147 also alleges that that bill was prepared "at the instance" of the licensing board and of the Department of Education. This apparently is correct, but the opposing petition points out that three of the five members of the licensing board and the representative of the Department of Education after hearing the discussion on Feb. 21 abandoned their support of No. 147 and joined in support of No. 147,716. The opposing petition suggests that it is possible that some of the petitioners favoring No. 147 may have signed that petition in the belief that they were endorsing a bill which continued to have the support of the licensing board and the Department of Education.

The bodies of the petitions argue the merits of the case and will be found on p. 518 of this issue.

Financing Decatur Water Co.

A few hours after the signing of the contract, March 7, between the city of Decatur, Ill., and a newly incorporated water company, bankers subscribed $500,000 and citizens $300,000 to finance the enterprise. About $1,000,000 is needed to acquire the site of an impounding reservoir, to clear the flooded area and to remove the roads and bridges. This amount was beyond the statutory debt limit of the city, as explained in *Engineering News-Record*, Feb. 17, p. 299. The dam to form the reservoir is now under construction, with J. Albert Holmes as resident engineer, representing Pearse, Greeley & Hansen, consulting engineers.

Pier Washout Wrecks Bridge

A 75-ft. steel bridge over Bald Eagle Creek, near Bellefonte, Pa., was wrecked on March 13 by failure of the south pier as the result of a washout. The bridge had been repaired only a year ago.

Engineer License Bills Progress

In Missouri, Senate Bill 11 to license architects, professional engineers, and land surveyors has passed the state senate and is now before the house. In New Jersey, the license bill is out of committee and ready for second reading. In North Carolina, the bill introduced in the legislature at the instance of the North Carolina Assembly of the American Association of Engineers has been passed by the senate and house.

Elevated Trafficways Proposed for New York City Vehicles

In continuance of its policy of discussing topics of major engineering interest in the metropolitan district the New York Section of the American Society of Civil Engineers at its meeting March 16 dealt with the subject of streets and parks. Charles W. Leavitt opened the discussion with a paper suggesting the relief of traffic congestion by the construction of a number of north and south trafficways to be cut through existing blocks of buildings and to be carried on elevated structures, except at Central Park, where vehicle tunnels were proposed.

In the matter of parks Mr. Leavitt presented statistics showing that New York City is deficient as compared with other municipalities. For Greater New York there is only one acre of park per 699 inhabitants as compared with the following population per acre of park area for other cities: Minneapolis, 100; Washington, 124; Boston, 245; St. Louis, 302, and Chicago, 700.

The paper was dicussed by Arnold W. Brunner, president of the Fine Arts Federation; Colonel F. S. Greene, former state commissioner of highways; Jay Downer, of the Bronx Parkway Commission; Amos Schaeffer, consulting engineer, Borough of Manhattan; Palmer Campbell, Hudson County, N. J., park commissioner; Charles Whiting Baker, Palisades Park Commission, and George B. Ford, consultant to the New York City Planning Commission.

Mr. Schaeffer in emphasizing the need for a more intensive use of existing streets before new ones are built, presented a cost analysis of the project outlined by Mr. Leavitt which indicated a grand total for the construction of the expressways, grading and paving the lower level of the new avenues and cost of land between $1,375,000,000 and $1,800,000,000.

Mr. Ford made a plea for the co-ordination of city planning by adjacent municipalities and outlined the work now under way in France whereby the plans of individual cities are passed on by a departmental board, which in turn reports to a central national planning commission.

Water Filtration Recommended for Buffalo, N. Y.

A mechanical water filtration plant for Buffalo, N. Y., with a rated capacity of 160 m.g.d. has been recommended by George C. Andrews, water commissioner, and George W. Fuller, consulting engineer, New York City, in a report sent to the City Council on March 16. A. W. Kreinheder, city commissioner in charge of public works, has recommended that the City Council authorize the Bureau of Water to prepare plans for the proposed filter plant so that contracts may be let by February, 1922. Mr. Kreinheder also recommends that land adjacent to the Ward St. pumping station be reserved for a filter plant of an ultimate capacity sufficient to serve 1,000,000 people. A public hearing on the proposed filter plant will be held on March 29.

Cost Estimated

The estimated cost of the proposed 160-m.g.d. filter plant is $4,000,000 without considering the development required by the Park Department, under whose jurisdiction is the land proposed for the site of the filters. The operating expenses of the filter plant are estimated of $120,000 a year, but it is stated that with a saving in pumping costs due to the elimination of needless waste, lower prices for fuel for pumping and with increased sales of water due to new consumers, it is probable that by 1925 Buffalo may be able to enjoy the benefits of water filtration without any increase over its present water rates—or, at most, an increase of not more than 5 to 10 per cent. Some six months ago a new rate schedule was adopted which it is expected will provide added income of about $600,000 a year—needed to meet increased operating costs and to provide a sinking fund for bond retirement.

Spring Valley Asks Rate Increase To Extend Water-Works

A substantial increase in water rates is asked for by the Spring Valley Water Co., San Francisco, in an application now pending before the Railroad Commission of California. The petition lists proposed improvements estimated to cost $15,000,000. To secure a loan for these improvements, the company urges that an increase in rates, which will pay interest on the loan, is necessary.

The improvements include $10,000,000 for a pipe-line around the southern end of San Francisco Bay to bring water from the Calaveras Valley into the city. This item is opposed by the city on the ground that it would be an unnecessary duplication of the aqueduct planned by the municipality to deliver water from the Hetch Hetchy supply. In reply, the company states that the Hetch Hetchy conduit crossing the bay at Dumbarton will reach the city at El. 240, whereas the Calaveras line, coming around the bay at a higher level, will deliver water at El. 400.

Railway Engineers Convention

(Continued from p. 521)

ganization. Corresponding members of committees were also recommended. Curtailment of volume of material without sacrifice of value is much desired. Because of the increasing complication of many questions he advocates more experimental work and less dependence on personal viewpoints. Mr. Safford made note of the association joining Engineering Council and the inexpediency, on account of the financial burden and objectionable plan of organization, of becoming a charter member of the Federated American Engineering Societies. He was of the opinion that, if it appears desirable and financially possible to become a member of the latter. action should be by referendum vote. Of the new problems, those having to do with economics are the most vital in his opinion because of the different relative values arising from the existing wage schedules and working conditions.

FINANCES

Financially the association has been able to maintain its work without increase of dues or making an inroad into its reserve funds, the receipts, $37,631.37, being only $755.18 less than the disbursements. Ten numbers of the *Bulletin* and the 1920 *Proceedings* with 1.500 pages, 50 per cent in excess of last year, have been printed. Publication of the revised *Manual* has been deferred to include the important changes of this convention. It will then contain in its 1,000 pages the net results of the organization for 22 years.

The membership campaign initiated in January, 1920, netted 521 applications. The total new enrollment March 1 was 195. A net increase of 313 for the fiscal year.

At the annual dinner Dr. David Kinley, president, University of Illinois, spoke of the common fields of the association and the university. William Renwick Riddell, Justice of the Supreme Court of Ontario, gave a stirring address on Canada and the ties that bind the English peoples together. John F. Wallace, first president of the association, in outlining the origin of the organization, indicated that the framers of the constitution felt that the preparation of scientific papers without direction was a waste of time; a program of investigation must be blocked out. Out of this idea grew the plan of standing committees covering the whole range of railway engineering work.

NEW OFFICERS

The officers elected for the ensuing year by the formal balloting are as follows: President, L. A. Downs; vice-president and general manager, Central of Georgia Ry.; vice-president, E. H. Lee, vice-president and general manager, Chicago & Western Indiana R.R.; treasurer, G. H. Bremner, district engineer, Bureau of Valuation, Interstate Commerce Commission; secretary, E. H. Fritch; new directors, C. F. W. Felt, G. J. Ray, and Col. G. H. Webb. J. L. Campbell, chief engineer, El Paso & Southwestern System, is the vice-president who's term continues. The new nominating committee is as follows: J. R. W. Ambrose, R. H. Ford, E. A. Hadley, J. V. Neubert and A. F. Robinson.

New President of American Railway Engineering Association

Lawrence A. Downs, vice-president and general manager, Central of Georgia Ry., and the newly elected president of the American Railway Engineering Association was born in Greencastle, Ind., in 1872 and was graduated from Purdue University in 1894. He

LAWRENCE A. DOWNS

entered railroad service in February, 1895, with the Vandalia R.R. From 1896 to 1898 he was in the engineering department of the Illinois Central R.R. and for nine years following was road master on the Amboy, Louisville, Louisiana, Springfield and Chicago divisions. From 1907 to December, 1910, he was assistant chief engineer, maintenance of way of the Illinois Central. In December, 1910, he became division superintendent of the Iowa division and later of the Minnesota and Kentucky divisions of the Illinois Central. In January, 1915, he was made general superintendent, Southern Lines, and in August, 1916, general superintendent of the Northern Lines of the Illinois Central.

On Jan. 1, 1919, he became assistant general manager of the Illinois Central R.R. and on Mar. 1, 1920, was appointed vice-president and general manager, Central of Georgia Ry.

Favor Engineering Department

After having failed of passage at the Feb. 28 session, the Humrichouser house bill, in the Indiana Assembly, creating a department of engineering under the jurisdiction of the state conservation commission, was passed by a vote of 65 to 18 in the house March 3.

Government Engineers Discuss Their Status

Subjects discussed by the 100 delegates to the convention of the Federal department of the American Association of Engineers, Feb. 28, Mar. 1 and 2 in Washington, D. C., included reclassification of government employees, federal-aid on highways, changes in Federal department rules, retirement, the Interstate Commerce and Civil Service commissions and the merit system of promotion.

Indiana Favors Interstate Harbor

The project for an interstate lake harbor, to be located at a site called "Illiana" on the Illinois-Indiana state line, has been approved by the Indiana legislature. A bill passed March 4 provides for the creation of an interstate commission and appropriates $25,000 for its work. A similar bill is before the Illinois legislature. This project has been proposed by Col. W. V. Judson, U. S. Engineers, as described in *Engineering News-Record* of Jan. 20, p. 120.

Report on Rincon Hill Regrade Project in San Francisco

Final data on the proposed regrading of Rincon Hill in San Francisco have been compiled, an assessment district prepared, and the change-of-grade ordinance approved, according to the annual report of the Bureau of Engineering in that city, just issued. This project contemplates the removal of 3,000,000 cu.yd. of soft rock and clay which "has long been a barrier to transportation between the business section of the city and the manufacturing and waterfront area south of Market St." Rincon Hill covers an area of 85 acres and has a summit elevation of 110 ft. The land is privately owned and is held in 309 parcels. Most of the district is practically waste land due to the excessive grades, and for the most part is occupied only by scattered second-class residences.

It is proposed to cut down the hill so that the maximum grades will not exceed 3½ per cent, and to widen and pave the streets traversing the area. The best available site for dumping the material is said to be in the Islais Creek district, about 3 or 3½ miles from the hill. The deepest cut to be made would be 89 ft. and the total cost of the work is estimated at about $4,000,000. At present the land on top of the hill is estimated as worth $1 per square foot, while land around the foot of the hill is worth $4 per square foot.

The removal of the hill will, according to the report, "not only provide direct routes for transportation, but will so rapidly enhance property values in the district itself that regrading the section will prove no burden on the owners of the land affected nor in the proposed assessment district." It is estimated that the contemplated work will take about 18 months after construction starts.

Federation Opens Offices in Washington

With the opening of its suite of offices in the National Savings and Trust Company Building, in Washington, the Federated American Engineering Societies will direct its work in the future from the national capital. L. W. Wallace, executive secretary of the organization, has been in Washington completing the arrangements for the opening of the national headquarters. He will not be able, however, to take up his residence in Washington for another month. In the meantime, the offices will be in charge of A. C. Oliphant, assistant secretary.

The principal effort being made at this time at the offices of the federated societies is in connection with the extension of the employment service of the organization. In addition to having one central office, the plan is to have branch offices in several of the larger cities. A full report on the employment service is to be made when the executive board meets in Philadelphia on April 16. Secretary Hoover, of the Department of Commerce, president of the federation, expects to attend the executive board meeting. At this meeting, a comprehensive report also is to be made on the activities looking to the establishment of a department of public works.

Copies of a model bill for the licensing of engineers are available at the office of the executive secretary. These bills are being sent out to those interested, not with the idea of offering a recommendation one way or the other in the matter but in the hope that any state legislation which may be enacted will follow the general lines of the model bill, which is the result of extended study.

Plan More Effective Co-ordination of Railroad Facilities

A plan for advanced methods in conducting railroad transportation which, it is stated, will produce far-reaching results, will insure annual savings of millions of dollars, increase facilities and service, and lower railroad fares and rates, was submitted March 21 to Senator A. B. Cummins, chairman of the Senate Committee on Interstate Commerce. These plans are presented in a printed statement issued by S. Davies Warfield, president of the National Association of Owners of Railroad Securities, accompanied by numerous exhibits. In a separate letter to Senator Cummins Mr. Warfield points out that unless intensive economical methods in railroad administration are adopted there is no alternative but government operation, followed by government ownership, although the country has given overwhelming evidence of being opposed to it. Representatives of the association will later appear before the Senate committee to formally present the plan in further detail. Senator Cummins has announced his intention to ask Congress to authorize an investigation into the causes of the unsatisfactory conditions of the railroads.

Mr. Warfield's statement takes the position that fundamentally new methods are obligatory, that wage adjustments must accompany and be part of the general program of intensive economies, many of which cannot be made effective by individual railroad systems handicapped by existing lack of co-ordination, and asserts that the present voluntary agencies are necessarily inadequate. It deals with equipment, financing, purchases, and operations, and would require the managements of the railroads to put into effect a new organization of the railway machine in the United States without waiting for the consolidations now being tentatively worked out by the commission.

New Jersey Cities and Towns Discuss Water Shortage

Water problems common to Plainfield, Elizabeth and twenty other New Jersey communities supplied by the Elizabethtown, Plainfield-Union and Middlesex water companies were discussed at a conference held at Plainfield March 10. The companies named have announced that there is danger of a water famine unless more water is made available and that they are unable to finance needed enlargements unless the cities and companies join in some means of relief. The meeting voted to ascertain the desirability and cost of a physical and financial examination of the properties of the companies. All but four of the twenty-two municipalities agreed to this decision. M. S. Ackerman, member of the City Council and head of the Water Commission of Plainfield, N. J., was chairman of the temporary organization effected at the meeting.

Standard Oil Valuation Made

What is said to be one of the most extensive valuations of industrial property made has just been completed for the Standard Oil Co. of California by Ford, Bacon & Davis, engineers, New York City. The work, which was performed under the direction of K. A. Harvie, manager of the western division of the valuation department, was completed in eight months. The work consisted of a minute examination of oil-producing fields, manufacturing plants, and all properties owned by the Standard Oil Co. of California located in Pacific Coast states, Alaska and the Hawaiian Islands. It is understood that the property involved aggregates approximately a half billion dollars in value. About 200 engineers were engaged in the valuation work.

New York Water-Power Bill

Following the Governor's message noted in these columns last week there has been introduced in the New York legislature a bill creating a state water power commission which would control all water power in the state under provisions somewhat similar to the Federal water-power act.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, Boston; Convention, Cleveland, June 6-10.

The Seattle (Wash.) Section, Am. Soc. C. E., at its meeting Feb. 28, was addressed by A. H. Dimock on "The Swan Lake Impounding Reservoir."

The American Institute of Electrical Engineers, at its Board of Directors meeting held in New York, March 11 heard the report of the Committee of Tellers of its canvass of the nomination ballots cast for candidates for the Institute offices becoming vacant July 31, 1921. William McClellan of Philadelphia, Pa. was nominated for president.

Personal Notes

NORMAN S. SPRAGUE, city engineer, Pittsburgh, Pa., has been dismissed by Mayor Babcock. The removal is generally believed to be part of a political situation that is likely to involve the resignation of several other city officials.

E. G. HARTFORD, assistant engineer, has been appointed office engineer Boston & Albany R.R., with headquarters at South Station, Boston.

WINTHROP E. NIGHTINGALE has been elected assistant professor of civil engineering Northeastern College and will assume the position of acting director of engineering practice on April 9.

JOSEPH MENDELSSOHN, civil engineer and architect, formerly designer of theatrical buildings for G. W. Lamb, theatrical architect, has joined the staff of George and Edward Blum, architects, New York, as structural engineer.

R. S. MOORE of Brooklyn, N. Y., has been appointed an assistant engineer on the Hudson River vehicular tunnel project in New York.

EPAPHRET CRANCH has been appointed city sanitary engineer of Petersburg, Va.

CRAIG P. HAZELET has been appointed instructor in structural engineering in the College of Engineering, University of Illinois.

HERBERT J. GILKEY has been appointed research assistant in theoretical and applied mechanics, College of Engineering, University of Illinois. He has had wide experience in surveying and mapping with the state engineer of Oregon and with the U. S. Geological Survey in Oregon and California. He was in charge of the map and drafting department of the American Relief Administration under Herbert Hoover at Paris headquarters from February to August, 1919. Since 1919 he has been structural engineer for the Lord Engineering Co., Chicago.

CHARLES W. ERISMAN has resigned from the Pennsylvania State Highway Department and has opened engineering offices in Lancaster, Pa., to engage in highway consultation and engineering, roads, streets, bridges, contractor's reports and estimates, farm and land surveys and drafting.

WILLIAM SNAITH has resigned as chief draftsman of the Riordon Co., Ltd., Mattawa, Ont., to accept a position on the technical staff of the Forest Products Engineering Corp., Chicago, Ill.

J. A. GORR, formerly division engineer, Shreveport division, Louisiana lines of the Southern Pacific, has been appointed division engineer of the Lafayette division, Lafayette, La.

FRANCIS W. BLACKFORD, civil and mining engineer, will sail for Bolivia, South America, April 2 to locate a railway line and to do other engineering work.

THERON M. RIPLEY has been reinstated as division engineer, New York State Highway Department, by Herbert S. Sisson, highway commissioner, and will have charge of the division office at Hornell, N. Y.

PERRY FILKIN, formerly division engineer, New York State Highway Department at Hornell, N. Y., has been transferred to the Buffalo division.

SQUIRE E. FITCH, who has been serving as division engineer in the Buffalo division office, New York State Highway Department since the death of C. J. McDonough in December, will return to his former position as superintendent of maintenance in the western half of the state.

L. R. SHELLENBERGER, structural engineer, until recently connected with Dwight P. Robinson & Co., New York, in the structural department, has opened offices in New York City as a consulting engineer. Special attention will be given steel frame buildings, reinforced concrete and foundations.

CHARLES ANDROS, for the past twelve years senior assistant in the New York State Highway Department, has taken a position in the United States Patent Office at Washington, D. C.

H. H. CHAPMAN, formerly assistant engineer of tests, has been appointed engineer of tests of the Atchison, Topeka & Santa Fé Ry., with headquarters at Topeka, Kan.

GEORGE P. MCLAREN, formerly engineer of the Ontario district, Canadian National Rys., has been appointed engineer maintenance of way, Eastern Lines.

R. L. PEARSON, formerly division engineer, New London and New Haven divisions, New York, New Haven & Hartford R.R., has been appointed maintenance engineer, Lines West.

E. R. LEWIS, formerly editor of the "Maintenance of Way Cyclopedia," has been appointed office engineer of the Michigan Central with headquarters at Detroit, Mich.

OBITUARY

CAPTAIN DAVID W. PAYNE, U. S. A., retired, died March 5 in Brooklyn. He was born in Corning, N. Y., in 1843 and was graduated from the U. S. Military Academy at West Point in 1865, when he entered the Corps of Engineers. While in the army he designed and built the first dredge boat used on the Mississippi. At the close of the Civil War he cleared the wrecks of the Confederate ships at the mouth of the Mississippi. In 1869 he resigned from the army to engage in foundry and machine shop work with his father, founder of the firm of B. W. Payne & Sons, manufacturers of steam engines and boilers, at Corning and Elmira, N. Y. He was the inventor of a number of improvements in steam engines, including the Payne automatic governor and the shaft-governed Corliss engine. He was engaged in a number of experiments in the development of machinery for making beet sugar, and during the early 80's developed ice machines, Wood's hydraulic riveters and presses, Tabor moulding machines, and the first Diesel engines built in this country, also armour piercing and cast iron projectiles for the navy. He was the editor of *Steam* and the author of Payne's "Handbook on Foundry Practice."

FRANCOIS HENNEBIQUE, the celebrated French reinforced-concrete engineer, died in Paris on March 7, 1921, at the age of 79 years. M. Hennebique was one of the earliest engineers in any country to apply reinforcement to concrete and developed the system which bore his name and which has had the widest use in Europe.

ERNST J. LEDERLE, chemist and twice commissioner of health, New York City, died March 7. He was born on Staten Island, N. Y., in 1865, and was graduated from the School of Mines, Columbia University, in 1886, from which institution he received the degrees of Ph.D. 1895 and D.Sc. 1904. After serving in the Department of Health, New York City, first as assistant chemist and then as chemist, Dr. Lederle was named commissioner of health by Mayor Low and served from 1902 to 1904. He then established the Lederle Laboratories, New York City. Subsequently he became consulting sanitary engineer of the Board of Water Supply, New York City, and a member of the New York State Water Supply Commission. These positions, with their salaries of $10,000 and $5,000 a year, he gave up to become health commissioner of New York City again, at $7,500 a year, under Mayor Gaynor.

ALBERT H. WOLF, consulting engineer, Chicago, died March 13 in Atlantic City at the age of 66. He started his engineering career with the Chicago, Rock Island & Pacific Ry., which he left in 1875 to enter the U. S. Lighthouse Bureau, where he designed several lighthouses on the Atlantic Coast. In 1881, after four years' study at the Universities of Berlin and Strasbourg, he practiced as consulting engineer in Montana and in Philadelphia, associated in the latter place with J. H. Linville. In 1884 he opened in Chicago an office as consulting and contracting engineer. He was one of the pioneers in the development of skeleton-constructed high office buildings and is said to have been the first to use built-up columns instead of round cast-iron columns. Mr. Wolf was a member of the Western Society of Engineers.

BUSINESS NOTES

KEMPER-MCLAUGHLIN CO. is the name of a firm recently organized by Joseph Kemper, city engineer of Utica, N. Y., for four years, and A. J. McLaughlin to engage in construction work.

H. S. GREENE, director of the Barber-Greene Co., Aurora, Ill., since its organization, has been elected vice-president in charge of sales of the above company.

HOWARD H. MARSH, for nearly eight years manager of publications of the Simmons-Boardman Publishing Co., New York, at Cleveland, Ohio, has resigned to become president of the Victory Equipment Co., New Orleans, La., specializing in construction and industrial machinery.

N. B. PAYNE & CO., New York, dealers in electric cranes and hoists, have extended their lines of material handling machinery to include the portable conveyors of the A. C. Warner Co., Philadelphia, Chicago automatic coal elevators and McKinney-Harrington package pilers and car loaders. Edmund Otto is now associated with N. B. Payne & Co.

Highway Bids of New York and Ohio, Received March 18, Analyzed

Ohio Bids Show Concrete Lower Than Bituminous Types—103 Contractors Bid on 21 New York Projects

The large number of contractors bidding in New York, the comparison of concrete with other types in Ohio, and the receipt of bids so far under the engineers' estimates in both states are features noted in an analysis of the bids received by these two states on March 18.

TABLE I—ANALYSIS OF NEW YORK HIGHWAY BIDS

Miles	Number Bidders	Engineer's Estimate	Low Bid	High Bid	Low Bid in Per Cent Estimate	Per Cent increase High Bid Over Low
4 89	4	$175.011	$147.878	$169.171	84	15 0
4 35	0	162.777	No bids			0 0
5 68	3	227.287	218.858	223.330	91	2 0
5 22	1	264.376	248.110	248.110	94	0 0
5 21	4	157.007	148.010	156.979	94	6 0
6 54	0	243.277	No bids			
2 28	14	91.008	78.300	89.931	86	15 0
2 71	4	99.258	91.189	95.633	92	5 5
8 37	3	288.097	259.522	278.187	90	7 0
5 99	3	199.428	184.340	189.666	90	3 0
2 99	9	20.953	17.993	20.952	86	18 0
3 34	3	144.965	138.084	144.474	95	4 0
9 37	7	289.339	263.600	283.125	91	8 0
2 85	3	123.790	113.448	122.467	91	7 0
0 59	9	26.903	23.906	25.874	89	9 0
	9	36.742	32.673	35.449	89	9 5
3 46	1	126.739	124.651	124.651	98	0 0
0 50	14	33.835	28.669	33.515	85	18 0
7 25	3	257.776	234.042	257.297	91	10 0
5 95	6	227.286	220.462	226.533	97	3 0
5 02	3	186.368	181.496	184.779	97	2 0

In Table I is given the comparison of the bidder's price with that of the engineer's estimate on New York projects. The low-bid average is around 95 per cent of the estimate, although in a few instances the per cent drops considerably below 90. The competition in bidding is seen by the fact that on two projects there were fourteen bidders, on three others nine each, on one seven. The rest of the projects—except two on which no bids were received—drew from one to six bids each. On two projects the high bid was 18 per cent in excess of the low bid and the low bid 85 per cent of the engineer's estimate. The smaller jobs seem to be the more popular. The New York bids are for the construction of approximately 90 miles of highways of varying types.

TABLE II—ANALYSIS OF OHIO HIGHWAY BIDS

Miles	Type	Engineer's Estimate	Low Bid	Bidders Per Mile Cost	Low Bid in Per Cent of Estimate
0 95	Monolithic Brick	$ 43.431	$42.612	$46.000	98
	Brick	397 896	356.325	57.500	90
6 19	Re. concrete	317.227	267.275	43 000	84
	Bit. concrete	361.538	332.858	54 000	95
	Brick	199.755	176.669	50.000	89
3.20	Re. concrete	159.120	135.812	42.500	85
	Bit. concrete	181.331	168.805	53.000	93
1 16	Bitoslag...	92.494	89 593	77.500	92
	Bituslag...	*	87.402	75 500	*
2 17	Bitoslag ..	170.879	160.118	73.500	94
	Bituslag		160.912	74.000	*
1 68	Concrete....	47.326	45.254	24.500	96
3 49	Brick		176.981	51.000	*
	Mon. Brick	179.675	176.957	51.000	98
1 21	Brick	85 536	78.233	65.000	92
0 53	Brick	19.317	18.076	36.500	94
	Sheet Asphalt	11.296	15.683	30.000	139
1 29	Brick	48.686	42.542	33.000	87
	Sheet Asphalt	29.101	38 429	30 000	131
	Concrete		61 369	37.500	*
1 63	Bit. Macad.	69.554	62.386	38.000	90
	Bituminous Macadam		60.239	37 000	*
1 04	Bit. Macad.	43 706	34 490	33 000	85
2 26	Bit. concrete	118 924	106.724	47 000	90
	Concrete		94 653	42.000	*
5 69	Bit. Macad.	159 871	137 434	24 000	86
2 00	Mono. brick		91 952	45.000	*

The Ohio bids showed an average of $38,000 per mile for concrete, as against $48,000 for all types of brick, and $51,000 for bituminous concrete. Sheet asphalt proved the least expensive in the bids, two projects of that type averaging $30,000 per mile. These costs include grading, drainage structures and pavement. The average of seven types included in the bidding are as follows: Sheet asphalt, $30,000 per mile; bituminous macadam, $33,000; concrete, including reinforced and plain, $38,000; brick, including monolithic, brick on rolled base, vitrified brick and brick on waterbound macadam base, $48,000; bituminous concrete, $51,000; bitulithic, $75,000, and bitoslag, $75,500.

Detroit to Vote on Municipal Cement Plant

At a recent session of the city council of Detroit, action was taken to submit to the people at the April election a charter amendment authorizing the establishment by the city of a plant for the manufacture of cement, vitrified crock and sewer brick. The proposed amendment would also authorize the city to acquire sand and gravel pits.

Increase in Homebuilding Indicated

Indications of a steady increase during the spring in residential building are contained in this week's Construction News. There are a number of apartments listed among the proposals, and in contracts let the number of apartments is steadily increasing. In New York City alone contracts have been let during the past week for the construction of eight apartment houses for a total of more than $1,250,000.

Increases in the value of miscellaneous building is seen in the fact that during the first three weeks of March contracts let were three times the value of the contracts let during the first three weeks in February. Most of the buildings in this class are educational, bank and office, and theater buildings. Forty-seven miscellaneous building contracts let during the past week called for a total expenditure of $7,[illegible].

Building Situation as Viewed by Federal Reserve Banks

In analyzing the reports of its member banks on building conditions during February, the Federal Reserve Board says:

"Building operations throughout the United States have declined during the past month. The reduction in the volume of construction is not, however, as great as the figures may indicate, due to the considerable fall in the prices of building materials this year from the abnormally high levels a year ago."

Reports from nine of the twelve districts are contained in the following paragraphs:

District No. 2 (New York)—Contracts awarded during January for residential building in New York State and Northern New Jersey were greater in value by about 90 per cent than in December. This represents about 40 per cent of the aggregate, as compared to 25.8 per cent in December.

District No. 3 (Philadelphia)—Thirteen large cities report January building permits valued at $1,917,548 as compared to $2,018,690 in December, and $4,939,784 in January, 1920. Decline in building activity paralleled in the lumber and brick manufacturing trades.

District No. 5 (Richmond)—Valuation of January permits decreased 45.4 per cent as compared with January, 1920. Reported that there appears to be developing a strong movement toward home construction, and various plans for bringing this highly-desired result are being put forward.

District No. 6 (Atlanta)—Appears to be considerable increase in valuation of permits issued in some of smaller towns. Practically all the larger cities show decreases. Total valuation much lower than a year ago.

District No. 8 (St. Louis)—Value of permits issued in the four chief cities during January, 1921, $1,488,804—increase over December of $915,471. Considerably under the January, 1920, valuation of $2,391,903.

District No. 9 (Minneapolis)—Number and value of permits issued decreased substantially as compared to both December and January, 1920.

District No. 10 (Kansas City)—Estimated value of January permits 48.2 per cent less than for January, 1920.

District No. 11 (Dallas)—Decrease of 58.1 per cent in value of permits issued in January, 1921, over January, 1920.

District No. 12 (San Francisco)—January, 1921, permits show a 44.2 per cent decrease in value compared to January, 1920, and a 10.3 per cent decrease in number.

The report concludes with the statement that "Lumber and other building materials, which were not affected by price readjustment as early as many other commodities, declined considerably in January but, in the case of lumber at least, were relatively stable during the first weeks of February. In fact from southern districts reports are made that there is considerable buying demand, although not enough to cause an increase in prices."

Illinois Road Bids

Analysis of the bids submitted Feb. 18 on highway work, [illegible] by the State of Illinois shows a low-bid permile average of [illegible] to be $32,233.25, and of combination bids, $33,215.40. Add to these figures the cost of [illegible] $7,500 per mile—furnished by the state and the total low bid average is slightly under $[illegible] per mile. [illegible] Record [illegible] reported this average cost as [illegible] $[illegible] per mile, in the issue of March 10, p. 448.

Boston Builders Break With Union Employees

The latest developments in the dispute between employers and employees in the building industry in Boston are a definite break between the two factions, a partial resumption of construction, and the possibility of a settlement by the State Arbitration Board. Many attempts have been made to end the strike, which began Jan. 20, but all have proved unavailing. The strike was a protest against the offer of the employers of a base rate of 90 cents per hour for the 1921 schedule. Employees demanded a higher rate, which the builders were not willing to give. Employers asserted that they were willing to make agreements with the unions any time before March 10 on a 90-cents-per-hour basis, which the unions have steadfastly refused to accept.

On March 11 several building jobs which had been struck and had been idle since Jan. 20 began again with non-union labor and with what union labor wished to work at the 90-cent rate. Officers of the Building Trades Council of Boston assert that the Boston builders are taking advantage of the situation in trying to force a reduction in the wage scale.

The employers agreed to accept Mayor Peters' plan, whereby those trades receiving $1 an hour under the 1920 schedule were to continue in that wage until May 1, after which a reduction of 10 per cent would be effected. This the unions also rejected. Arbitration of the question is now talked of, but it is understoood that the contractors will not arbitrate upon a 90-cent basis, but upon an 80-cent basis.

Jurisdictional Awards to Be Published by Board

According to a resolution passed by the National Board for Jurisdictional Awards in the Building Industry on March 12, the decisions, rules and other records of the board will hereafter be published in an official pamphlet edition, besides being made known through general publication channels. This decision follows solicitation by unauthorized parties for contributions, advertisements and subscriptions to defray the expenses of the publication of the board's decisions.

Building Officials' Conference in Cleveland

The seventh annual meeting of the Building Officials' Conference is to be held in Cleveland, Ohio, Apr. 27-29. The headquarters will be at the Hotel Statler. The meeting is being arranged by F. W. Lumis, secretary-treasurer, Springfield, Mass. Consideration will be given to a number of subjects of interest to building inspectors and superintendents, and several excursions will be made to various building material plants in the vicinity of Cleveland.

Harrisburg Building Mechanics Ask Wage Increase

According to recent information from the Harrisburg, Pa., Building Contractors and Employers' Association, the union plasterers have asked for an increase from 87½ cents to $1.15 an hour. It is also understood that the painters will ask for an increase of 30 cents an hour, making their hourly wage $1. The new wage scale of the plumbers calls for an increase from 80 cents to $1 an hour, say press reports.

Youngstown Builders Plan 20 Per Cent Wage Cut

It is reported that the Youngstown Building Trades Employers Association, Youngstown, Ohio, is planning to submit to the trade unions a schedule calling for a 20 per cent wage reduction in the new agreements which become effective May 1. Approximately 5,000 workmen are involved. It is understood that journeymen will oppose the proposed reduction.

Union Carpenters Cut Own Wages

Union carpenters of Birmingham, Ala., have voluntarily cut their wages 14 per cent, the reduction becoming effective March 15. The announcement of the reduction was made by the secretary of the carpenters' district council. The reduction was made in the hope that it might stimulate home building, and followed a reduction of 11 per cent in the wages of union bricklayers.

To License Builders in New Jersey

A bill introduced in the New Jersey legislature by Assemblyman Eldridge, of Union County, proposes to create a state board for licensing master builders in the various trades followed in the state. The board is to be named by the governor and to consist of an architect, a civil or mechanical engineer, a master builder and two journeymen, to serve without pay.

Atlanta Votes for Water-Works and Other Improvements

At an election held on March 8 the voters of Atlanta, Ga., approved a total bond isssue of $8,850,000 for use as follows: Schools, $4,000,000; waterworks, $2,850,000; sewers and sewage disposal, $1,250,000; bridge and viaduct, $750,000. We are informed by P. H. Norcross, consulting engineer Atlanta Water Department, that besides the bonds voted on March 8 for waterworks improvements, there is available $450,000 unexpended appropriation, making a total of $3,250,000. The proposed water-works improvements include: A 21-m.g.d. addition to the filter plant; a 10,000,000-gal. clear water basin; a force main 48 in. in diameter and 21,000,000 ft. long from the river station to the filter plant; additional pumps at the river station, together with coal and ash handling equipment, a new river intake, and preliminary settling basins; additional distributing mains. Plans for the filter plant and clear water basin are now being prepared and it is expected that work will be started immediately.

Contract to Rebuild Corpus Christi Causeway Let

A treated-timber-pile causeway is to replace the concrete causeway at Corpus Christi, Texas, which was destroyed by a hurricane in September, 1919. An article describing the storm and its effects is contained in *Engineering News-Record*, Nov. 13-20, 1919, p. 848. The contract for the construction of the causeway has just been let by the county engineer of Nueces County to Austin Brothers Co., of Dallas, Texas, the contract price being in excess of $300,000.

Ask to Resume Work on Hudson Bay Railway This Year

On March 16 a resolution asking the government to resume work on the Hudson Bay Railway was introduced in the Canadian House of Commons by J. A. Campbell of Nelson, Man. Hon. J. D. Reid, Minister of Railways, stated emphatically that no further work would be done on the road this year, the only reason being financial stringency, which rendered it necessary to postpone construction work until conditions were more favorable.

Brick Makers and Government Bureaus To Study Brick

Negotiations are in progress looking to a co-operative agreement between four associations of brick manufacturers and the U. S. Bureau of Mines and the U. S. Bureau of Standards. The plan is to make a comprehensive study of certain of the fundamental problems in ceramics which are confronting the manufacturers of brick. A substantial sum is to be made available for that purpose. The associations which are parties to the negotiations follow: The Face Brick Manufacturers Association; The American Common Brick Manufacturers Association; The National Paving Brick Manufacturers Association; The Hollow Building Tile Manufacturers Association.

San Francisco Contractors Fined —Three More Indictments

Of the five San Francisco contractors who were indicted by the Grand Jury last fall on the charge of illegally combining to add 12 per cent to bids on grading jobs, four entered a plea of guilty and were sentenced to pay a fine of $1,200 each. The case of the fifth contractor, William Scott, who entered a plea of not guilty, has not yet come to trial. Grand jury indictments were returned on March 10 against three more contractors, Peter Montague, Gor-

don S. Chamberlin and Arthur Granfield, charging violation of the Cartwright anti-trust act, as did the original five indictments. Reference to the original indictment appeared in *Engineering News-Record* Sept. 23, 1920, p. 626 and Oct. 7, 1920, p. 722.

Plumbers Get Jail Sentences

Thirty-one of the thirty-eight individuals and firms, master plumbers, indicted as a result of disclosures made by the Lockwood committee in its investigation of building conditions in New York City, were sentenced March 22, six men receiving 30-day sentences and two, ten-day sentences. Fifteen firms were fined a total of $30,000. The defendants had pleaded guilty to the indictment charging them with violation of the State anti-trust law, through the operation of a "code of practice" designed to eliminate competition.

Pacific Northwest Contractors Hold Joint Session

At the joint convention of the Associated General Contractors of the Pacific Northwest, and the Northwest Master Builders' Association, in Spokane, March 3-5, action was taken dissolving the Northwest Master Builders Association, the withdrawal from it of Spokane and Portland builders, and changing the name to Washington State Contractors' Association. The new association will include builders of the state, outside of Spokane. Spokane and Portland builders will join the ranks of the general contractors. The General Contractors took action to change the name of its organization to the Association General Contractors of America, Pacific Northwest Chapter, and elected the following officers: Matt M. Dougall, Portland, president; I. N. Day, Portland, secretary-treasurer; S. C. Morin, Spokane, Frank J. Walsh, Tacoma, and R. E. Miller, Seattle, vice-presidents.

David Thacker, Yakima was elected president of the Washington State Contractors' Association.

Number Unemployed Decreases

According to reports made from data collected by the United States Employment Service, there was a decrease of 1 per cent in industrial idleness during the month of February. The report is based upon information received from 1,433 firms in sixty-five principal industrial centers. The report shows that for the last day of January there were 1,643,253 workers employed as against 1,626,958 on Feb. 28. Agents of organized labor assert that the actual idleness is not indicated by these figures.

Returns show that the greatest increase in unemployment in February was in the iron and steel industry, which reported an aggregate decrease in labor employed of 7.3 per cent. The decrease in employment in railroad labor shops was 6.6 per cent. A total decrease of 56,896 employees was reported in the following industries: Iron, steel and other products, railroad repair shops, chemicals and allied products, liquor and beverages, miscellaneous, food and kindred products, stone, clay and glass products, paper and printing, and tobacco manufacture. Industries reporting increases in employment during February were vehicles and land transportation, textiles and other products, leather and finished products, lumber and its manufacture, metal and metal products other than iron and steel. The total in these six classes was 40,601. The resumption of work in Detroit automobile factories placed 20,417 men in work in February who presumably were without work in January.

Thirty-six cities reported a decrease in the number of employed of 60,235, while twenty-nine cities reported a total increase of 43,904.

Explosion Wrecks Chicago Elevator

The working house of the Chicago & Northwestern Ry. grain elevator at 122d St. and the Calumet River, Chicago, was wrecked by a dust explosion March 19, with the loss of four lives and a great quantity of grain. The building had a machinery room of structural steel cased in concrete, supporting a group of cylindrical concrete bins, these being surmounted by a cupola about 93 ft. high having structural steel framing with light curtain walls of reinforced concrete built up by the cement-gun, as described in *Engineering News-Record*, April 25, 1918, p. 819. The total height was about 215 ft. and the bins had a capacity of 931,000 bushels. The storage bins in the rear of the building have a capacity of 10,000,000 bushels.

It is reported that a slight explosion occurred first, which is a characteristic of dust explosions. This seems to have been in the driers and to have been followed by the main explosion which swept through the structure. The elevator was built in 1918.

American Architects Begin on Louvain Reconstruction

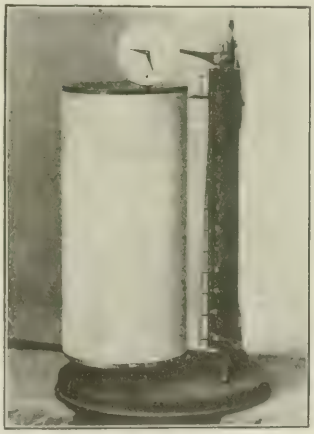
Whitney Warren, of the firm of architects of Warren & Wetmore, New York City, has gone to Belgium to begin plans for the reconstruction of the Louvain Library, destroyed by the Germans in 1914. He was accompanied to Belgium by two other American architects. After preliminary plans have been made the architects will return to this country to finish them. It is expected that the cornerstone of the library will be laid some time in July of this year.

Combined Water-Level Recorder and Flow Meter

A combined water-level recorder and flow meter has been perfected by John L. Stevens, consulting engineer, Portland, Ore., and is now being made and sold by Leupold Voelpel & Co., Portland, Ore. The recorder (see view) is a complete water-level recorder in itself, designed for small conduits, weirs or other devices where the range of heads does not exceed 2 ft. The flow meter is a separate integrating attachment that may be put on at any time. The combined instrument is covered by patent 1,356,322.

The purpose of the flow meter is to save the labor of computing the volume of flow from the record of water levels. It may be set to record the total volume of water passing the instrument in acre-feet, gallons or any other unit desired. It is operated by an adjustable spiral cam that may be set for any weir, headgate, canal, flume or ditch that is rated, or for any device or condition where the height of water is an index of the flow.

A pen carriage is moved up and down by a float resting on the water. The pen marks a line on the record paper fastened around a drum that is turned by an eight-day clock inside the drum. The combination of these two



WATER-LEVEL RECORDER AND FLOW METER

motions makes a record of the rise and fall of water. The record of heights may be made either to actual size or to one-half actual size by a simple adjustment of the line to the float.

The flow meter operates somewhat on the principle of a planimeter. A friction wheel resting on top of the drum is turned by it. The angle this wheel makes with the direction of motion of the drum is made to vary adjustably with the height of water. A suitable gear train causes hands to indicate on a graduated dial the number of revolutions made by this friction wheel. By a simple adjustment of a spiral cam and the use of an integral multiplier the revolutions thus indicated are readily converted into acre-feet, gallons, cubic meters or any other unit of volume flowing in any rated conduit or passing any weir, headgate or other measuring device.

A check is always had on the record

of the flow meter through the simultaneous records of water levels. Thus the convenience of the water meter is secured with the additional advantage of being able to check the results and determine rates of flow if desired.

New Type of Trenching Machine

A new type of trenching machine, with full multipedal traction has been placed on the market by the Austin Machinery Corporation. It is designed to turn practically within its own radius, has full caterpillar traction and is a "one-man" machine.

The full multipedal traction steers through heavy friction clutches—one on each side—its action in this respect being similar to the military tank. It is of sufficiently light weight to handle trenches for house connections, sewers, etc. The machine will cross sidewalks, climb over a curb, cross bridges, and travel over all types of pavement.

A screw hoist raises and lowers the digging arm automatically, and the endless chain and buckets are of standard type. The screw hoist also acts as a lever to force the buckets to dig, by crowding the bucket line against the face of the ditch or cut.

A cleaning device takes care of the sticky dirt, and scrapes out each bucket as it passes a point at the head of the excavator boom, directly over the conveyor belt. This can be adjusted to deliver the excavated material to either side of the machine.

The gasoline engine is of four-cylinder four-cycle type, cooled by an enclosed radiator. Some of the details which are of interest to sewer, water, gas, electric and oil pipe line contractors and corporations are as follows:

The digging width with 18-in. buckets, will run from 20 in. to 28½ in., and with 24-in. buckets, from 26½ in. to 29 in. The standard boom will dig up to 6 ft. in depth, although the machine may, with extensive equipment, dig 8 ft. deep.

The conveyor belt is reversible, so that it can deliver dirt on either side. An important feature of the working performances is its interchangeability for digging trenches with vertical banks or small ditches with sloping sides.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.58	$4.25	$3.75	$3.58	$3.86	$5.90	$4.70	$5.00	$5.00
Structural rivets, 100 lb.	5.08	.....	7.05	5.08	5.50	6.90	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb.	3.00	3.75	3.85	3.48	3.88½	4.37½	3.60	4.50	4.25
Steel pipe, black, 2½ to 6 in. lap, discount	39%	45-65-5%	40@45%	31%	46-9-5%	29@33%	36¾@42¾%	40%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	64.00	66.20	64.10	67.80	70.00	87.65	75.00	80.00
Concreting Material:									
Cement without bags, bbl.	3.10	3.00	2.85	2.17	2.60	3.10	3.09	3.10	4.28
Gravel, ¾ in., cu.yd.	2.50	2.62½	1.75	2.75	2.00	2.50	2.50	1.50	1.50
Sand, cu.yd.	1.25	1.52½	1.75	2.75	.75	1.10	1.65	1.50	1.50
Crushed stone, ¾ in., cu.yd.	2.15	2.50	3.20	2.75	2.25	3.50	2.50	3.50	2.10
Lime, finished, hydrated, ton.	21.00	18.00	25.00	20.00	29.00	32.00	25.40	27.00	32.00
Lime, common, lump, 200 lb. bbl.	3.30	2.00	2.50	1.65	2.00	3.20	2.25	3.25	16.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	48.00	35.00	45.00	53.00	41.00	47.00	27.00	35.00	120.00
Common brick, delivered, 1,000.	21.70	12.00	25.00	15.00	18.00	16.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	0.14	0.21	.12	.06	.11	.12½	.13	.25
Hollow partition tile, 4x12x12, block	.2444	.15	.19½	.108		.11	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.73	.74	.88	.82	.78	.97	.79	.79	.98
Common labor, union, hour.	.75@.80	.35	.60@1.00	1.00	.50	50@.63½	.81¼	.75	.....
Common labor, non union, hour.	.....	.25	.40@.60	.50	.50	37½@.50	.50@.55	.50	.30@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. **New York** quotations are at warehouse, except cement and brick, which are delivered, and tile, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses, except C. I. pipe, which is mill price, plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

The principal price changes are in lumber and linseed oil. Pine is highest in Montreal, $120 per M ft. b.m., against $35 in Atlanta, but the Canadian city looks for an early decrease. Atlanta is down from $37.50 to $35, while Chicago reports that the decrease of $2 is only a minor fluctuation and does not represent the state of the lumber market as a whole. Prices are down $1 in Minneapolis and San Francisco. Linseed oil dropped as follows: 15c. per gal. in Montreal, 4c. in Minneapolis, 3c. in Chicago and Atlanta, 1c. in Dallas.

In Seattle, sand and gravel sells for $1.50 per cu.yd., loaded on trucks or railway cars. According to the Pioneer Sand and Gravel Co., the price at pits 12 to 40 miles from Seattle is 75c. per cu.yd. on scows, while at a pit 40 miles from the city the price is 50c. In New York price of gravel was lowered 50c., March 23, making the present price $2.50, as against $3 since June, 1920.

Steel prices changed only in Montreal, San Francisco and Dallas. Structural rivets can now be bought for $7.05 in Dallas, against a former price of $8.50. Reinforcing bars are available at $3.60 in San Francisco, drop of 15c., while the decline in Montreal is 25c. Steel beams are down 75c. in Montreal; rivets, 25c. Cast iron pipe in Montreal is now $80 per ton, instead of $90.

The "liquidation" of labor continues. In Chicago continued unemployment has forced unskilled common labor down to 50c. per hour, whereas recently rate was 60@65c. Montreal reports: "Labor plentiful, work scarce." In Colorado 97 Cheyenne building crafts are striking against a dollar a day decrease. Denver contractors and unions have practically reached agreement on a dollar reduction. Following this settlement in Denver the lumber interests are pushing a campaign to show that now is the time to build. The National Association of Builders' Exchanges forcasts a general wage reduction.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren *Editor*

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Freight by Container

A CAR specially designed for truck-body-freight-containers, used in store-door delivery service, has been put in operation by the New York Central lines between Chicago and Cleveland, as noted elsewhere in this issue. Previously these columns have urged a full trial of the motor truck in railroad terminal service and have pointed to line haul of container-bodies as one of the possible extensions of such a system of operation as is now employed at Cincinnati for the interchange of less-than-carload freight between railroad main and sub-stations. The published tariff for the new store-door delivery service states that it is for the purpose of trial. While team-track cranes already existing will be used for transfer of containers between car and truck, expansion of the service may dictate some revision of less-than-carload terminal layout and the use of specialized handling equipment. Here there will probably be large opportunity for skillful adaptation of existing facilities to an improved system of operation.

Keeping a Big Job Going

EVEN in flush times, million and a quarter-yard concrete jobs are not commonplace. The size, therefore, adds all the more interest to the description in this issue of the construction organization and procedure in building the Wilson Dam (formerly known as Muscle Shoals Dam) in Northern Alabama. In such a project the big problem is to assure the uninterrupted flow of materials, and to show how that was provided for on the job in question is the principal purpose of the article on page 537. It warrants the careful reading of both engineers and contractors.

Fate of Wilson Dam Project

LESS than two weeks after the article on the Wilson Dam appears, work on the huge project will come to a standstill. After spending $17,000,000 on the project, the government, speaking through Congress, has decided to let the job lapse. What will be done with it cannot be foretold with certainty. When the last administration went out of office there was no plan. Now some light appears. The new Secretary of War, Mr. Weeks, states that if a lessee can be found to operate the plant on terms that will give the government a reasonable return on the investment, he will recommend to Congress the appropriation of sufficient funds, approximately $30,000,000, to finish the plant. Chief opposition to further appropriation in the last Congress seemed to be due to an unwillingness to have the government operate the plant—presumably in connection with the nitrate plant built at Muscle Shoals as a war measure. Certainly the investment already made should not be allowed to remain idle if, on completion, the plant can be operated on a sound economic basis. If it can be, and the government is willing to make a contract that will fairly safeguard the contractor, there will undoubtedly be tenders for the operation of the plant. Moreover, even if the return that can be secured is not what one would expect from a privately financed venture it is obvious that it might be cheaper for the public to incur a minor loss rather than lose the entire interest on the $17,000,000 already spent and fail at the same time to get any income toward amortization. The negotiations which will likely ensue as a result of Secretary Weeks' statement will make interesting reading.

Wage Deflation

LAST week's acceptance by the packing-house employees of wage cuts of 8 cents an hour for time workers and 12½ per cent for piece workers is significant of labor's appreciation that wages must come down. The agreement covers plants widely scattered and, while it does not effect arrangements that have the national character of the railroad wage agreements, it comes nearer having a national import than any but the railroad labor situation. The proposals made by the packers were not acceded to in full. The basic 8-hour day is retained and all agreements made by Judge Alschuler acting as "administrator" or arbitrator will remain in effect until Sept. 15 of this year when they will terminate. Another indication of labor's appreciation that the wage trend must be downward was the decision of the marine workers at New York to accept a reduction which would wipe out the advances made to them by the Railroad Labor Board last year. The reductions here referred to are, of course, an essential part of the industrial deflation process and their special significance lies in the fact that they have been effected by arbitration and without strikes.

Disparities in Highway Bids

DURING the past few weeks bids have been received for the construction of hundreds of miles of highway in four of the large road building states, New York, Pennsylvania, Ohio and Illinois. While the types to be constructed in these four states have not been identical there has been enough of a general similarity to indicate a wide disparity in the bids. Ohio and New York have secured fair prices and have put many miles under contract. Peculiarly, in these two states no contract is awarded which is in excess of the engineer's estimate. Illinois' prices do not seem to be excessive, while Pennsylvania felt justified in rejecting most of the bids because they did not reflect the downward price trend. But why, for instance, should a contractor's bid for almost identical work be much higher in Pennsylvania than in New York? Is there justification for wide difference in per mile costs for the types? Is that difference accountable by the physical character of the territory through which the road is to pass? Are

the specifications and the spirit of enforcement held to be a greater risk in the one state than in the other? To those questions we have tried to get answers, but without satisfactory results. It would help highway engineers and contractors greatly if the facts could be impartially set down.

Getting Together on Highway Policy

WHILE Congress recently was considering highway legislation we urged editorially that all who are interested in the continuance of federal appropriations for highway work should get together and go to Congress endorsing a single plan. The soundness of that advice has been borne out by what actually happened in Washington during the closing days of the session, as recited in the news section of *Engineering News-Record* week before last. A highway measure appropriating $100,000,000 passed in the House but failed to come to vote in the Senate, due to the opposition of Senator Townsend, who insists, in the face of an overwhelming sentiment for the federal-aid policy, upon pushing the "national highway" plan. The determination to push the national plan in Congress was born at a time when it seemed impossible to secure extensive federal-aid appropriations. Since the vigorous propaganda for the national method began there have been liberal appropriations under the federal-aid plan, while repeated Congresses have given evidence that the country, at least so far as it speaks through its representatives, is committed to the policy of building roads with the joint use of federal and state funds. That being established, it behooves the advocates of the national plan not to allow their efforts to defeat federal highway appropriations entirely. That is just what they did in the last session. They defeated the appropriation, moreover, not on its merits but through parliamentary tactics. What direction our highway expenditures may take at a later stage of highway development need not be discussed now. For the present the country is committed to the federal-aid plan and it would be well if all advocates of highway expenditures would get together and agree upon that form of use for federal highway funds.

Results of Highway Research

THE extremely rapid expansion of highway transportation during the last year or two has emphasized the acute need for research work of a type never before demanded. It requires only a brief study of the nation's motor vehicle statistics to indicate that today's problems cannot be solved by yesterday's formulas.

Road failures during the past twenty years can be classified into three main groups: The first of these, covering the period of the waterbound macadam road and the horse-drawn vehicle with steel tires, is made up of failures due principally to abrasion; roads actually wore out under traffic. In the second group the type of failure is completely changed by the swiftly moving rubber-tired automobile which drew the binder out of the road surface, resulting in a loosening of the stone, rapid ravelling and a dust nuisance. This condition led to types of construction in which bituminous binders were employed. In the third group great weight transmitted by solid rubber tires, with accompanying impact forces depending, among a variety of other factors, upon kind and condition of tires, speed, height of obstruction or drop encountered on the road surface, and the amount of sprung and unsprung weight, play a prominent part. This type of road failure, as contrasted with the first two, is essentially of a structural nature and is far more serious than its predecessors inasmuch as it involves not merely the surface but the whole depth of the pavement and, in many cases, the foundation as well.

This structural conception of highway design, while comparatively new, is now widely accepted. With it came the realization of the utter lack of information regarding such subjects as the impact of motor trucks and the resistance of various types of road to it, the supporting values of various kinds of subgrade materials, subgrade drainage and the distribution of pressures through road surfaces of various types to the subgrade.

For some time past the U. S. Bureau of Public Roads has been conducting investigations in each of these specialized fields, and the first comprehensive report on the work is summarized in an article on p. 553 of this issue, dealing with the measurement of motor-truck impact. Descriptions of the method were made public a year or more ago. While the report is a preliminary statement of results and presents no final conclusions, it is a document of far-reaching importance. The pioneering work with which it deals has been in progress for two years and has involved a wide variety of tests with different types of trucks, loadings, tires, both pneumatic and solid, speeds, and heights of obstruction or drop. Nothing approaching in scope and completeness the present data on impact has ever been secured. In fact, study of vehicle impact might be called original with the bureau. The report is the first step in a quantitative determination of the effect of motor transport on highways.

It should be clearly understood that the present data deal with only one phase of the general problem—the *amount* of impact force. Supplementary information on the other closely related subjects, enumerated above, will be forthcoming later. With such basic data in hand, co-ordination and interpretation of results will open the way to the establishment of sound methods of highway design and construction, and sound policies regarding vehicle regulation, thereby insuring, to a degree now unknown, the economical expenditure of the vast sums which will be devoted to roadbuilding work and the protection of highways from unreasonable use by overloaded trucks.

The report carefully avoids any statements which could be constructed as definite conclusions, but it does give a summary of what it terms the "indications" of the tests in so far as they have progressed. Impact depends to a great degree upon tires—not only their type but also their condition. Even though very wide, solid-rubber tires which are worn or thin produce extremely high impact forces, while the effect of pneumatic tires in reducing impact is marked. In extreme cases impact as high as 7 times the static load on one rear wheel was recorded with a solid tired truck, although the average value was about 4 times the static load. For pneumatic tires, on the other hand, the average impact value is not more than 1¼ times, and, in extreme cases, not more than 1¾ times the wheel load. A decidedly important indication of the tests is that, under certain conditions, light-weight, high-speed

trucks produce as high impact forces as heavy, slow-moving vehicles.

Containing data which may ultimately cause radical changes in highway design or in motor-vehicle construction and equipment, the report is an indication of the returns that may be expected from the expenditure of money for highway research.

Construction Responsibilities

WHO pays the losses involved in a mismanaged piece of public works construction? About half a million dollars, at the least count, was lost—not merely diverted but totally destroyed—in the Cleveland clearwater basin enterprise, recently brought to a close by an important court decision summarized on page 549 of this issue. Who pays for this loss? For the present, no doubt, the money comes out of the Cleveland taxpayers' pockets. But, where the plain fact is that engineers were responsible by making a notorious mess of the entire basin work, will the loss not ultimately fall on the engineering profession, in the discredit and loss of prestige that the case inevitably entrains?

All the responsibility for the failure and its attendant evil history, we regret to say, rests on the shoulders of engineers without a shred of excuse in storm, fire or other act of God, in accidental error of calculation, or in fault chargeable to someone else. Not only this, but blame rests on them, in conjunction with city politicians and lawyers, for attempting to make the contractor pay the piper and in addition deprive him of a considerable sum of money rightfully due him for work done. All this is known, more or less definitely, to the citizens. Not only from the decision but from facts learned long before the decision was rendered, the people know that the basin construction was incompetently and negligently planned, and that all subsequent troubles had origin in this fact. They also know of the preposterous attempt to divert the responsibility for the outcome under cover of the fact that the contractor did a large amount of very bad work. Is it to be expected that they can retain high regard for a profession that lends itself to such proceedings? Refuge will try to be found in the contention that the engineers were honest and that, at least in urging or abetting the suit, their judgment was in error; but granting such contentions, they do not weigh heavily in the face of the facts disclosed.

In checkmating the attempt to hold the contractor accountable for the engineers' faults, and at the same time condemning him to full payment for his own bad work, the court decision gives powerful support to sound practice in public works. Primarily, this inures to the interest of the public, but it will also benefit contractors and engineers. Should it accomplish nothing else than to eliminate or make less probable such bootless contentions as those on which the clearwater basin case was built up, it will be of lasting value.

Contractors will find in the illuminating analyses and findings of the master and court renewed assurance that when they do public work they may count on ample protection of their rights and need not fear ruin so long as they themselves do not fail of performance. Perhaps no essentially new points of law are brought out, yet some old points are presented in distinctly new light. This is done both in the findings of the master, by which he brushes aside many of the cobwebs with which the technical facts of the case had been surrounded and in the court's application of the principles of law to a number of matters vital to the contractor: the validity of a contract in the face of ambiguous clauses concerning available funds, the right to recognition of completed performance, the right to prompt acceptance, the binding character of liquidated-damages agreements, and the obligation to pay for repairing faulty work. Going behind the decision to the facts of the case, the contractor will also find it instructive to note that his own responsibility in connection with a public works contract is a very real one, and that if he allows the dictates of hurry or the negligence of employees to jeopardize the quality of his work he may land in bankruptcy. There is no apology and no relief for bad work.

And, much more forcibly, there is no apology or relief for bad engineering. The clearwater basin was a total failure because, in the first instance, the preliminary exploration and the fundamental planning were inadequate. Indeed, the whole filter plant of which it is a part was affected most seriously by the same cause, and its history of reconstruction and restoration attempts is not yet ended. But this was only an initial error. On top of the routine adoption of a conventional design of structure, incapable of resisting settlement such as was to be expected in the soil at the site chosen, there came inadequate inspection and lack of that team work between contractor and engineer in the field which assures safe control and direction of the undertaking.

Minor though the last mentioned point may seem, it is perhaps the most significant of all. Thorough engineering in the field would have exposed the earlier mistakes and under favorable circumstances would have made their correction possible. Whoever follows the case through attentively, indeed, will be impressed with the fact that the missing co-ordination of owner and contractor was perhaps the most serious single fault of the whole enterprise. Explorations are more or less perfect, generally less; and designs are often nothing more than paper guesses; but the engineering that is done in the course of the actual construction is the finally determinative work, and will make or mar the result. The obligation upon the engineer to inspect the work and therewith to direct and control the construction enterprise is compelling and inescapable.

Reducing the whole to its elements, it may be said that the case restates the truth that conscientious engineering and fair dealing with the contractor are indispensable to sound results in construction. In respect to conscience and care as well as in respect to fairness, a responsibility rests on the engineer that he cannot evade.

In a case with so many sobering and anxious features for the engineering profession, it is a satisfaction to see also an illustration of what the engineer can do in furtherance of sound public relations, even far outside his narrow field. An engineer, acting as special master, played a determining part in straightening out the tangle of technical facts in which the case had become involved, thereby leading up to a constructive court decision. Robert Hoffmann's contribution to the analysis of the dispute is a gratifying and gratifying feature of the case. It demonstrates that under the right circumstances the engineer can help as much in the sound handling of law as, we hope, the lawyer can hold in keeping engineering on a footing of equity.

Million and a Quarter Yard Concrete Job Was Carried on Rapidly at Wilson Dam

Description of Construction Plant That Was Placing About 40,000 Yards of Concrete Per Month—Main Concreting Plant Equipped With Four-Yard Mixers

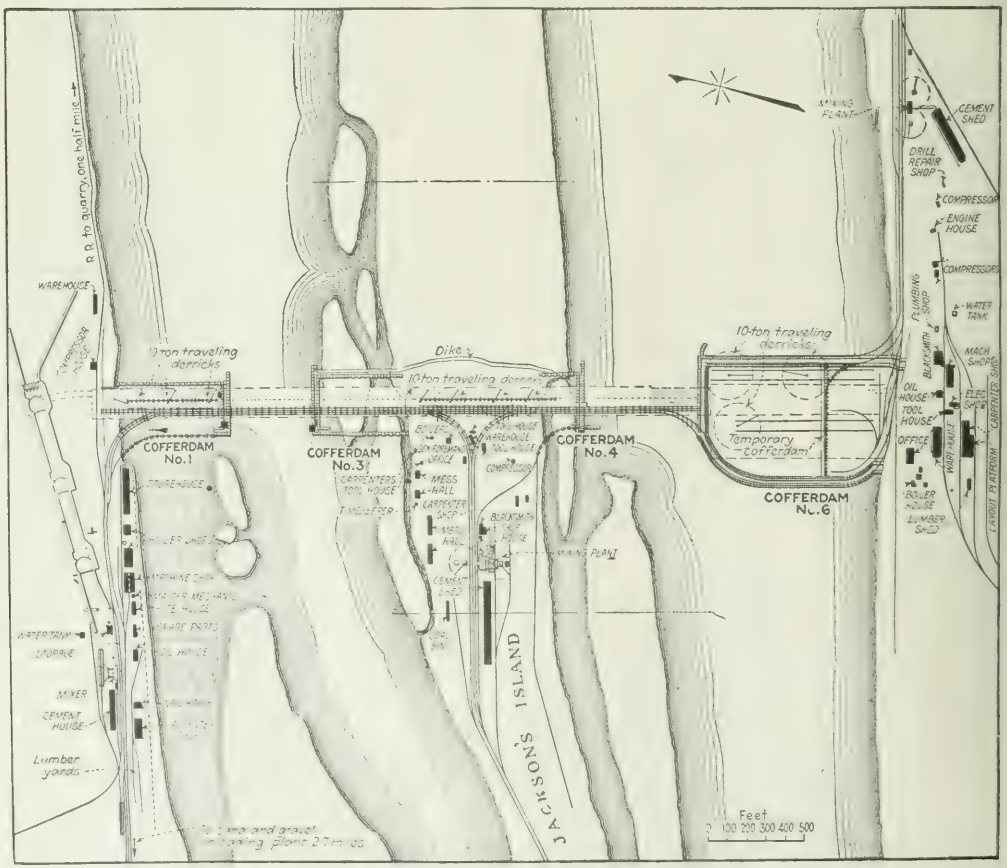
STARTED in 1918 and seriously delayed several times, the construction of the Wilson Dam in northern Alabama, known more widely under the name of the Muscle Shoals Dam, was going ahead rapidly when Congress shut the work down. Concrete pouring began on a large scale last October. In that month 28,000 cu.yd. were placed; in November, 26,000 cu.yd.; in December, 40,000 cu.yd.; in January of this year, 38,000; in February, 37,000 cu.yd. These yardages were entirely in the dam. In addition 5,000 cu.yd. were placed in the power house in February. Meanwhile all supply sources have been developed so as to allow of continuou full-capacity operation on both dam and power house.

To the end of February approximately $13,500,000 have been spent on the project, out of a total estimated cost of $50,000,000. The structures when completed will contain 1,260,000 cu.yd. of concrete masonry.

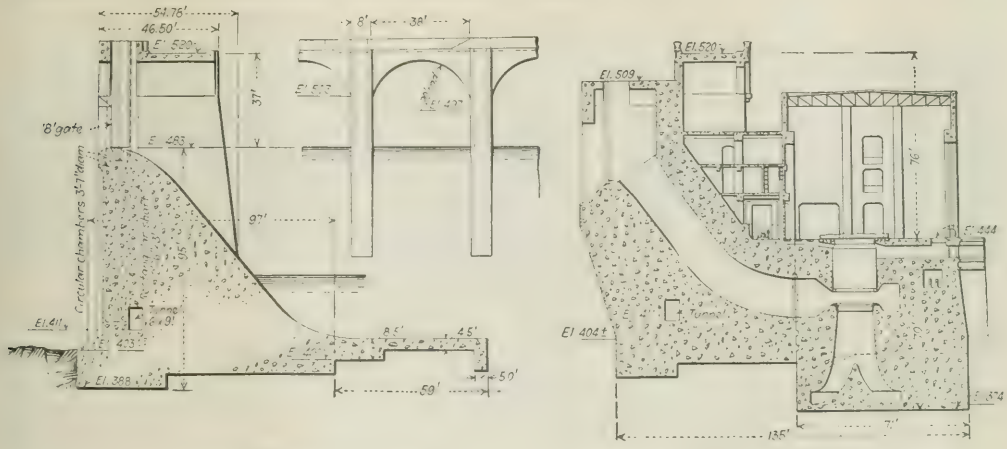
It is proposed in this article to describe only the construction plant and the general construction procedure. Only so much information will be given regarding the design as will enable one to comprehend the task that as set before the construction engineers.

Structures to Be Built—The Wilson dam is a gravity-section concrete structure located at Muscle Shoals, in the Tennessee River, about 2½ miles upstream from Florence, Ala. The total length is 4,111 ft. The spillway section has a length of 2,890 ft., while that portion in which the power house is incorporated has a length of 1,221 ft. In this description repeated mention will be made of the "power house," but it is to be understood that that structure is built integral with the dam itself and on the same axis as the spillway section.

The dam crest is 80 ft. above the elevation of the river bed, and will carry gates 18 ft. high, raising the water level to a height of 98 ft. above the stream bed and creating an available maximum of about 500,000 hp.



LAYOUT OF CONSTRUCTION PLANT, WILSON DAM



CROSS-SECTION THROUGH DAM AND POWER HOUSE

Four units of 30,000 hp. each have been contracted for, and space for fourteen additional units is provided in the power-house design. Carried above the crest of the dam will be a roadway bridge.

On the north bank (the power house is on the south side) will be a flight of two locks, each 60 x 350 ft. between hollow quoins (300 ft. available length).

The project has long been under discussion by the Corps of Engineers, U. S. A., but no action could be secured until the war necessity for nitrate arose. The construction was then authorized (in April, 1918) under broad powers granted the President, to be paid for out of funds placed at his disposal by Congress, with the exception of using the current in the nitrate plant or plants to be built at or near the dam site. Work was suspended by order of the War Industries Board on Aug. 21, 1918 and was resumed on Nov. 9 of that year. The reorganization of forces was commenced at once, but owing to the scarcity of men and materials and unfavorable winter and river conditions, little progress could be made until the beginning of the spring of 1919, at which time work was resumed in earnest and the first cofferdam was completed. Meanwhile work was concentrated on a steam power plant and on the nitrate plants themselves, with the result that nitrae plant No. 2 was put into operation before the close of the war, though with purchased current, the steam plant not being finished until long after the armistice

In 1919 work was again resumed on the dam, the first cofferdam being completed and pumped out about the middle of the year. Subsequent delays were caused by changes in design, and full-swing concreting operations were not possible until October, 1920.

As has been stated, approximately $13,500,000 have been spent to date and the government is obligated for an additional expenditure of $525,000, by reason of contracts for four turbines and $779,000 for four generators. Funds available permitted of full operations only through February and an additional appropriation of $10,000,000 requested from Congress was refused. Consequently work is now being shut down as rapidly as possible with a view to retaining enough of the funds now available to care for the plant, property and buildings for a reasonable period.

The thought of the advocates of the project is that the current will be chiefly used for nitrate manufacture in nitrate plant No. 2, the product being sold in peace times for agricultural purposes. The construction, it should be borne in mind, however, has had no connection with the nitrate plants and it is the latter, and not the dam, that are referred to when the Muscle Shoals plant, or the Muscle Shoals project, of war days is mentioned.

Skeleton cross-sections herewith show the spillway and the power-house sections of the dam and give an idea of the work involved in the construction.

The Construction Task—The construction task may be quickly visualized by calling attention to the site conditions and to the chief quantities involved:

1. On the north bank the nearest railroad connection (with the Louisville & Nashville) was 2½ miles away; on the south (with the Southern Ry.), 3 miles.

2. The nearest town was not only 2½ miles from the site, but lacked rail connection with the dam site and was unable to care for the 4,500 persons whose services would be required in connection with the construction. Consequently it was necessary to build at the site a camp of very large proportions.

3. The stream is a flashy one, subject to enormous flood increases, the average summer minimum falling to about 12,000 cu.ft. per second and the maximum (recorded in a flood in 1897) increasing to 500,000 cu.ft. per second. This involves, in an unobstructed river, a maximum rise of 33 ft.

4. The excavation required amounted to 620,000 cu.yd. distributed as follows: Locks, 228,000 cu.yd.; power house, 216,000; dam, 176,000. The lock excavation is in the dry; the power-house and dam excavation, principally in the stream bed.

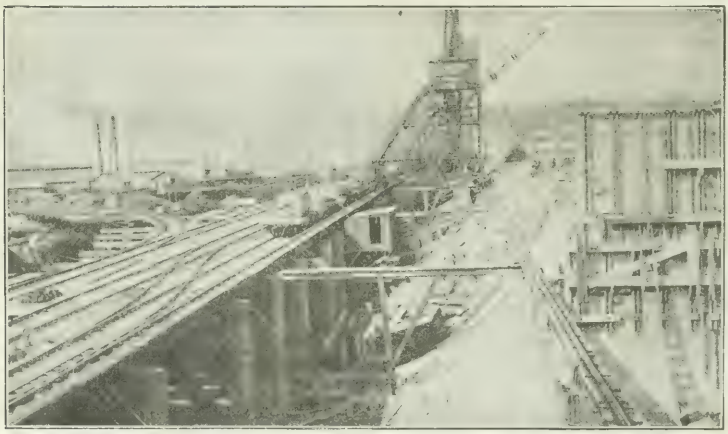
5. The concrete masonry involved totaled, as already stated, 1,260,000 cu.yd., and was divided as follows: Dam and bridge, 665,000 cu.yd.; power house, 498,000 cu.yd.; locks, 72,000 cu.yd.; miscellaneous, 25,000 cu.yd.

Construction Procedure—The diagram herewith shows the layout of the construction plant. The scheme, in the main, consists in building on the downstream side of the dam a construction bridge, carrying four lines of standard-gage track across the north channel and three

MARRIED NEGRO QUARTERS; SOME OF THE PERMANENT RESIDENCES IN THE FOREGROUND

lines across the south channel. This bridge is of substantial construction—steel girders on concrete piers—so as to withstand the floods that are likely to sweep over it in times of high water. The tracks on the bridge connect with the rails of the railway systems reaching Sheffield on the south bank and Florence on the north bank, thus allowing for deliveries to any part of the work from either of the trunk lines. The installation of four lines across the north channel (one more than over the south) is due to the greater traffic over the former, for across it must come all the sand, gravel, and the plum stones for the concreting operations.

On the downstream side of the dam, between the crest and the construction bridge, is a 38-ft. gage track for the cranes which remove the rock from the dam foundation and handle forms, plum stones and concrete.



CRANE TRACKS AND CONSTRUCTION BRIDGE ON DOWNSTREAM SIDE OF DAM

The location of the construction-plant service buildings is clearly shown on the plan. As will be noted, there are separate groups on the north and on the south banks, the former being intended for the equipment and service on the dam operations proper and those on the south bank for the equipment and service required in building the power house.

The heart of the job is the main mixing plant on Jackson Island, for upon its output depends the progress of the principal item of the work, the concrete masonry of the dam. From it tracks lead in both directions along the dam, and while a separate mixer plant is provided on the south shore to serve the power house, concrete for the latter could be secured in case of necessity from the Jackson Island plant. The capacity of the main mixer plant was determined largely by the equipment that could be employed with reasonable continuity for taking rock out of the dam excavation, handling forms, and placing concrete. The handling equipment on the dam consists of seven Terry full-circle cranes, traveling on the track previously mentioned, and having a capacity of 10 tons at 75-ft. radius. Two of these cranes work together on each of the blocks of the dam and can each handle twenty 4-yd. buckets of concrete per hour; that is, the two cranes can put 160 cu.yd. of concrete in place per hour. To keep these cranes served, the mixing plant was equipped with two 4-yd. Smith mixers. Allowing for three minutes in the drum per batch, the mixer turnout synchronizes with the capacity of the placing cranes. The best concrete run for an 8-hr. shift has been 1,060 yards.

Obviously on such a large job continuity of operation needed to be given careful thought. For that reason ample provision is made for large reserve storage and for sufficient equipment to keep up the rate of progress in case of breakdown of individual units. This is illustrated by the storage capacity provided at the main mixer plant—20,000 cu.yd. of gravel and crushed stone, 15,000 cu.yd. of sand, and 25,000 bbl. of cement. Moreover, in case of shutdown of the main plant by accident, the concrete reserve plant on the north shore can be called into service without blocking traffic on the construction bridge. At a later date, when through tracks are finished across the south channel, even the south shore plant could be called upon for reserve service. The shore concrete plants are both equipped with two 2-yd. mixers. That on the north shore will be used chiefly for the mixing of concrete for the locks. A cement warehouse of 15,000 bbl. capacity is provided at the north bank concrete plant, and one of 25,000 bbl. capacity on the south shore, giving a total capacity on the job for storing 65,000 bbl. of cement, a provision believed wise in view of the difficulty experienced last year in securing adequate and continuous supplies.

The bridge trackage, to emphasize again the provision

to secure adequate plant capacity, is ample to keep the various services going without interference. Two tracks are available across the north channel for service between the shore and Jackson Island, leaving the other two for haulage of concrete, forms, etc., to the dam itself. Across the south channel there will be less through traffic than from the north shore to the island, and three tracks are expected to prove ample. At present only one of the tracks across the south channel is completed, but work upon the remainder of the construction bridge and trackage is actively under way.

TWELVE-ACRE COFFERDAM INCLOSING POWER-HOUSE SITE

In normal concreting procedure on the dam two standard 40-ft. flat cars are hauled in a train by a 25-ton locomotive, each flat carrying three of the 4-yd. buckets. The cars are large enough for four buckets each, but in order that the concrete shall be dumped as soon after mixing as possible the number of buckets is limited to six to a train. The center-to-center spacing of the mixers themselves, by the way, corresponds to double the spacing of the buckets on the flats, so that alternate buckets, should four be used to a car, can be filled at one time. The 4-yd. buckets, stated to have given excellent service, were built by the Atlas Car Co., of Cleveland. Two-yard buckets are provided for concreting the piers of the bridge and for narrow and small parts of the work.

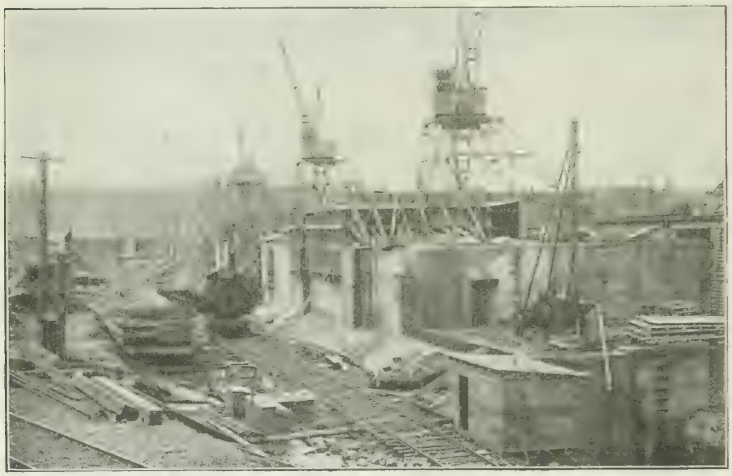
GENERAL VIEW OF JOB; INSIDE FIRST COFFERDAM CAN BE SEEN FOUNDATION OF DAM, CRANE RUNWAY AND CONSTRUCTION BRIDGE

Concreting in the power house will be handled with the aid of three McMyler full-circle cranes, traveling on tracks laid on sills on the stream bed. These cranes have masts 100 ft. high, have 115-ft. booms, and a capacity of 10 tons at 118-ft. radius. They will handle the buckets from flat cars to place.

Procedure of Work. The first work attempted, aside from the building of the camp, the filling and grading of a railroad yard on the north shore, the laying of railroad track on the north shore and the provision of the service buildings, was the construction of a narrow-gage railroad line across the north channel from which the piers of the construction bridge could be built. The line was carried on timber cribs and over it came the pier forms and concrete, both handled to place by derrick boats conveniently moored. The completion of the north channel construction bridge and the tracks thereon enabled excavation to begin in the dry on Jackson Island, and also the erection there of the main mixer plant, the accompanying cement warehouse and certain service structures.

The construction of cofferdam No. 1 on the north shore of the river proceeded simultaneously with the construction of the bridge, and as soon as possible, the construction of cofferdams 3 and 4 (on the north and south shores of Jackson Island) and cofferdam 6 (inclosing the power house site) were taken in hand. River arm and down stream cofferdams consist of two rows of 16 x 16 ft. stone filled round-timber continuous cribs

with a sheeted clay chamber from 12 to 20 ft. wide between, the top of which is covered with a thin layer of stone to serve as riprap. The upstream coffers (except for the power house) consist of but a single row of continuous stone filled cribs sheeted on the upper side, with the sealing material filled in above. It will be noted that this arrangement provides for submerged river action in time of flood without injury to the coffer dams. All cofferdams were originally built to a height of 14 ft. above ordinary low water, but cofferdams 3 and 4 have been raised to a height of 20 ft. above ordinary low water (26 ft. above the stream bed) and cofferdam 6 to a height of 17 ft. above ordinary low water (21 ft. above the stream bed). All cofferdams are subject to overflow in freshets, but, so far, overflow has occurred only once. The extra height given to the Jackson Island and power house cofferdams saved those two dams from being overtopped in a recent freshet.



BLOCK OF WILSON DAM CARRIED TO HEIGHT OF 43 FT. ABOVE RIVER BED

The procedure adopted with a view to handling the floods is as follows:

1. Except for the portion on Jackson Island and 400 ft. adjoining the lock on the north shore, which will be carried up to crest height at once, the entire dam is to be built with alternate sections open to pass the stream discharge. Sections 12 ft. long are to be carried to crest height and from them will rise 8-ft. piers to carry the roadway bridge. Between these 12-ft. blocks the dam will be carried up only to El. 411, thus leaving alternate 12-ft. blocks and wide openings. The openings will be alternately 30 and 38 ft. wide, this variation being due to the fact that though the bridge piers are placed uniformly on 46-ft. centers, the additional width of 4 ft. (to make the 12-ft. block) is added on one side of the pier.

2. Work was rushed on the portion within cofferdam 1 until all concrete was brought up to El. 411, or higher. This was accomplished during January last, and the cofferdam was then removed, thus giving additional area for passing the spring floods.

3. Work in cofferdams 3 and 4 will also be pushed hard, so that the cofferdams there can be removed and allow cofferdam 2, across the present open part of the north channel, to be built. The entire flow would then be diverted through the south channel and through the openings in the portions of the dam built within cofferdams 1, 3 and 4. It is hoped that by the end of the present construction season all the piers in the portions included in cofferdams 1, 2, 3 and 4 will be up to full height.

4. In the spring of 1922 it is planned to close with a cofferdam the opening in the south channel (to be called cofferdam 5) thus diverting the flow to those portions built within the four earlier cofferdams. It is the expectation that by October, 1922, the roadway bridge will be completed for the entire length of the dam and all open sections up to El. 411, so that work may then begin, in regular procedure across the whole length of the dam, to build in the openings up to full crest height.

5. During all these operations there will be no disturbance of cofferdam 6, inclosing the power-house site, so that without interruption work may proceed therein on excavation of foundation and tailrace and the placing of concrete.

Under the plans as originally made a different method of construction procedure was to be followed. It was planned to leave openings through the bottom of the dam for its full length, the whole dam being built up to full crest height without the necessity of forcing water over partially finished work. It was to fit this procedure that the existing construction layout was planned. The piers for the construction bridge are on 23 and 36 ft. centers while those for the crane-track vary from 14 to 24 ft. centers, and were spaced so as to avoid the originally planned temporary openings. Moreover, since no water was to come over partially finished work, the upstream crane rail could be left on the downstream face of the dam without any change in the existing construction layout, until closure was completed. The openings through the base were later to be closed by gates on the upstream face and the tunnels concreted.

However, when the present consulting engineers were called in they advised in favor of the procedure which is now being followed, being fearful that the channels in the base of the dam might become choked with drift and prevent the closing with gates. Under the present method of procedure, the upper crane rails, suported by the piers to be incorporated in the concrete of the dam, will of necessity have to be removed, except below that portion of the dam closed off by the temporary bulkheads, as soon as the concrete in the closure openings has been raised two lifts. As closure proceeds, the crane rails will be removed below completed lifts and placed, under protection of the bulkheads, behind that portion of the dam in which the six foot lifts are being placed. In this manner, it is hoped to be able to use the Terry cranes to complete the entire work notwithstanding the change in plan of construction.

Excavation—The excavation within the stream bed is entirely in Lauderdale chert, a hard cherty limestone. On both banks, however, the strata above the Lauderdale chert consists of Keokuk limestone. Large quantities of this had to be excavated at the lock site and the dam abutment on the south shore. The Keokuk limestone is easily handled, but the chert is very hard and is difficult to drill. The drilling and blasting procedure, however, offers no particular points of interest. Spoil was removed from the dam foundations in skips and handled by the Terry cranes to 20-yd. side-dump cars. At the power-house site part of the excavation is similarly handled by the McMyler cranes, but the greater part of it is handled by steam shovels, loading directly into cars. Inclines and switchbacks connect the tracks within the excavation area to the running tracks on cofferdam 6. Spoil areas were conveniently located on Jackson Island and on both the north and south shores.

The character of rock encountered in the lower lifts of the power-house excavation was suitable for crushing for concrete and at present the spoil is being taken to the crusher plant located at the main mixer installation on Jackson Island, the crushed stone being used not only for the dam concrete but being hauled back to the south shore concrete plant for use in the power-house structure.

Air compressor plants are located on the north shore and on Jackson Island for supplying compressed air for work on the dam section, and another plant on the south shore supplies the air needed on the power house section. The plant on each section has two machines and has a capacity of about 4,000 cu.ft. of air per minute.

Materials Supply—Sand and gravel are secured from river bars about 12 miles below the dam. Two suction dredges, equipped with washing screens, are in operation at this point, and the materials are brought by barges and tow boats to a dock at the Florence bridge, 2½ miles below the dam site. Here the materials are removed by two gantries equipped with 4 cu.yd. buckets and deposited in a storage bin, having a capacity of 1,500 cu.yd. of gravel and 750 cu.yd. of sand. From these bins gravel and sand can be dropped directly into side-dump cars and hauled to the mixer plant.

Plum stone, crushed rock and crib filling stone is secured from a quarry on the north bank about half a mile above the dam site. The greater portion of the rock in the lock excavation is used as plums or for crushing.

Cement has been purchased from six different companies, and in order to insure a supply last year when the car shortage was so serious the government bought seventy-nine standard-gage boxcars, which were used exclusively in cement service from the plant of the Lehigh Portland Cement Co. at Mitchell, Ind. By this means the job was kept in a continuous supply of cement during last summer.

Miscellaneous Equipment and Facts—Brief mention of the quantities of some of the equipment, chiefly of that not already mentioned in this article, will give some idea of the "planting" of the job. The equipment inventory shows that there are thirty locomotives, ranging in weight from 25 to 60 tons; seventy-nine standard box cars; fifty-six standard flats; seventy eight dump cars, practically all of 20 cu.yd. capacity seventeen locomotive cranes; ten steam shovels; two 15-in. suction dredges; three tow boats, and twenty sand and gravel barges. At the main mixer plant on Jackson Island is a crushing installation consisting of a 48-in. Allis-Chalmers crusher, operated by a belt-driven 300-hp. motor and six 12-in. crushers.

The Terry cranes have a mast height of 67 ft. and boom length of 83 ft. The capacity, as previously stated, is 10 tons at a 75-ft. radius.

With the exception of the concrete mixers, the derricks and the locomotives, practically all of the equipment is electrically driven, power being purchased from the Alabama Power Co. and brought to the job over high-tension lines.

There are approximately 28 miles of standard-gage railroad track, not including that upon spoil banks, in excavations and in other locations where it is subject to frequent shifting. In other words, there are 28 miles of running track. Eighty-pound rail has been used exclusively in all tracks, and in the judgment of the construction superintendent has fully warranted the outlay.

The piers for the construction bridge are on 36-ft. centers, while those for the crane track on the dam are on 23-ft. centers. The piers for the construction bridge were put down in depths of 7 to 8 ft. of water. All foundations are on rock. In fact, the rock is clean across both channels.

Organization—All work and design are under the general supervision of Maj.Gen. Lansing H. Beach, Chief of Engineers, U. S. Army.

The construction is under the direction of Col. W. J. Barden, Corps of Engineers, U. S. A., district engineer. The work is divided into five chief divisions: Engineering, under Lt.-Col. W. C. Weeks, Corps of Engineers; administration, W. M. Williamson, which has charge of the camp and its administration, and also of the employment of labor; supply, under Maj. S. C. Godfrey, Corps of Engineers, which purchases all supplies and has charge of disbursements; construction division 1, which takes in the dam proper and the locks, under Joseph Wright; construction division 2, the power house, under Maj. John S. Butler, Corps of Engineers.

Hugh L. Cooper & Co., of New York, are the consulting engineers, responsible for the design.

At the beginning of March about 4,600 men were on the payroll. All civilian employees are under civil service.

To house the workers and take care of the necessary services a camp of 517 buildings has been required. This number of buildings is exlusive of the buildings directly connected with the construction operations.

Business in Agricultural Engineering

That the training of agricultural engineers should include more attention to commercial aspects is the opinion of Stanley F. Morse, consulting agricultural engineer, New Orleans, as expressed in his presidential address to the Southern section of the American Society of Agricultural Engineers. This will necessitate higher salaries to secure instructors of wide practical experience. Lectures by farm operators, agricultural engineers and county agents may form part of the course, and frequent visits should be made to profit-making farm enterprises. Students should have more field work by placing them on well-managed farms and plantations during the summer, and new graduates should be assisted to secure minor positions with concerns engaged in commercial farming.

Operating Costs of Engineering Practice

Factors Include Education, Capacity, Class of Work, and Direct and Indirect Expenses of Business—Cost Keeping

IN ANALYZING the cost of an engineer's practice the factors are of great variety and those to be included will depend upon the class of service performed. There are involved also the kind of organization, the kind and extent of area tributary to the engineer's location, the time and manner of developing the business and the educational work of the engineer for himself and for his client. It has been said that if all engineers engaged their services on the same basis, the engineering profession would receive ultimately what it is justly entitled to for services rendered and clients would have a better understanding of what they receive for the prices paid. This condition has led to an analysis of cost of engineering practice by C. H. Young, president of the Central States Engineering Co., Muscatine, Iowa, for the purpose of establishing a basis for standardization of charges for service. At the annual meeting of the Iowa Engineering Society he presented his methods and results in a paper which is abstracted below:

Engineers may be classified by the character of their practice, as follows: (A) One who has his office at home and operates a one-man practice; (B) one who has a small office, employs assistants for part of the time and operates a one-man practice for the remainder of the time; (C) one who has a business organization, stenographer, chief engineer and departments employing a number of men so that he may perform various classes of service; (D) one who holds a position which provides office equipment and salary and who devotes part time to private practice; (E) a professor who devotes excess time to private practice; (F) an engineer who consults only on large projects along a particular line; (G) one who does some contracting and fills in his time at engineering.

Cost of Education and Equipment—An engineering education is the foundation for a superstructure of engineering practice. Considering that the cost of a college education is $500 per year and that different classes of engineers would require four-year and six-year courses, some engineers would acquire a larger part of their education from their personal ability to study out problems in their own way. Table I presents the cost of education and equipment for engineers of the seven classes. Equipment covers tools, fixtures and transportation facilities. For classes D and E it is assumed that only 25 per cent of their time would be given to engineering practice, because of other duties. For practical experience a five-year period has been assumed.

Promotion—Promoting jobs, dues to associations, etc., as the engineer must keep up with the times. He must also watch the changes in different bodies of men and keep them in touch with his qualifications.

Bonds—The cost of surety bonds amounts to 1 per cent of the penalty of the bond or 1 per cent of the bond required. As the amount of the bond furnished is fixed by the parties requiring it, this is an indefinite expenditure, but it is an item paid by the engineer.

Insurance — This represents the cost of workingmen's compensation which is compulsory under the State Law. It fluctuates from time to time.

Traveling—This includes traveling to jobs that are not obtained and visiting jobs under construction in order to secure information. Many trips are necessary to get final settlement on the work after it is completed. This item

CENTRAL STATES ENG. CO.

DAILY REPORT

Client's Name _____ Date _____

Employees Name _____ Hrs. Worked _____

Nature of Work _____

Expense	Amt.	Paid	Remarks
Auto			
R. R. Fare			
Transfer			
Brdg. Toll			
Meals			
Lodging			
Stakes			
Stationery			
Misc.			

Remarks _____

FIG. 2. CLASSIFICATION OF EXPENSES FOR CLIENT'S BILL

CENTRAL STATES ENGINEERING CO.
OF MUSCATINE, IOWA

IN ACCOUNT WITH

Year Month	Date		Chief Engineer	Asst. Engineer	Draughtsman	Field Helper	Transportation	Meals Lodging	Miscellaneous	TOTAL

FIG. 1. ASSISTANT'S DAILY JOB REPORT (3x5 IN.)

TABLE I. CAPITAL INVESTMENT COST OF AN ENGINEERING PRACTICE

Class of Engineer's Service or Practice	Cost of an Engineering Education: Four Years	Six Years	Five Years' Practical Experience	Necessary Capital: Equipment	Money in Accounts	Total Capital Necessary	Total Amount of Business Including Wages, Expenses
A	$2,000	.....	$1,000	$2,000	$2,000	$4,000	$4,500
B	2,000	.....	1,500	3,000	4,000	7,000	6,500
C	2,000	.....	3,000	8,000	12,000	20,000	30,000
D	2,000	..	500	2,000	2,000	4,000	1,200
E	. .	3,000	1,000	1,000	1,000	2,000	1,500
F		3,000	3,000	2,000	2,000	4,000	6,500
G	2,000		2,000	3,000	4,000	7,000	2,000

NOTE.—25% of time for D and E considered available.

also includes expenses to attend society meetings in order to keep up with the times.

War Tax—This is an item on all cost, as it represents the tax not only on profits but also on telephone, telegraph and express bills.

Interest on Investment—This must be a part of all estimates of cost, amounting at present to 7 per cent.

Interest on Jobs—This is interest on money borrowed to carry on work, for engineers must receive their wages and expenses must be paid whether or not collections are made. Very few assistant engineers have enough money to wait until preliminary expense is paid by the job. Again, a great many warrants must be discounted from 1 to 4 per cent, dependent upon the credit of the project, because the banks have to hold these warrants until the bond issue is put through.

Discount—As mentioned above, it is necessary sometimes to discount warrants and hold bills between Board meetings. Sometimes these warrants cannot be cashed for several years.

Job Expense—This includes miscellaneous transportation of men, expense of lost time for men receiving steady pay, storage, job office rent, etc.

Repairs—Repairs to tools and equipment; tools lost or stolen.

Depreciation—Every engineer has depreciation on his equipment which amounts to 10 per cent per annum on its cost. In some cases this should be doubled.

Risk—This factor is indeterminate. Sometimes during preliminary surveys the bills are not paid. The preliminary bond may be insufficient or the work may be held up by legal procedure so as to delay the engineer's pay. Money must often be borrowed for an indefinite time to carry on business and discounts.

Office Expense—Stenographer, rent, light, heat, janitor, postage, telephone, telegraph, control systems, books, supplies, advertising and similar expenses which every business must pay.

Salaries—This is a local question and would be determined easily by a summation of the salaries paid during the year, but it is hard to anticipate just what salaries should be paid on any particular job because of the fluctuation of the other factors involved. The several items or cost factors encountered in an engineering business or practice are listed in Table II, so that the engineer may recognize that such factors exist, if he has not realized it.

Cost-Keeping and Organization—In this company's practice, job tickets (Fig. 1) are made out in duplicate for each job each day, one being filed under the client's name and one under the employee's name, for making up the bill and salary respectively. These tickets are 3 x 5 in., filed in a card index box. They are put up in books of fifty tickets and each man makes out his own ticket. In transferring the items to the client's bill they are entered under several headings on the form shown in Fig. 2.

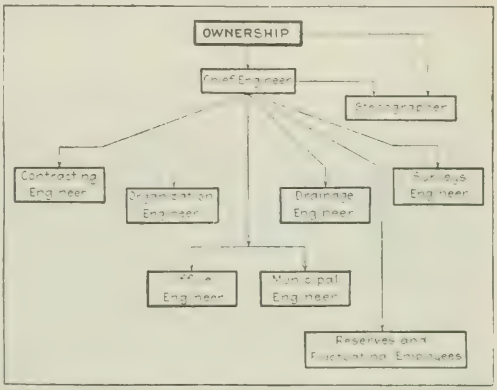


FIG. 2. ORGANIZATION CHART OF AN ENGINEERING FIRM

No material is secured without an order, so that the amount of materials purchased is recorded on the stubs of the order book. In this way an itemized account is kept of every transaction and every item.

Engineers operating in Class C, especially, must devise some operating plan to transmit the responsibility to the various departments. Much expense can be saved clients where men in different departments are experienced in a particular class of work, thus rendering competent service which could not be rendered by one engineer who would not be versed in all kinds of engineering business. In Fig. 3 is shown an organization which might be a factor in successful operation and consequently a factor of cost.

One factor that is indeterminate but must be taken into account is the loyalty of the employee and his abidance by the ethics of the profession. This item may be very large when men have to be trained over and over again to fill the different departments of the work. While it is always a gratification to the engineer to see his employees advance, there comes a limit to the amount of salary that can be profitably paid.

Whether or not the employee would receive an apportionment of the profit would depend upon his loyalty, his attention to business, the success of his work and the class of service the engineer performed. And again it would depend upon the value of business over a period of years, taking the good years with the bad years, the successful collections of accounts, and the education of clients.

TABLE II. COST FACTORS IN ENGINEERING BUSINESS

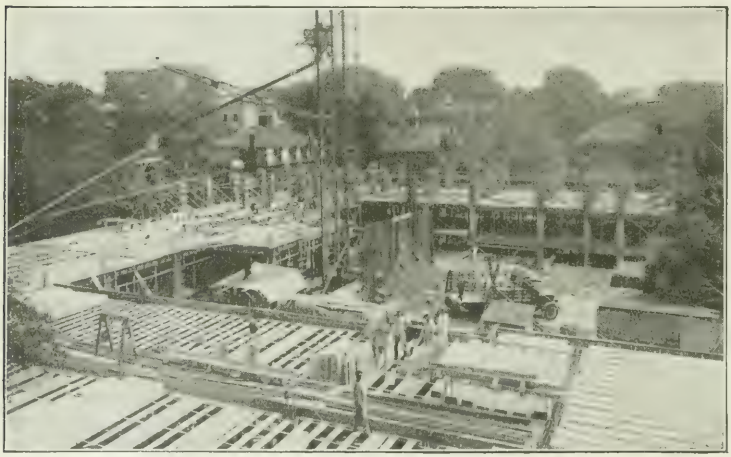
Class of practice (A to G)	Items
	Continuance of business
	Vacations
	Lost time
	Personality
	Natural ability
	Personal application
	Efficiency
	Promotion
	Bonds
	Compensation insurance
	Fire insurance
	Life insurance for business security
	Traveling expense on jobs secured
	Traveling expense on jobs lost
	Traveling expense to society meetings and educational trips
	War tax
	Interest on investment
	Interest on jobs
	Discount
	Repairs
	Renewals
	Depreciation
	Risk
	Stenographer
	Rent
	Light
	Heat
	Janitor
	Postage
	Telephone
	Telegraph
	Control systems
	Books
	Supplies
	Advertising
	Miscellaneous office
	Salaries
	Cost keeping system
	Bonus
	Collections
	Organization outlines
	Training of new employees
	Education of clients
	General improvement and education

Use Special Light Gypsum Blocks In Floor Construction

Economical Construction Results from Light Weight Floor of Interlocking Gypsum Tile in Reinforced-Concrete Building

By A. V. Bekay
Chief Engineer, Barney-Ahlers Construction Corp., New York City

In the floor construction of a seven-story reinforced-concrete frame apartment house, recently built in Buffalo, N. Y., a new form of light gypsum tile blocks, producible on a quantity basis, were used in a manner of the well-known tile and joist systems. The lightness of the gypsum block resulted in a decided saving in the weight of the reinforcing steel and the supporting members of the building. The dead load of the floor system was far below that heretofore attained in this type of construction. The ready production lent itself to a low price for the tile, appreciably below that currently paid for a corresponding terra-cotta or a tin-pan tile. The ease in handling, coupled with the excellent plant layout and construction organization, made possible the finishing of the building ten days ahead of an already close speed schedule. In other words, all of the well-known advantages of the terra-cotta tile or tin-pan floor systems, that is in formwork and rapidity of construction, were further added to by economy of production and greater economy of design. A further saving also resulted from the fact that the tile provided a smooth ceiling for the grounds of the plastering. The plaster was put on in a very thin two-coat work, giving a proper finish for apartment occupation.



GENERAL VIEW DURING CONSTRUCTION SHOWING METHOD OF HANDLING CONCRETE MATERIALS

The building is symmetrical about the center line, except for a few openings. The beams and girders were confined entirely along the corridor partitions, thus giving an unbroken ceiling throughout. The columns were arranged to project only into the corners of the unimportant rooms. This was accomplished by keeping two faces of the columns flush for the entire height of the building.

The details of the typical floor construction are shown in the drawings. The L-lock floor tiles were supplied by the Ellok Corporation, Buffalo, N. Y., and were fabricated a short distance from the site of the work. The Ellok plant for manufacturing these tiles consisted of a long single-story building, built directly along a railroad siding, where the raw gypsum and other materials were stored under cover. Along each side of the building were arranged two sets of individual molds. The blocks were manufactured and set up ready for handling so rapidly, that by the time the liquid material was poured in the last mold of a row, the first blocks were ready for removal and curing, preparatory to their being trucked to the site of the work. In other words, there was a steady supply of this important part of the work directly to the job. Due to the excellent organization and interest of the Ellok Corporation, which could be duplicated under similar conditions, the construction was not delayed by the tile.

Six-inch deep tiles were used for the short spans and 8-in. for the long spans. The 6-in. weighs 36 lb. per tile and the 8-in. 40 lb. Each tile covers an area of 20 x 30 in. Reducing it to a square foot basis, the weights are 8½ and 9½ lb., respectively. These weights are decidedly less than for the usual terra cotta tile systems and a considerable saving in the reinforcing steel resulted.

One of the drawings shows the typical method of formwork used. In general the forms consisted of 2 x 8-in. planks, 20-in. centers, placed directly under each concrete joist and in turn supported by a series of stringers about 4 ft. apart. This type of formwork proved to be very economical and the ease of stripping permitted the use of practically one set of forms for the entire structure. In order to obtain a level ceiling, the forms were lined up with unusual care, with a maximum allowable variation of ⅛-in.

Owing to the advantages of the continuous bottom, the setting of the tile was easily accomplished. The trough for receiving the concrete joists was formed by simply laying the upper section of the tile over the lower section. Time and money were thus saved, as no shifting or lining up was required, as is the case with the usual systems of individual units.

Upon removing the formwork a smooth flat ceiling was obtained. The ceilings were finished by applying a very thin two-coat work of plaster. The tile eliminated the customary heavy three-coat plaster ceiling as is required with the ordinary tile and joist construction and the furring and lathing as is necessary in the tin-pan joist system. Repairs to the ceiling can be readily made by cutting out a section of the tile and replacing with plaster boards and plastering over same.

A careful inspection by the architect, in which practically every tile was tested and considered as to alignment, resulted in only about 250 tiles having to be

VIEW OF THE GYPSUM TILE IN PLACE

replaced or repaired. This in a large measure was due to the damages done by cutting for various other trades, such as for plumbers and electricians.

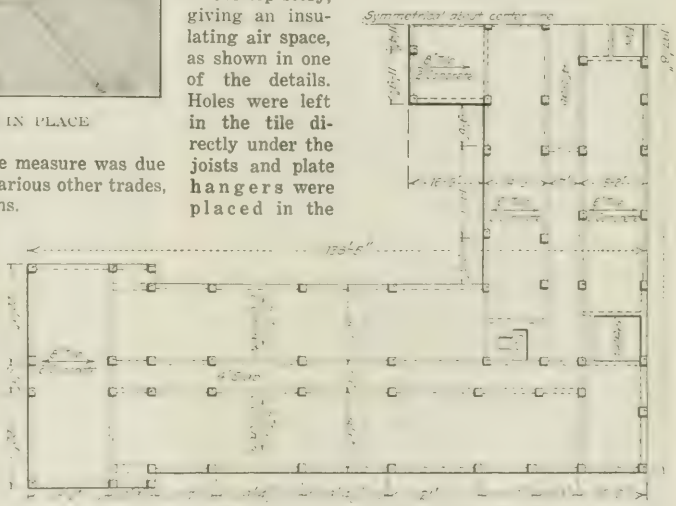
In general two bars were used in each joist, one straight and one bent. Wire-chair bars were cast into the lower section of the tile. The 2-in. concrete slab over the tile was reinforced with ⅜-in. round bars spaced 24-in. centers. The joists adjacent to, or under, the various room partitions, were provided with extra reinforcement to carry the additional loads.

The corridor construction is shown in one of the details. This consisted merely of a 4-in. reinforced-concrete slab and was poured entirely separate from the joist construction. No provisions were made for continuity, owing to the great difference in the spans of the two types of slabs.

GYPSUM BLOCK CEILING FORMWORK, SUPPORTED

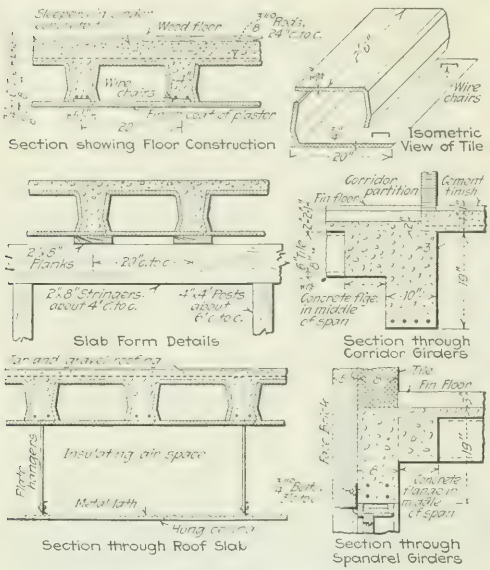
The drawings also show a section through the typical girders. The concrete flange was provided for, by stopping the tiles short of the girders and using plaster board end pieces. These flanges were used only in the middle half of the girders. The length of a standard tile being 30 in., special tiles varying in length from 12 to 24 in. were used to fill out the odd places.

A section through the typical spandrel girders is shown. A continuous steel angle, bolted to the concrete, was provided to support the brick facia. Galvanized iron anchors were used to tie the brick into the concrete and were placed in the forms before concreting. The concrete frame was entirely covered with the brick facia on the front and court, but was left exposed on the sides and rear. A hung ceiling was provided for in the top story, giving an insulating air space, as shown in one of the details. Holes were left in the tile directly under the joists and plate hangers were placed in the forms before concreting. The concrete in the slabs, girders and the upper story columns was of a 1:2:4 mix and the lower story columns of a 1:1:2 mix. Test specimens 6 in. in diameter and 12 in. long were cast of the general run of the concrete as deposited in the forms and were tested for compression. These cylinders were made in pairs, one set for each floor.



HALF PLAN OF APARTMENT HOUSE, CONCRETE FRAME AND GYPSUM TILE FLOOR

The plant installation and general method of handling the work was carefully laid out before the plant was shipped to the site. The plant consisted of a chuting system, with a steel tower, erected on the inner court, opposite the center portion of the building. The boom and the counterweighted section of the chuting system, by swinging through a large arc, enabled the placing of the concrete directly throughout the entire floor. The columns were poured one or two days previous to the pouring of the floor slab, thereby giving greater stability to the form structure and allowing for the full shrinkage of the columns' concrete. This procedure gave an opportunity to clean up the floors previous to the placing of the steel in the joists, beams and girders. A ¾-yd. batch mixer was placed sufficiently below grade to enable an economical handling of the concrete ingredients. The sand and gravel was excavated and screened directly from the Niagara River.



DETAILS OF GYPSUM TILE FLOOR SYSTEM

A large timber bulkhead was built against the back side of the mixer and the ready-mixed sand and gravel which was delivered by trucks, was dropped as close as possible to this bulkhead. A common scoop, such as is generally used for scraping and excavating work, was handled by one man and pulled by the same hoisting engine that was used for lifting the concrete in the tower. A cable was brought over the sheaves to form a straight lead toward the top of the pile. When the cable was slack, this man would haul the scoop backward down the pile and on a signal the hoisting engine would pull the new load up to the top of the pile, thereby giving a constant source of supply for the mixer. In front of the bulkhead was a storage platform.

The tile was somewhat brittle but with the spouting system the concrete work proceeded economically and successfully. Because of the high efficiency of the plant and a constant supply of materials, excellent progress was made. The first floor slab was poured on July 12 and the last pent house roof slab was poured on Oct. 16, ten days ahead of schedule, making a total of fourteen weeks to complete the reinforced-concrete structure.

J. W. Wilson of Detroit, Mich., was the architect for the building and the Stuyvesant Properties, Inc., the owners, who let the various features of the building direct. The reinforced-concrete structure and floor system was designed and built by the Barney-Ahlers Construction Corporation, of New York City, for whom the writer acted as chief engineer on this project.

Per Capita Lumber Consumption

In the United States the per capita lumber consumption was highest in 1906 at 515 ft. b.m. In 1900 it was 460 ft. and 20 years previous, 360 ft. In 1913 it had dropped to 430 ft. and by 1918 was down to 300 ft. The estimated 1920 consumption is 307 ft. From 1851 to 1911 the consumption in England increased from 40 to 120 ft. and in Germany from 1840 to 1900 it doubled, reaching 150 ft. France now uses 90 ft.

Factors Determining the Duty of Water in Irrigation

By Justin T. Kingdon
Consulting Engineering, Cheyenne, Wyo.

In order to show the various and interrelated factors which determine the use of water in irrigation the classification given below has been prepared for use in court cases and is based upon the chart accompanying an article on "Factors Determining the Duty of Water in Irrigation," by H. F. Robinson, supervising engineer, U. S. Indian Irrigation Service, in *Engineering News-Record* of Aug. 21 1919, p. 355. This newer scheme may be useful to engineers and others engaged in irrigation development as a guide in the analysis of conditions on new projects and for the improvement of conditions on projects already in operation. Some repetition in the factors is unavoidable because of their interrelations.

The term "duty of water," as applied to irrigation, is understood generally to mean the amount of water actually needed to grow a crop. In view of the many varied conditions found in practice, the accompanying classification covers rather the broader subject of the "use" of water. Under this application the "duty of water" may be defined as the amount of water artificially applied in growing a crop.

Factors Affecting the Duty of Water in Irrigation

Fixed Factors

1. Precipitation: A. Quantity. B. Distribution.
2. Water resources available.
3. Climate: A. Humidity. B. Length of growing season. C. Altitude. D. Latitude. E. Evaporation. F. Temperatures (a, favorable; b, unfavorable).
4. Topography: A. General. B. Local.
5. Geology: A. Kind of soil. B. General surface and subsurface structure.

Factors Subject to Change

1. Economic conditions:
   A. Crops grown.
   B. Cost of water.
   C. Transportation of crops (a, hauling to market; b, local sale; c, local feeding).
   D. Hired labor (a, availability; b, cost; c, skill; d, reliability).
   E. Labor not hired.
   F. Financial problems relating to the control of water supply through (a, public administration; b, community or company management; c, the individual consumer).
   G. Stage of irrigation development.
   H. Preparation of land.
2. Length of irrigating season.
3. Stage of watershed development; A. New. B. Intermediate. C. Settled.
4. Stage of land development; A. New. B. Intermediate. C. Settled.
5. Crops grown.
6. Soil cultivation; A. None. B. Ordinary. C. Careful.
7. General soil conditions; A. Raw land. B. Unsettled. C. Settled.
8. Skill of the water user.
9. Position of the water table.
10. Water supply (see separate classification below).

Water Supply (Factor Subject to Change)

1. Quantity.
2. Distribution.
3. Quality.
4. Temperature.
5. Use: A. Municipal. B. Domestic. C. Stock. D. Irrigation.
6. Control: A. Direct flow. B. Storage. C. Storage needed but impracticable.
7. Characteristics of individual streams:
   A. Geology of channel: (a, tight; b, porous; c, character of stream bed).
   B. Habits: (a, normal; b, flashy; c, debris; d, silt).
8. Delivery to irrigators: A. Continuous. B. Rotative. C. Careful control. D. Individual responsibility when the water is under (a, private ownership, b, public control).

9. Availability: A. Based on priority. B. Based on riparian rights. C. Whenever desired. D. Outside the growing season only. E. Indeterminate.

10. Losses of water:

A. Stream. 1. Location of priorities. 2. Geology of channel. 3. Problems of delivery. 4. Return Seepage.

B. Irrigation works: 1. Storage (a, seepage; b, evaporation). 2. Transportation (a, seepage; b, evaporation).

C. Field: 1. Deep percolation (a, kind of soil; b, ditches poorly arranged; c, too small an irrigation head; d, poorly graded land; e, faulty attention). 2. Evaporation from the soil: (a, no cultivation; b, average cultivation; c, careful cultivation; d, faulty attention). 3. Avoidable surface waste; (a, faulty delivery; b, faulty distribution; c, poorly graded land; d, faulty attention). 4. Unavoidable losses: (a, deep percolation; b, evaporation; c, surface waste).

D. Miscellaneous losses in delivery of water for: (a, domestic use; b, stock purposes).

Factors Which May Be Corrected

1. Control of water: A. Public administration. B. Community company management. C. The individual water user.

2. Errors in adjudication: A. State administrative board or court decree. B. Granting rights to the use of more water than is economical.

3. Basis of payment: A. Bulk quantity delivered. B. Amount delivered as continuous flow. C. Acreage irrigated.

Expressways Proposed to Relieve N. Y. Traffic Congestion

C. W. Leavitt Suggests Elevated Vehicular Routes —Amos Schaeffer Analyzes Cost of Plan

TO RELIEVE traffic congestion in the Borough of Manhattan, New York City, a number of north-and-south elevated vehicular expressways through the centers of existing city blocks and vehicular tunnels under Central Park were proposed by Charles W. Leavitt, landscape engineer, at the meeting March 16 of the New York Section of the American Society of Civil Engineers, which was devoted to a discussion of the subject "Streets and Parks of the Metropolitan District." The routes suggested for these new traffic ways are as follows:

1. Between 1st and 2nd Aves., from 24th to 127th St.
2. Between 2nd and 3rd Aves., from 10th to 128th St.
3. Between 5th and 6th Aves., from 8th to 59th St.
4. Between 9th and 10th Aves., from 14th to 11[illegible]th St.
5. Between 10th and 11th Aves., from 17th to 73rd St.

Extracts from Mr. Leavitt's paper follow:

Connection between the ground and these elevated expressways should be made every ten blocks or so, by ramps leading to the less traveled ways, such as 15th, 24th, 35th Sts. Wheeled vehicles from the expressways should not be brought into already over-crowded ways such as 14th, 23rd and 34th Sts. Pedestrian approaches might be made more often, by stairways or ramps. Arrangements could be made for stopping automobiles on the sides of the express ways, as here doubtless will be popular locations for stores because of the passing traffic. In the center there might be through roadways, where speed could be attained with no interruption from cross traffic.

It has been suggested that these expressways be constructed as overhead tunnels, using the roofs for access to adjacent buildings. This would mean closed vehicular passageways above ground. While gas fumes make closed tunnels for automobile traffic impossible at present, the improvement in locomotion which rightfully may be expected some day will relieve this condition and make it possible to use motor vehicles in tunnels both above ground and underground. This would permit the projecting of the vehicular express way between 5th and [illegible] Aves. from [illegible] St. in the form of a subway under Central Park, and make it a most desirable means of entrance and exit to and from the city.

At first it might seem a Herculean task to destroy enough buildings in the center of blocks to permit the construction of these thoroughfares but, if it is done under an excess condemnation plan, the city should reap a return far greater than the cost of condemnation. One hundred feet on either side of an express way might be condemned and sold after the express way is put through. The added ratables also would be a source of income and, moreover, there would be made available much property now more or less inaccessible. The space under the express ways could be used for garages, storage houses, parking, service entrances to store basements, etc.

Cost of Plan Analyzed

Discussing Mr. Leavitt's proposals, Amos Schaeffer, consulting engineer to the borough president of Manhattan, presented figures indicating the cost of the expressways suggested; portions of his remarks follow:

Expressways are suggested above and between the avenues in Manhattan for the entire width of the island. Such heroic treatment can only be resorted to after all other efforts for relief have been exhausted. On the assumption that expressways will be 100 ft. wide the assessed value of the land for all is approximately $275,000,000. The price which the city has to pay for property is usually from 50 to 100 per cent in excess of the assessed value. The property necessary for these expressways would, therefore, cost from $412,000,000 to $550,000,000. It is suggested that excess condemnation be applied to an additional 100 feet of land on each side of them, which the city could afterward sell and from which it could reap a return far greater than the cost of condemnation, which would increase taxes and make available property which is now more or less inaccessible. Assuming that the city could sell the excess land at a profit—which is open to debate—it would require a capital of $1,236,000,000 to $1,650,000,000 for the land.

There are approximately 27 miles of expressways, which at the rate or $5,000,000 a mile, would cost $125,000,000. The grading and paving of the lower level of these avenues would cost an additional $15,000,000, which together with the cost of the land makes a grand total of $1,375,000,000 to $1,800,000,000 as the cost of the complete improvement.

A more intensive use of existing highways must be made before new ones are laid out in the Borough of Manhattan. For example, it has been suggested at various times that a subway be built to carry the 6th Avenue elevated railroad traffic and that the elevated structure be converted into a vehicular highway ending at Central Park, where the traffic would be absorbed by the park roads. More immediate relief must be found by a study of local congestion and the application of remedies.

The construction of the Park Ave. viaduct and the high level roadway around the westerly side of the Grand Central Station have been very effective means of relief in the vicinity of 42d St. and 5th Ave. Some further changes are necessary to obtain the maximum benefit from this improvement. The intensity of traffic on the Park Ave. viaduct is as great as that on 5th at 42d St.; the intensity of traffic on Fifth Avenue was reduced after the opening of the viaduct. Traffic observations made about a year ago showed that the intensity of traffic on both thoroughfares was about the same, namely, 6.5 vehicles per lane of traffic per minute. Two years ago the intensity on 5th Ave. was 6.2 vehicles per lane of traffic per minute, while that on the Park Ave. viaduct was 8.8. These observations indicate the greatest intensities during a period of one hour between 5 and 6 p.m.

Particular attention should be given to a study of the zoning law in its relation to transportation. The authorities should make an effort to distribute the private activities more uniformly throughout the city instead of encouraging them to concentrate in one or a few spots. It is not necessary to have promiscuous manufacturing industries located in the same section. It is a convenience to have the retail department stores in one locality so that people [illegible] easily and quickly from one to another, but it is not necessary to have the garment factories in the same locality.

Conditions of Madison Water Tank After 30 Years' Service

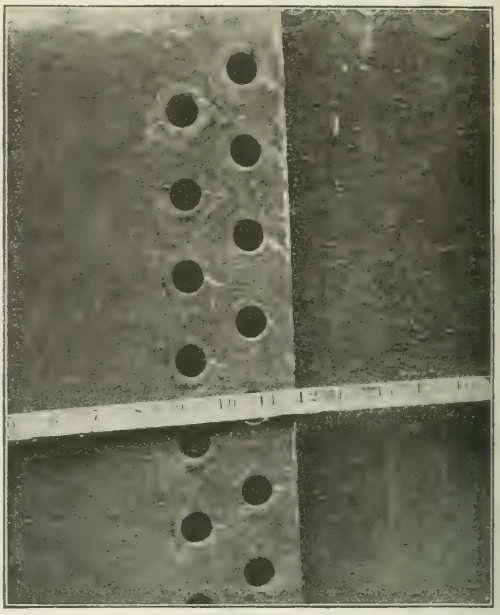
By Walter E. Miller
Civil and Hydraulic Engineer, Madison, Wis.

SINCE those who have to do with public utility valuation and rate making are frequently confronted with the question of proper or reasonable allowance for depreciation, the essential facts concerning the condition of the water tank and supporting and inclosing masonry tower of the water-works of Madison, Wis., at the time of removal after thirty years of service, may be of value to many engineers.

This structure was erected in 1890. Its demolition was completed early in January, 1921. It was removed because (1) the daily consumption of water and the pumping rates had so greatly increased since the tank was erected that the size of the tank became too small to be of material value, and (2), because the tower and tank obstructed an important street. The history of this structure shows how greatly the allowances for depreciation might differ, depending upon whether they include or exclude the functional as well as physical depreciation.

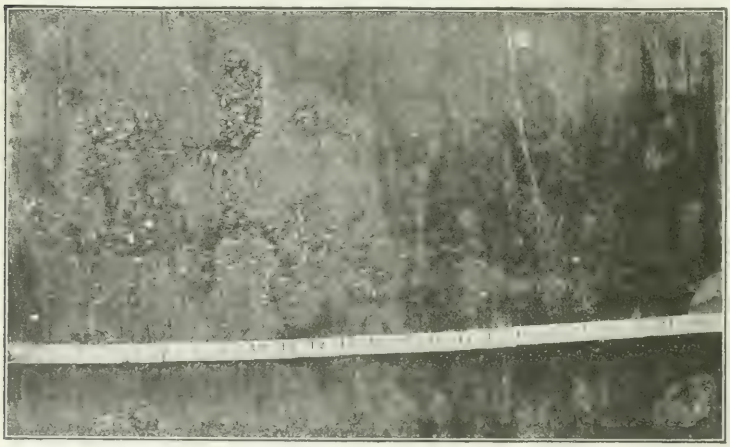
The structure stood in the center of East Washington Ave., one block from the Capitol square. It consisted of a steel tank, 12⅓ ft. in diameter by 60 ft. high, supported and enclosed by a cylindrical brick wall above a one-story square structure of stone masonry. The bottom of the tank was 72 ft. and its top was 132 ft. above the street. The height to the top of the weather vane above the ornamental canopy or roof of the tank was 161 feet.

The tank rested on a grillage of steel rails laid upon four 16-in. I-beams carried by the heavy brick wall. Above the bottom of the tank the wall had three thicknesses, nominally 8, 6 and 4 in. The lower third of that portion was laid in contact with the tank and had a thickness of the widths of two bricks laid flat. For the middle third of the tank the wall consisted of two rings of brick, one laid flat and one on edge, and was 2 in. from the tank. Around the top third of the tank 4 in. from it was a wall one brick width in thickness.



INTERIOR VIEW OF PLATES BELIEVED TO HAVE BEEN IN FOURTH AND FIFTH RING FROM BOTTOM OF TANK
Fifth ring plate has been dropped

Examination of the structure before and during its removal revealed but little deterioration; so little as to make it appear that its thirty years of actual service would be but a small part of its possible physical life. The most noticeable and important deterioration was incipient disintegration of the outer brickwork near the level of the bottom of the tank, but this might have been repaired at moderate expense had the continued use of the structure been desired. Notwithstanding the apparent fact that the tank plates had never been cleaned and repainted the greater part of their surfaces was still well preserved and smooth, although in places the paint was gone and rust had formed. In a few places there was a noticeable pitting of the metal, but in no case had this gone far enough to warrant any apprehension as to weakening of the plates. Some close-range photographs of typical portions of the plate surfaces on their inner or water-side show insignificant deterioration of the metal. The general average condition of the outer surface was somewhat better. It is obvious that only the inner surface could readily have been cleaned and repaired.



WETTED SURFACE OF PLATE IN SECOND RING ABOVE BOTTOM OF MADISON TANK

Important Contracting Questions Decided in Cleveland Clearwater Basin Suit

Litigation Over Unpaid Balance and Cost of Rebuilding After Collapse of Roof Section Five Years Ago—Delayed Acceptance, Measure of Damages, and Certification of Funds Among Main Points Involved

DECISION by the U. S. District Court at Cleveland of a contract suit arising from construction and subsequent partial collapse of a clearwater basin for the city's new West Side filtration plant gives information on a number of perplexing and important questions in public-works construction contracts. Because of the light thrown on contract relations and the wide application of the principles involved, a summary of the case is given below, although an appeal is still under consideration by the city. The court decision as well as findings previously reached by a special master is in substance a complete denial of the city's claims in the case.

A remarkable tangle of events, including entire reconstruction of the basin, led to the original contractor's suing the city three years ago for unpaid balance and extras. The city made counterclaim for damages for delay, *and for the whole cost of reconstruction.* The court referred the case to Robert Hoffmann, chief engineer of the city's Department of Public Service, as master to hear and decide the issues. After hearings in which voluminous testimony was presented, the master reported his findings to the court a year ago, and, upon review of various exceptions to these findings, a decision was finally rendered by Judge D. C. Westenhaver on Nov. 12 last. It approves the master's report except on one point of law involved.

The court rejects the city's claim that the first contractor is liable for the cost of reconstruction decided upon by the city, but requires him to refund payments made for the defective concrete. Liability of the contractor for liquidated damages is reaffirmed, but the contractor is held entitled to reasonably prompt acceptance after substantial completion. In general the decision upholds rules of fair dealing with the contractor, among others the rule that he is not to be held liable for defects of the engineer's planning.

How the Case Originated

Filtration of its Lake Erie water supply was decided on by Cleveland eight years ago, and a large filter plant was laid out on a low lake-front flat a mile west of the central part of the city, between the lake-front bluff and the old channel of the Cuyahoga River, which here runs parallel to the shore. The subsoil conditions were not well known, but some explorations showed much soft material and peat. Ordinary spread footings were adopted for the filter house and the several basins, however.

The design of the plant was made by special filtration engineers retained by the city, headed by the late R. W. Pratt, reporting to C. F. Schulz, then commissioner of water. (For a description of the plant see *Engineering News* of Oct. 19, 1916, p. 732, where general layout plans are given.) That an inadequate view was taken of the foundation conditions became evident very quickly after completion of the major part of the plant, through destructive settlement of the filter house and part of the adjoining coagulation basin, as described in *Engineering News* of Dec. 7, 1916, p. 1099. A pumping station on the same site, founded on piles, has given no trouble in spite of heavy machinery loads.

Design of Basin—The 25,000,000-gal. covered clearwater basin, 195½ x 938 ft. in ground plan, 27 ft. clear inside height, was located close against the bluff bounding the site on the south. Its design, following conventional practice, comprised a lower 6-in. concrete floor on which was laid an upper groined-arch floor 6 in. thick at the crown and 18 in. thick at the columns; gravity side walls; square columns spaced 15 ft. 9 in. on centers; and a groined-arch roof of 6-in. to 12-in. thickness cut into four-column units by construction joints along the center lines of bays. An earth fill of 2 ft. was to be placed over the roof.

A contract for the construction of this basin was let to the Walsh Construction Co., of Davenport, Iowa, on March 29, 1915, and the work was carried out between that time and the end of the year.

Trouble in Construction—Numerous troubles arose during construction, of quite different kinds. Bad ground as well as delays on the part of both engineers and contractor were concerned. The ground in the bluff south of the site slipped and moved, parts of the south wall footings were pushed out of place while being concreted, and part of the floor heaved. Leaking sewer and water pipes contributed other troubles. Trenches for the main conduits showed flow and heaving of the ground. Part of the construction was to be completed in 90 days, according to the contract, but soon after starting the contractor was ordered to wait for changes in plans and could not finally take this part of the work in hand till long after the 90-day limit was over. Delays of various kinds made night work necessary. There was a lack of adequate inspection force, and often no inspectors were present during the night shift.

It is in every way probable that, due both to the delays experienced and to the troublesome nature of the ground, the conduct of the work was under the influence of great hurry part of the time, to the prejudice of careful workmanship. Negligent foremen played a part in this result, it would appear from some of the facts. As to materials, the city selected the aggregate from several samples submitted by the contractor, and through its inspection had continuous control of its quality as also of workmanship and setting of forms. As to cement, subsequent charges of skimping in cement have no foundation, according to testimony presented at the hearings, but the total of cement used exceeded, if anything, that required by the quantities and mixtures.

Disputes—Delayed completion and extra work due to the city's changes and to the emergency troubles encountered led to disputes between the city and the contractor before the work was wholly completed. The bond-issue funds available for the job were exhausted before the contractor had been fully paid. The director of finance stopped payments, although the engineers reported the completion of work amounting to nearly $30,000 more than the certified funds. In January, 1916, the city's engineers reported the job completed

but the director of public utilities declined to issue a certificate of completion. During the early part of 1916 settlement developed in the basin structure, as was made evident by cracks in the roof and by an outward tipping of the north wall. The basin was filled to a depth of a few feet of water, but on account of leakage at cracks in certain partition walls in the basin it was again emptied.

Roof Collapse—On July 9, 1916, shortly after the basin was emptied, one roof section comprising four columns and four panels collapsed. The stubs of the four broken columns showed diagonal laitance streaking and chalkiness, and in places very bad honeycombing (see *Engineering News*, July 27, 1916, p. 186, and *The Engineering Record*, July 29, 1916, p. 151, for illustrated descriptions of the collapse).

An investigation of the failure was carried out for the city by J. H. Herron, N. C. Johnson, and F. C. Noble, in the course of which many patches, streaks or bands of porous or chalky character were found in the concrete. There was a wide band of this kind in the north wall, where in fact some leakage had been observed previously. Also, flexure cracks showed in the columns, suggesting a northward pressure of the roof.

A reconstruction plan was developed by Messrs. Johnson and Noble for the city, which consisted of building a new reinforced-concrete structure around and inside the old. It included a layer of heavily reinforced concrete over the roof, a similar one on the floor of the old basin, reinforced side walls inside the old, concreted integrally with the new floor and roof work, and reinforced-concrete jackets around the old columns continuous with the new floor and connecting with the new roof by way of openings cut in the old roof around the columns. The city demanded that the Walsh Construction Co. build this new structure, in obedience to the clause of the contract requiring it to repair and replace any faulty work discovered prior to one year after acceptance of the basin. Acting on the results of an investigation made for the Walsh company by Sanford Thompson, Wilbur J. Watson and J. M. Armstrong, who disagreed with most of the conclusions reached by the city's experts, the company refused. Thereupon the city called for bids and let a contract to the John F. Casey Co. of Pittsburgh (*Engineering News*, Nov. 23, 1916, p. 1009, and Dec. 14, 1916, p. 1150). The cost of this work as carried out amounted to $326,277.35. The original basin had been contracted for at unit prices totaling $272,636 on the estimated quantities, but actually cost (including extras) $311,067.41.

The filter plant and reconstructed clearwater basin are now in operation, and have been operating during the past three years, in progressive proportion.

Suit was brought by the Walsh company for unpaid balance. In answer the city claimed that the contract had not been completed; that its liability was limited in any event by the available funds certified on the contract, and that the extras had not been ordered in writing; and it further entered counterclaim for the payment of liquidated damages for delay in completion (the length of this delay being not stated) and also for the *entire cost of reconstruction*, alleging that the reconstruction was necessitated by the contractor's faulty work. The defects charged included allowing excessive loam, clay and fines in the sand, and soft stones in the coarse aggregate; improper proportioning and mixture; failure to clean the surface of the concrete before placing additional concrete; failure to deposit the concrete so as to give a compact, dense and impervious concrete; failure to join the old and new concrete in such a way as to prevent cracks and leaks occurring; failure to keep the concrete moist and prevent shrinkage; failure to remove water prior to depositing concrete; failure to step off the concrete at construction joints; use of leaky and misplaced forms; failure to prevent displacement of reinforcement; general use of excessive water; pouring the columns in two or more lifts; allowing cracks to form in the dividing wall between the two sections of the basin; and failure to give personal attention to the work.

Findings of Master and Court

The findings of the special master, so far as concurred in by the court, were:

(a) The original contractor is not liable for the cost of reconstruction, but only for the cost of remedying defective work. The defective concrete found was computed as 1,922.67 cu.yd., of original value $14,431.86, but estimated to cost $56,000 to cut out and replace. As this method of repair was not chosen by the city but the basin was reconstructed instead, he is liable only for the original value.

(b) The existence of defective work does not prejudice his claim that the work was completed, and he was entitled to reasonably prompt acceptance by the city; the master fixed a date of constructive acceptance.

(c) The contractor is entitled to payment for extra work ordered (even though not in writing), but not for work due to a proper risk of the contract, such as slides, nor for extra work arising from the presence of a city railroad track not shown on the city's plan but present on the site when he bid.

(d) He is liable for liquidated damages for delay in completion, at the rate fixed in the contract, proper extensions of time being allowed for delays caused by the city, up to the date of completion fixed by the master.

On the important question whether the city is liable under the contract for an amount exceeding the moneys certified on the contract by the city's director of finance as being available for the contract, the master held that it was not liable, and that therefore the contractor could not recover the balance due and extras, but on the other hand was relieved from liquidated damages for delay, as the contract terminated when the money was exhausted and completion thus became impossible. Judge Westenhaver, however, reverses this finding, after full analysis of the law; he holds the city liable for unpaid balance and extras, and holds the contractor liable for payment of liquidated damages.

The court also holds the contractor's surety liable, in spite of minor changes in and additions to the contract, which the surety claimed had been made without his consent.

On a number of the points involved the reasoning is given below by citations from the report and the decision, as having essential bearing on proper contract administration.

Certification and Validity of Contract

Specific clauses of the city charter require that every contract, to be valid, must be endorsed by the city's director of finance with a certificate that funds are available for the purpose of the contract, stating the amount. A clause of the clearwater basin contract made the same requirement. Accordingly, the director of

finance certified on the contract that $272,636 was available, this being the total for the engineer's estimate quantities at the unit prices bid by Walsh.

The court held that, like similar provisions in the Ohio general code, the charter requirement of certification applies only to contracts paid from taxes, not from bond issues, and that the basin contract would have been valid without certification. The court further observes:

In making a contract upon a unit basis, especially one of this magnitude, it is impossible to do more than to make an approximate estimate, and this is what was done. It was expected and contemplated that these quantities might be exceeded. Likewise in a work of this character and magnitude, unforeseen conditions will arise during performance which make necessary changes and alterations in the plans in order to accomplish the main object and purpose of the contract. This also, the contract evidences, was contemplated by the parties, and provision is made therein for changing and altering the plans during performance and for extra work, the necessity for which it was expected would arise but the nature and extent of which could not be determined in advance. If the master's conclusion is sustained, the city's power to make a contract upon a unit basis would be utterly destroyed.

Obviously the proper construction of these sections whenever applicable must be one which will permit a valid contract to be made and will enable both parties to determine at the time of making it whether or not the contract is a valid one and susceptible of full performance. It is either valid at that time or it is invalid; if valid when made, it binds both parties until fully performed; it does not become invalid because of the failure to estimate correctly in advance the amount necessary to be certified.

Substantial Performance and Delayed Acceptance

In confirming the master's finding that the faulty work found does not bar the claim of substantial performance, the court says:

It is settled law that if a contractor performs in good faith, is guilty of no intentional violation of his contract but has merely deviated from the plans, or was not guilty of allowing defective materials or faulty workmanship to creep in during performance, he is entitled to recover upon the theory of substantial performance. . . . It is also settled that if a contract is substantially performed, a refusal of the engineer or architect to accept, even when such acceptance is made a condition precedent to the contractor's right to recover, is unreasonable and arbitrary, and will not bar recovery.

The master, in considering whether the delay of the director of public utilities to accept the work was justified, remarks as follows:

In the testimony of Thomas S. Farrell, director of public utilities, he stated that he had reason to refuse acceptance, but upon cross-questioning it was brought out that the reason for this feeling was not on account of defective work of the plaintiff, but because failures had occurred in other structures in the immediate vicinity built in connection with the filtration plant which made him look with distrust upon the work of the plaintiff.

Taking into consideration the meetings held between the contractor's representatives and the city, the endorsement of the work and comments upon plaintiff's claims for extra payment made by the city's engineer, the protection which the contract afforded in case defective work was found even after the making of the final estimate, the one-year period of maintenance, and the fact that the city had assumed at least a partial control of the reservoir by placing it in charge of its foreman and with its own forces made repairs upon the reservoir for defects which were not considered as the fault of the plaintiff, it would appear that the director of public utilities could and should have given the formal acceptance required under the contract, which in turn would have established the date when the final settlement for the work would have become due, subject to the terms of the contract.

Thereupon the master fixed a date about three months after completion as a constructive date of acceptance.

Contractor's Liability for Reconstruction

Opposing claims of improper design and improper construction were analyzed by the master in deciding whether the cost of rebuilding the basin should be charged to the original contractor. He states, with respect to the relative influence of defective workmanship and defective design:

Testimony indicates that some defective concrete was placed by plaintiff, and that also other defects existed in the structure which it was not proven were due to workmanship or materials furnished by the plaintiff.

The reservoir for which plaintiff held contract was of a type requiring a firm, unyielding foundation so that any unequal settlement could be prevented. Any unequal settlement would have a tendency to open up the concrete at construction joints and form cracks at other locations in the structure depending upon the amount and extent of such unequal settlement. . . . The structure was evidently designed upon the assumption that a suitable soil was to be encountered for the foundation. A different condition seems to have developed.

After mentioning the slides and upheavals, the formation of settlement cracks in the basin structure, outward tipping of the north basin wall, flexure cracking of the columns, and the like, he finds that:

All of these conditions are evidence of the instability of the foundation soil, such as might be expected at the location, such as occupied by the reservoir, where a quicksandy soil was encountered at a depth of 8 or 9 ft. below the level of Lake Erie, and only a short distance removed from the old river bed.

Testimony seemed plainly conclusive that many defects in the structure which it was contended required correction were incidental to the use of concrete or to the design, and at all events were due to other causes than workmanship and material furnished by the plaintiff.

Passing upon the sufficiency of the soil and its preparation for assuming its load in connection with a structure such as this reservoir, was certainly an engineering matter and an obligation which the engineer was bound to assume. To claim liability upon the part of the contractor for failure due to faulty bottom conditions, inducing settlement cracks, seems entirely without justification, as the design of the structure should have been such as to make them impossible. . . . To have expended $328,000 in making repairs to a structure costing in the neighborhood of $300,000, the defective work of which was confined to a part which involved a sum less than $60,000, seems quite inconsistent on the face of it and difficult of justification.

The repair work of the city did not consist of a replacement of defective work, so that it will never be possible to know the exact extent of the defects, nor will the cost of replacing it ever be determined. It covered any weakness or defects which the unacceptable concrete presented, but it did much more, as it largely strengthened the structure, enabling it to overcome the danger of a yielding foundation which might have caused the failure of the original structure. It thereby gave the city much more than it would have had even had all the concrete in the original structure been perfect.

The court reaches the same conclusion, and dismisses the city's objections thus:

The site was selected by the city. The plans and specifications were designed and prepared by the city. The entire design of the reservoir was prepared by the city. The contractor was bound to furnish materials and perform labor only in constructing a reservoir of that design and upon that site, without any power to modify the design or

plans to meet unexpected conditions. . . . The city or its officials could make changes, if any were deemed necessary to correct the faults of the design, but the contractor was not at liberty so to do. . . . In cases of this character it is settled law that if the contractor performs his contract according to the plans and specifications, he is not responsible for the failure of the structure because of faulty design or because the structure as designed and built will not answer the purpose for which it was intended.

The cases most strongly relied upon by the city . . . belong to an entirely different class, and relate to contracts in which there is an absolute undertaking to do a particular thing or to insure a given result, or where the loss or failure is due to accident during the progress of performance.

Liability for Defective Work

Determining the proper sum to be allowed the city for the concrete found to be defective involved the question of whether the reservoir had any value with the presence of this defective work, and the question as to what should be taken as the measure of damage. On the second point the master said:

Testimony showed that the defects in the concrete supplied by plaintiff were mainly due to excess of water in mixing. It showed that the materials used were accepted by the city's authorized representatives; it showed that the proper amount of cement specified in the specifications was used; in fact, nearly all defects were those possibly of workmanship and not materials in so far as the contractor was concerned.

. . . Had defendant let a contract to remove or replace such defective concrete to the extent required to place the reservoir in a condition, in which it could reasonably be expected to have been placed by plaintiff, then the amount of damage to the defendant might have been determined. Defendant, however, elected to use another method.

Defendant's damages therefore seem to lie wholly in determining how much of the concrete could reasonably be considered as defective under the specifications, due allowance being made in passing judgment upon the fact that the concrete was furnished as a commercial proposition and in a manner customary at the time. Defendant should not be called on to pay for concrete not of the quality specified.

Cost of Correcting Faulty Construction

The court takes up the question of reduction of value of the basin by the defective workmanship, as follows:

The measure of damages properly to be applied is that applicable to a contract which has been substantially performed but into the performance of which has entered defective materials or faulty workmanship, or departures from the plans and specifications. In cases of this character, two rules have been applied, depending somewhat upon the circumstances of each case. One is that the contractor is entitled to recover the contract price diminished by the difference between the value of the building to the owner in its defective condition, and its value if perfectly constructed. This rule is applied whenever the structure or building is useful to the owner in its defective condition and it is neither fair nor reasonably practicable to remedy the defects by the making of repairs. In other cases where there is a failure to complete the work, and such failure may reasonably be remedied by the expenditure of additional labor and materials, or where the defects are of such a character that they may be fairly and reasonably remedied by the expenditure of labor and materials, the proper rule seems to be to deduct from the contract price such sums as would be reasonably necessary to complete the work according to the contract or to make such repairs. . . . Apparently the master's conclusion is that the reservoir, except as to the collapsed portion, was worth as much with the faulty workmanship as it would have been with perfect workmanship, and that by reason of its original defective design, it was worth practically nothing in either condition, except as it served as a basis for the new and different reconstruction work provided for in the Casey contract.

The sum of $56,350, found by the master to be necessary to remedy the faulty workmanship, would undoubtedly be the true measure of the city's damages, if the structure had otherwise been adequate. . . . Moreover, it is the method of making repairs and the measure of damages provided in the contract for defects in material or workmanship, whether the necessity therefor arises before acceptance or afterward and within the guaranteed period of one year from the date of such acceptance. The difficulty in applying this rule is that the repairs were not made, for reasons for which the city alone was responsible. . . . In view of all these circumstances, the master was right in holding that the cost of repairs which were not made, and the making of which would have served no useful purpose, is not to be taken as the true measure of the city's damage. . . . If the contractor is required to surrender all compensation for that part of the work which was thus found to be defective, it would seem to me that substantial justice is done.

The decision reached is that the Walsh Construction Co. is entitled to recover unpaid balance and properly ordered extras, amounting to $38,879.21, and the city is entitled to recover liquidated damages, $5,950, value of defective concrete, $14,635.68, and value of the collapsed section, $346.49.

Protection for Reinforced Concrete Against Electrolysis

Abstract of subcommittee report, Committee on Electricity, American Railway Engineering Association.

A WATERPROOF SHELL protecting the concrete structure is the most plausible form of protection of reinforced concrete against electrolysis because the arrangement not only protects the reinforcing bars from moisture and later oxidation but also protects the concrete surrounding the rods from abrasion and, eventually, exposure of the iron. Last year it was suggested that the following methods be considered: (1) Use of copper plated reinforcing bars; (2) Introduction of reinforcing bars made of copper alloy; (3) Reinforcing bars surrounded by rough insulating enamel impervious to salt water and moisture; (4) Waterproof plastic layer of material with petroleum asphalt base, or some established waterproofing material free from electrolytes, surrounding base of concrete.

Further studies have led to the conclusion that the first three methods proposed are not practical because of high cost.

The fourth method is recommended, but attention is called to the necessity of using the proper waterproofing material on the inside of the protecting shell. The waterproofing pitch should remain flexible for an indefinite time; should have a melting point in the neighborhood of 200 deg. F., and be elastic in stretch at least ½ in. at a temperature below freezing and have approximately an inch stretch at 60 deg. F. If the pull is gradually applied, the stretch should be approximately 6 to 7 in. at 60 deg. It is rather a surprising fact that such waterproofing material has been manufactured for twelve or fifteen years but in general use only for roofing material and in pavements. It is made by distillation of an asphalt base and oxidized by blowing with air, the latter process giving the material the stretching quality.

Asphaltic petroleum pitch is soluble in gasoline, which is likely to be present in city sewerage, but recent experiments show an elastic waterproofing pitch may be made from coal tar that is insoluble in gasoline but retains all of the characteristics of the asphaltic petroleum pitch.

It is necessary to protect with waterproof pitch the top or other exposed portions of concrete structures, as well as the sides, to prevent penetration of salt air or moisture.

Indications from Motor Truck Impact Tests

U. S. Bureau of Public Roads Makes Report on Research Work With Wide Variety of Motor Trucks, Loads, Speeds and Tires

Indications toward which the results of its determination of motor truck impact forces on road surfaces point have just been made public by the U. S. Bureau of Public Roads in the form of a report by Earl B. Smith, senior assistant testing engineer in charge of the experiments, under the general direction of A. T. Goldbeck, engineer of tests, and Thomas H. McDonald, chief of the bureau. While final conclusions can not yet be drawn from the work, which has been in progress at Arlington, just outside of Washington, D. C., for two years—and is still uncompleted—the results indicate that impact value depends very largely upon tire equipment and that it is possible to operate a light-weight truck under load and speed conditions that will produce as high impact values as a heavy truck under certain conditions.

Impact values with solid rubber tires are shown to be as high as 7 times the load on one rear wheel encountering a 1-in. obstruction at a speed of 16 miles per hour. The average impact, however, is about 4 times the wheel load when solid tires are employed. With pneumatic tires, on the other hand, the average impact is not more than 1¼, and the maximum not more than 1¾, times the static wheel load.

A summary of the report, the full text of which is being published by the U. S. Bureau of Public Roads, follows:

THE term "impact" in its ordinary use means the force with which a moving body strikes another body. The term is used here in this sense and its specific application is to the force resulting when a truck wheel strikes the surface of a road. This action may occur when the wheel falls from one level to another, or when it strikes an obstruction and bounds upward and finally falls to the road surface. In the second case there is an impact reaction at the time of striking the obstruction and a second impact at

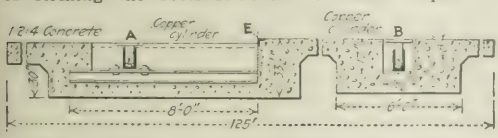


FIG. 1. SPECIAL ROAD SECTION FOR IMPACT TESTS
Truck wheel strikes plungers A (drop) or B (obstruction) compressing copper cylinder.

the time of striking the road. The impact will vary in intensity with the speed of the truck. The impact considered here is only the force acting vertically or normal to the road surface. Other components will be less severe than the vertical, which is therefore the critical and controlling force.

Static loads or forces are measured as only a single factor, i.e., as weight or pressure. An impact force is the result of mechanical energy or of mass times acceleration; it is a function of weight, distance, and time. Since each force may be made to produce a deformation, we may express an impact force as equivalent to a static force which causes the same deformation. This is not, of course, entirely satisfactory; it is a permissible approximate comparison, and is only practical in its application when the load or force producing the impact is large and moving at a moderate velocity.

In employing the deformation method a ½-in. copper cylinder is placed at the bottom of a heavy cylinder under a loose but neat fitting plunger, and the impact is received on the head of the plunger. The deformation of the copper is then measured and compared with the deformations produced by static forces.

In all discussions of impact forces from motor trucks it is the effect at one rear wheel only which will be considered, since here the force of impact is greatest and it is at this point that the controlling factors have the greatest influence.

Experimental Results

For the purposes of the tests which have been made a special runway of concrete was constructed, as shown in Fig. 1. This runway is so designed that the height of the head of the plunger *B* is flush with the road surface. The "obstruction" tests are made at this place by bolting to the plunger head a strip of hardwood 4 in. wide and 16 in. long, using thicknesses of ¼, ½, ¾, 1, 2, 3, and in the case of pneumatic tires, 4 in.

The "drop" tests are made at the drop-off edge *E*, the plunger beyond and in the lower pit being so placed that the plunger head *A* may be elevated to give "drop" distances varying from 0 to 3 in. The plunger may also be moved away from the edge *E* any distance to receive the blow of the wheel as it jumps varying distances, depending upon the speed of the truck. A ½-in. copper cylinder, heretofore mentioned, is placed under each plunger as shown. By this preparation it is easy to secure the data from both types of tests during one run or passage of the truck.

The impact of only the left rear wheel is measured. A bridge is placed over each plunger head to protect it from the front wheel. As this wheel passes, the bridge is jerked out leaving the plunger head clear to receive the impact of the rear wheel. In the case of the obstruction test, the right wheels (front and rear) do not strike the obstruction. But in the case of the drop test both right and left wheels are caused to drop the same amount.

Truck speeds are determined with a stop watch by noting the time to pass two points which are 30 ft. apart. These speed determinations are accurate to a maximum variation of 10 per cent.

The indications given by the measurements of the copper cylinders may have a maximum variation of about 5 per cent. The introduction of a copper cylinder as a means for measuring the impact also introduces a cushioning effect which in turn serves to reduce the impact value. A few experiments have been conducted to determine approximately what this cushioning effect may be.

The impact values shown on the charts as ordinates are the actual static indications from the ½-in. copper cylinders as measured immediately after the test. This is known as the static equivalent, and is plotted as such in all of the charts without corrections of any kind. It is realized that these values are only comparative and are not actual impact values. To arrive at a more nearly actual impact indication, or maximum force value, it will be necessary to correct these static equivalent values by increasing each by the cushioning factor and multiplying by some factor to allow for the fact that the copper cylinder measures the average impact and not the maximum. The value of this last factor may be from 1.5 to 2, depending upon the equation of the stress-strain diagram. No corrections of this kind have been made in any of the data or charts presented.

The tests are planned to show the influence of only the important factors upon the value of the impact force. The speed of the truck is considered to be one of the most important factors. It is most spoken of in connection with the operation of a truck, and the one factor against which are aimed more traffic rules and laws than any other. The determination of its effect upon the value of the impact force is very important. For this reason speed values, in miles per hour, have been made the independent variable in most of the tests.

Trucks of different weights and capacities have been used in the tests. Some of the trucks have comparatively heavy unsprung parts and some have light unsprung parts. The effect of this factor was especially studied in the tests upon two trucks of the same capacity under different loadings and speeds, each truck being equipped with the same set of tires.

Tire equipment was considered to be a very important factor. As far as possible, each truck was tested, at different speeds and loadings, with several kinds and conditions of tires.

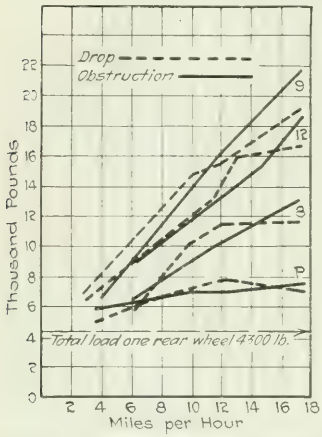


FIG. 2. COMPARISON OF TIRES, 2-TON TRUCK, UNSPRUNG WEIGHT, 1,000 LB.

P—Pneumatic, 130 lb. air, 19 x 9-in. cord, new, deflection, 1 in.
8—Cushion, 36 x 5 x 3-in., dual, defl. 0.58 in.
12—Solid, 36 x 8 x 2½-in., one, defl., 0.30 in.
9—Solid, 36 x 4 x 2 in., dual, defl., 0.28 in.

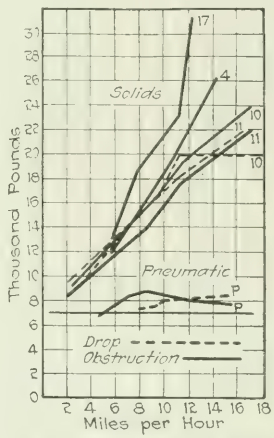


FIG. 3. COMPARISON OF TIRES, 3½-TON TRUCK, LOAD 4½ TONS, UNSPRUNG WEIGHT, 1,300 LB.

Load, one rear wheel; 7,000 lb. Obstruction and drop, 2 in.
P—Pneumatic, one, 42 x 9-in., new, air 142 lb., defl. 1.4 in.
4—Dual, 36 x 5 x 1⅞-in. worn, defl. .2 in.
10—Dual, 36 x 5 x 2½-in., new, defl. 0.32 in.
11—One, 36 x 10 x 2½-in., new, defl., 0.32 in.
17—One, 36 x 10 x ¾-in., worn, defl., .09 in.

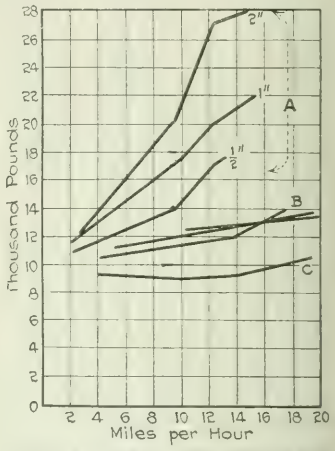


FIG. 4. SOLID AND PNEUMATIC TIRES ON TRUCKS OF APPROXIMATELY SAME WEIGHT

A—Solid, 40 x 6-in. dual, 5½-ton truck, load 7.5 tons, one rear wheel load 9,625 lb., obstructions 2, 1 and ½ in.
B—Pneumatic, 48 x 12-in., special 5-ton truck, load 7.15 tons, one rear wheel load 10,500 lb., obstruction 4 in.
C—Same as B with 1-in obstruction.

To get a definite idea of the effect of the height of fall, or of the height of an obstruction or irregularity in a road surface, this factor was used as one of the variables in most of the tests.

What Charts Show

The experimental results obtained during the conduct of these tests are plotted in 133 charts. After securing and studying results many interesting and important comparisons present themselves. No attempts will be made at this time to analyze all possible comparisons between the results shown on the charts. A few of the important features and indications are shown in Figs. 2 to 7, inclusive.

Fig. 2 shows an important comparison of the effect of the tire equipment upon the value of the impact. The truck used in this comparison was of 2-ton capacity, carrying a 2-ton load. Four different tires were used and a complete series of tests was run with each, using in each case the speed as the independent variable. The comparison is shown with both the drop and the obstruction test. To draw attention to the obstruction test only, it is noticed that the impact value (the ordinate) shows a considerable change with only a slight change in the tire deflection. The impact value,

with all conditions the same except the tire, is the greatest for the solid rubber tires and the smallest for the pneumatic tire, the cushion tire giving an intermediate value. At low speed the difference is not so great. At a speed of 17½ miles per hour the pneumatic tire gives an impact value of only 1.75 times the rear wheel pressure on the road surface, the cushion tire over 3 times, and the solids 4.3 to 5.1 times. In this particular case, the cushion tire gives an impact value of 63 per cent of the solid tire average, and the pneumatic only 36 per cent. It should also be noticed that for the pneumatic tire the impact value increases only very slightly with the increase of speed.

Fig. 3 shows also a comparison of the effect of tire equipment. The truck used in this case was of 3½-ton capacity, loaded with 4½ tons, the unsprung weight being equal to 1,300 lb. The total load at one rear wheel was 7,000 lb. Here, it should be noticed that with pneumatic tire equipment the impact force was only 15 per cent greater than the actual wheel load. The four different solid tires which were used in this series show very clearly the effect of the condition of the tire. Tire No. 17 gave some very high impact values even at 12 miles per hour. This tire was badly worn, having a thickness of only ¼ in. above the rim. The other solid tires gave impact values somewhat in proportion to their deflection or condition. The results as shown by tires Nos. 10 and 11 indicate the usual impact values that may be expected with good solid tire equipment, while the results shown by the use of tires Nos. 4 and 17 show the increase or extreme values that may be expected from the same truck when the tires are in a badly worn condition.

Fig. 4 is also a comparison between the effects of solid and pneumatic tires. The truck used in this case was of 5½-ton capacity, loaded with 7½ tons. This figure is intended to show the very great cushioning effect of pneumatic tires in comparison with solid tires. In this case a 4-in. obstruction was used during the test with the pneumatic tires, and the resulting effect was very much less than when using a solid tire on ½-in., or 1-in., or 2-in. obstruction. The figure also shows the effect of the air pressure in the pneumatic tires upon the value of the impact force.

Fig. 5 shows also a comparison of tires. This shows that in general the magnitude of the impact force is dependent upon the condition and deflection of the tire. It shows, as did Fig. 3, the wide variation in impact values that may be expected from the same truck equipped with tires of different conditions.

Fig. 6 shows a comparison between trucks. Two 5½-ton trucks were used in this case and each was loaded so that the total rear wheel load was the same in each case. Truck A had an unsprung weight of 1,950 lb. and truck K had an unsprung weight of 1,300 lb. Both trucks were equipped with the same set of tires. The purpose of this comparison is to show the effect of unsprung weight upon the impact value. It is very clear that the truck having the lighter unsprung weight produced the smaller impact values under the conditions of this test.

The purpose of Fig. 7 is to show the possible impact values which may be obtained by using trucks of different capacities. It is clear that the light truck, *W*, if run at a sufficient speed, may give impact values as high as a heavy truck, when run at the ordinary truck speeds of 8 to 10 miles per hour. These impact values were all obtained from a 2-in. obstruction. This figure shows that it cannot be said that a heavy truck always gives the highest impact values, without stating several qualifying conditions, especially the condition of speed and of tire equipment. This statement refers to impacts only. It should be noted in particular that a light truck running at high speed will produce large impacts only occasionally and never very heavy load pressures; while a heavy truck will produce in addition to impacts a continuous heavy pressure on the road surface.

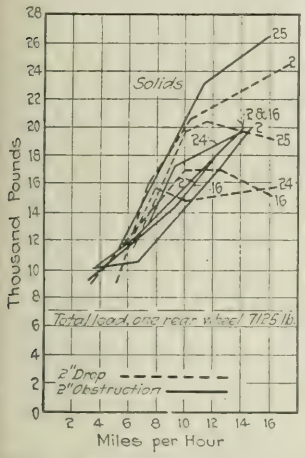


FIG. 5. COMPARISON OF SOLID TIRES, 5-TON TRUCK, LOAD 5 TONS, UNSPRUNG WEIGHT 1,300 LB.

2—Dual, 40 x 6 x 2-in., old, defl., 0.23 in.
16—One, 40 x 10 x 2½-in., new, defl., 0.28 in.
24—Dual, 40 x6 x 2¾-in., old, defl., 0.33 in.
25—Dual, 40 x 6 x 1¾-in., old, defl., 0.15 in.

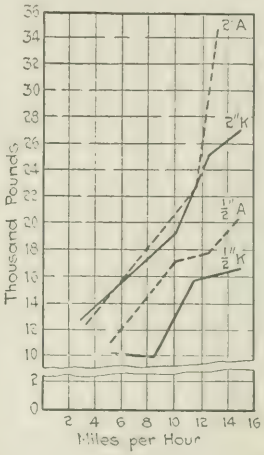


FIG. 6. COMPARISON OF TRUCKS VS. SPEEDS

Drops 2 and ½ in., good dual solid tire. 40 x 6 in.
A—Wt. (sprung) 8,150 lb.; wt. (unsprung) 1,950 lb.
K—Wt. (sprung) 8,800 lb.; wt. (unsprung) 1,300 lb.

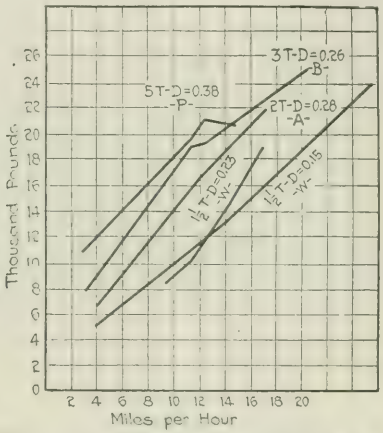


FIG. 7. COMPARISON OF TRUCKS OF DIFFERENT CAPACITIES; TIRE DEFLECTIONS INDICATED; ALL OBSTRUCTIONS 2 IN.

The results presented here must not be considered as final. The investigation has not been completed, and will continue under different conditions for some time. It is not the intention in this paper to state final conclusions or to deduce final laws and comparisons. It is, however, thought desirable to state briefly some of the indications toward which these results may point:

The impact value depends very largely upon the tire equipment. The condition of the tire—that is, whether it is new or badly worn—determines the amount of cushioning effect it may offer. The deflection of the tire depends upon its depth and quality, and any condition of the tire which adds to its deflection will, of course, serve to reduce the impact. The actual shape and construction of the tire seem to have considerable influence upon its cushioning effect. No account, however, has been taken of the power-consuming factor of any particular type or shape of tire.

So far as they have been tested, cushion tires seem to offer a decided advantage in reducing the impact. In this connection it should be stated that the name "cushion" on a tire does not necessarily make it such a tire. Some definitions and deflection requirements should be adopted for the classification of tires. Certainly a tire which does not have at least a deflection value of 40 per cent to 50 per cent of the deflection of a pneumatic tire under the same capacity load should not be classed as a cushion tire.

Pneumatic tires, as might be expected, show a very great influence in reducing impact values, and the impact produced with such equipment seems to increase only very slightly with the speed.

Considering the effect only upon the impact, the width of the tires, or the load per inch of tire width has very little controlling influence. The deflection of the tire is the main factor and this is controlled only slightly by its width. A decrease in tire width increases the load per square inch of tire, which in turn causes a slightly greater tire deflection. This, then, should tend to slightly decrease the impact. It will thus be seen that a large tire width does not tend to decrease the impact, but rather to increase it. It is a fact that a very wide but thin solid tire will give much higher impact forces than a narrow thick one. In so far as the unit load on the road surface is concerned, this must be considered from an entirely different viewpoint.

The speed of the truck has an important influence upon the value of the impact force, but it is a somewhat complex relation. It is not a simple arithmetical ratio, nor can it be expressed simply as a certain power of the speed ratio. When striking an obstruction or irregularity, the curve showing the impact values in relation to speed is approximately a straight line. But the equation of this curve depends upon the characteristics of the truck, the height of the obstruction, and the deflection of the tire, as well as the speed. For approximate comparisons it may be stated that the impact increases with the increase of speed:

10 to 100 per cent for solid tires;
10 to 75 per cent for cushion tires;
and 0 to 10 per cent for pneumatic tires.

An average of any of these limiting percentages must not be used, as the performance of any truck is too variable, and the relation of the other controlling factors cannot be predicted.

When dropping from one level to another the speed affects the impact value somewhat according to the percentage variations, given in the preceding paragraph, up to the point of a critical speed of 9 to 12 miles per hour. Beyond the point of critical speed at which the wheel falls freely there should be no increase in impact value.

Although heavy unsprung weights may give higher impact values than lighter unsprung weights, it can not be said that this is the major controlling factor. With all other conditions remaining constant this may be true. But other controlling factors, such as tire equipment, spring stiffness, load carried, and speed, may have a greater influence and overcome any difference due to the unsprung weights.

It is easily possible to so operate a light-weight truck under certain load and speed conditions that it will produce as high impact values as a heavy truck under certain conditions. Much remains to be learned, however, as to the relative destructive effects of light-weight, fast-running vehicles, and slow, heavy trucks.

The impact values as shown on the accompanying charts may be as high as 7 times the load at one rear wheel for a solid tire over a 1-in. obstruction at 16 miles per hour; an average value being about 4 times. For pneumatic tires the maximum impact value is probably not more than 1⅜ times rear wheel load, and the average not more than 1¼ times.

Mr. Smith's report concludes with an acknowledgment to J. T. Pauls for his painstaking and thorough effort in conducting the field tests, and for his aid in preparing and plotting the charts; and to C. A. Hogentogler for helping to secure and analyze the data. This investigation is under the general direction of Thomas H. MacDonald, chief of the Bureau of Public Roads, and A. T. Goldbeck, engineer of tests.

More About Marshall Irrigation Plan

That the U. S. Geological Survey is in no sense a sponsor for the plan for "All-California Irrigation" mentioned in the issue of Feb. 10, pp. 273 and 277, as being promoted by R. B. Marshall, is shown by the following paragraph from a letter sent to the California Press by George Otis Smith, director of the Survey:

"Neither the Surveyor nor any member of its staff has initiated, given serious consideration to, or endorsed the Marshall plan, either as a whole or in any of its details, nor has the Survey's work been directed toward a solution of the many far-reaching problems which it involves. The only information collected by the Survey that is applicable to the solution of these problems is that which relates to the physical factors of topography, water supply, and geology. Of these factors, Colonel Marshall, during his connection with the Survey, was officially concerned only with topography. Furthermore, the information has been collected with view to its general use as a basis for the beneficial development of the resources of the State and not with specific relation to the Marshall or any other particular plan. Of the tremendous financial, legal, constructional, and human factors involved in such a project neither the Survey nor any of its members has made an official study. Neither Colonel Marshall's former connection with the Geological Survey nor his use of data collected by that organization should be regarded as lending the Survey's authority to his plan or as indicating its practicability."

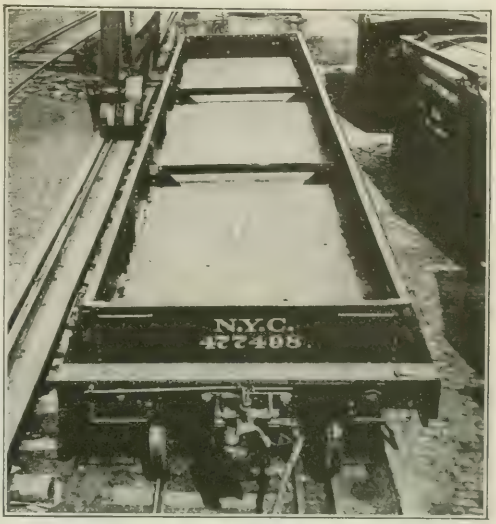
New Container Car for Store-Door Delivery Freight Service

Operated by New York Central Between Chicago and Cleveland in Special L. C. L. Service—Existing Cranes Handle Bodies

A NEW specially designed truck-body-container car of 50 ft. length for less-than-carload store-door delivery service has been put in operation by the New York Central R.R. between Chicago and Cleveland. It carries two containers of 7,000 lb. capacity each and two of 3,500 lb. capacity, specially designed to fit in with standard motor-truck equipment and for easy handling between car and truck by existing cranes during inauguration of the service. The purpose of the new freight service is to advance deliveries, to eliminate rehandling at stations and loss and damage in transit and at stations.

The railroad already had put in service a special steel car for express business with nine containers. The new car has been designed for less-than- carload freight service and it is stated in the published tariff that the car will be used between the railroad company's 12th St. station at Chicago and the East 38th St. station as Cleveland, "in conducting certain tests to develop the transportation advantage to be derived from handling less-than-carload merchandise freight in containers."

The frame of the container car is similar to the low-side gondola car. It is 50 ft. long—or 9 ft. longer than the longest New York Central box car—in order to take maximum loads in bodies that would best fit in with motor-truck equipment. With a car length of 40 ft. it would be possible to carry two containers of size to fit a five-ton truck chassis. The frame of the car is of steel, designed to correspond with the width of the containers, which cannot be as wide as the standard car floor because of state highway laws regulating overall width of motor trucks. To prevent the use of the floor space along the sides of the containers as a running board an oak filler with slanting sides is used. The containers fit into the body of the car, which is 22 in. high, and are held by sectional guides of ¼-in. pressed steel relatively located on the sides of the car to receive shoes at each corner of the containers, on their lengthwise sides, to hold them securely. The pressed steel guide shoes on the containers are 10 in. high and 4 in. wide, extending 1½ in. from the face of the body. Dividing the car into three sections are four



CAR DIVIDED INTO THREE SECTIONS HOLDS CONTAINERS SECURED BY SIDE GUIDES

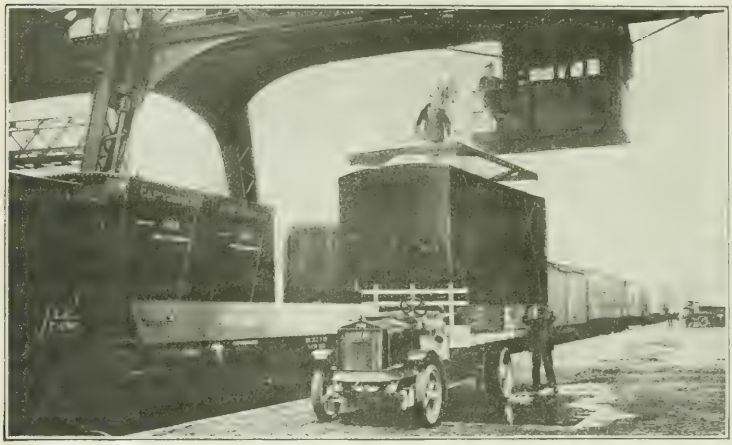
Pressed steel guides located to receive shoes at each corner on long side of container. Slanting sides of car body 22 in. high prevent use of car floor at sides as running board.

NEW CONTAINER CAR FOR LESS-THAN-CARLOAD STORE-DOOR DELIVERY SERVICE

Specially built to transport [illegible] containers [illegible] of 7,000 lb. and [illegible] capacity

diagonal steel plates extending from the car underframe to the steel sides. To each diagonal plate the ends of two steel straps are riveted, dividing the car into three distinct sections. The outside width of the containers is 7 ft. 11 in., including depth of shoes, and the dimension between the sides is 8 ft., giving a play of only ½ in. on each side.

The containers are interchangeable, except that the two smaller ones must occupy a one-third section of the car, the same space occupied by one of the larger containers. The load may consist of six small or three large containers or four small containers and one large. The containers open at one end by double swinging doors to give an opening 6 ft. 8 in. high and 3 ft. 7 in. wide. The doors are equipped with a strong locking device. To open the container it is necessary actually to raise it out of the car. Should the car run with one section empty the steel cross plates will prevent opening of the door just as the ends of the car do when completely loaded. The dimensions of the containers are as follows:



GANTRY CRANE AT CLEVELAND TEAM TRACKS HANDLES CONTAINER-BODY BETWEEN CAR AND TRUCK

Crane carries special cradle with eyelets fitting hooks on container to relieve it of strain from close rigging to the crane hook

LARGE CONTAINER

Outside length, 14 ft. 8¼ in. Outside width, 7 ft. 7 in. Outside height, 7 ft. 7⅜ in. Inside length, 14 ft. 2 in. Inside width, 7 ft. 1½ in. Inside height, 7 ft. 7⅜ in.

SMALL CONTAINER

Outside length, 7 ft. ½ in. Outside width, 7 ft. 7 in. Outside height, 7 ft. 7⅜ in. Inside length, 6 ft. 7 in. Inside width, 7 ft. 1½ in. Inside height, 7 ft. 7⅜ in.

The containers have steel frames, with floors strongly reinforced. The sides are of fir wood. At each top corner there is a heavy hook attached to the steel frame to rig them for handling between car and truck. A special "cradle" of length and width similar to the larger container is provided as an accessory to cranes at transfers to reduce stress on container frames from close rigging. The cradle carries eyelets to fit hooks at each corner of the larger containers.

Existing team tracks and existing gantry crane equipment for heavy service are being used as transfer points at Cleveland and Chicago for the handling of the containers between car and truck. It is expected, however, that the service will prove sufficiently successful to warrant expansion that will require some revision of terminal transfer facilities and minor revision of layout. Inbound and outbound transfers would be established for the less-than-carload store-door delivery service, equipped with special superstructures to carry cranes more especially adapted to the service than the existing cranes that are now being used but which were built for heavier service, although satisfactory to effect transfers in operation on a small scale.

The first service trip was made March 19, 1921. The car left Chicago loaded with a shipment of groceries from Reid, Murdoch & Co. for its Cleveland branch. Eight minutes were required for placing one of the large empty containers on the waiting motor-truck chassis bound for the shipping dock of the wholesale grocers, where loading of the container was accomplished in about 33 min. The loaded container was rigged, hoisted and placed on the car in 5½ min. and the second empty container was set out of the car onto the truck chassis in 3½ min. After loading it was replaced in the car in 6 min. At Cleveland, where the car arrived at the Wasson St. crane track of the New York Central, unloading of the first container to truck took 7½ min. Replacing to car after return from consignee's plant required 6 min. To remove the second container consumed but 2½ min. It was seen that much less time was required for removal when the crane was close to the container, the first operation consuming most of the time. It is stated that every article shipped was received without any damage or marking whatever and in the same position in containers as placed by the shipper. The time of operation, it is expected, will be materially reduced.

The special service is being offered at rates the same as those already existing for the various kinds and classes of l.c.l. freight, no charge being made for the weight of the containers. For the purpose of test, says the published tariff, shippers and consignees will be allowed the use of containers for loading and unloading at factories, warehouses, etc., the expense of drayage or trucking to be borne by the railroad and that of the contents of the container by the shipper or consignee.

The special car was built by the Merchants Dispatch Transportation Co. at its East Rochester shops from the plans of the New York Central. The service is operated by the L. C. L. Co., a subsidiary organization.

Colors for Highway Routes

The standard colors for route designations now in use in New York, Connecticut, Massachusetts and other Eastern States were adopted by the New Jersey Highway Commission recently. Blue bands are to be painted on poles along north and south routes; red bands for east and west routes; and yellow bands for diagonal routes, such as northeast, southwest, etc.

Revised Constitution for Am. Soc. C. E.

New Method Proposed for Electing Officers; By-Laws Provided To Cover Certain Provisions Now in Constitution

IN CONFORMITY with the announcement made at the annual meeting in January, the committee on referred amendments of the American Society of Civil Engineers has reported to the board of direction the revised form of constitution and the document is now in the hands of the members. It will be discussed at the annual convention at Houston April 27.

The outstanding features of the revision are a new method of electing officers and the splitting of the present constitution into two documents, a constitution and a set of by-laws. A primary system, by ballot, is proposed for electing officers, while the object of putting certain provisions in the form of by-laws is to make them easier of amendment.

In its report the committee explains that its object was to harmonize in as far as practicable the suggestions regarding revision that have been made. Special attention was given to the nomination and election of officers, and to the subdivision of the society for that purpose. The committee states that it made as few changes as possible, and only those that were consistent with the attainment of the purpose in mind. It believes that the proposed revision is one that will give the society "(1) a form of government that would be more directly representative of the membership body as a whole; (2) a method of nomination and election of officers that would bring the entire membership into participation and avoid as far as possible the probability of preponderating influence of any locality."

New By-Laws

Believing that the following provisions of the present constitution are of such a nature that it should be possible to change them without going through the difficult procedure required for constitutional amendment, the committee has thrown them into the form of by-laws:

Election of members (but not qualifications of members); payment of dues (but not the dues themselves); management, being a specific description of the duties of the board of direction and of the officers; committees, being a statement of their duties and the rules governing the activities of special committees; student chapters (an entirely new section, not existing in the present constitution); meetings, being an order of business for conducting annual meetings and regular business meetings.

Under the proposed revision to amend the constitution would, as now, require a two-thirds vote. The by-laws, however, could be amended by a two-thirds vote of the board of direction, provided there be thirty days' notice in writing before the meeting at which the proposed action is to be taken.

Officers and Their Election

By the proposed revision of the constitution the number of members of the board of direction would be reduced from thirty, as at present, to twenty-five, a president, four vice-presidents, eighteen directors, and two past presidents. The secretary, the treasurer, and three past presidents would be removed from the board. The elimination of the treasurer is proposed in the interest of equality of representation of the different geographical districts, it being felt that the treasurer probably would be, for reasons of efficiency, a resident of District No. 1.

A new method of determining the distribution of directors is proposed. Instead of being determined as now, by constitutional provision as to the number from each district, the number would vary from year to year in accordance with the number of members in each district. At the beginning of every year the total number of members would be divided by eighteen (the number of directors). The quotient would be the approximate number of corporate members for which there would be one director. It is provided, however, that no district shall be without at least one director, and if the method furnishes more than eighteen directors the board shall determine "in accordance with district membership as nearly as practicable" in which district the representation shall be reduced." The board would each year review the boundaries of the existing districts and change them if necessary. For the purpose of electing vice-presidents the board would group the districts into four zones, and one vice-president would be elected to represent each zone.

For the nomination of candidates for office the revision proposes two letter-ballot primaries, to be conducted after the order of the present method of balloting for officers. Suitable blank forms would be sent out not later than April 1 and every corporate member would be expected to submit the name of a nominee for the office of president, for the vice-presidency for his zone, and for the directorship or directorships in his district. These ballots would be canvassed on one of the first three days in June.

Not later than June 15 statement of the results of the first ballot would be mailed to each corporate member, together with a request for a second ballot. Nominees receiving less than 5 per cent of the total votes cast on the first ballot would be ineligible for the second ballot. The second ballot would be canvassed on Aug. 15, 16 or 17, and the candidates receiving the greatest number of votes for the respective offices would be designated as the "official nominees" for such offices.

Nominations by declaration might be made by petition of twenty-five corporate members "resident within the district or zone to which the office is attached."

Ballots for the actual election would go out thirty days before the annual meeting and would contain both the official nominations and the nominations by declaration. The vote would be canvassed on the first day of the annual meeting, as at present.

Other Changes

The following changes and additions are also made:

The title "Associate" is changed to "Affiliate."

Under qualifications for membership the following sentence is added, "Responsible charge in engineering teaching may be construed as responsible charge of work as required by the constitution."

The authorization of student chapters is inserted in the constitution.

No change is made in the method of disciplining members, but the committee suggests that this procedure needs revision at an early date.

An executive committee, such as has existed for the past several years without express constitutional authority, is provided for.

An article is introduced recognizing local sections, which are not provided for in the present constitution. In this section is a provision that the board of direction may annually appropriate from the funds of the society for the use of the section a sum not to exceed $3 per member of the section.

In the proposed by-laws the functions of the present finance committee would be taken over by the new executive committee, a public relations committee would be established, and the present elaborate provisions for the appointment of special committees would be done away with, the board of direction merely being given power from time to time to appoint such special committees as in its judgment may be necessary.

Dust Explosion at Large Chicago Grain Elevator

Foundations Disturbed—Some Cylindrical Concrete Bins Demolished—Steel and Concrete Superstructure Wrecked

ONE of the worst dust explosions on record occurred on March 19 in the large Chicago grain elevator of the Chicago & Northwest Ry. at 122nd. St. and the Calumet River. Six men were killed and four injured, about 500,000 bushels of grain were lost or damaged and the plant was badly wrecked, although the majority of the storage bins remain intact.

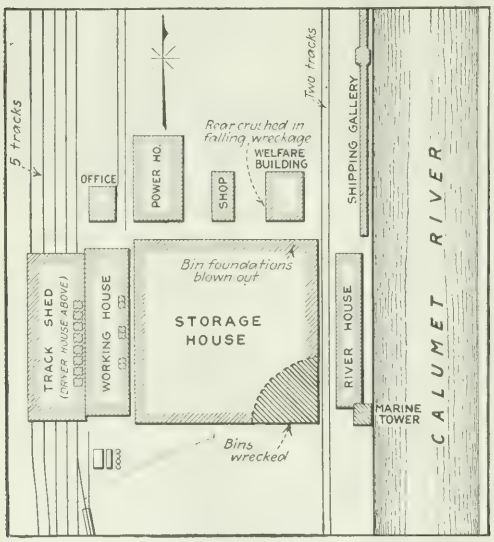


FIG. 1. PLAN OF CHICAGO GRAIN ELEVATOR WRECKED BY EXPLOSION

The general arrangement of the elevator plant is shown by the plan, Fig. 1. Over the track shed was the steel-frame drier house, in which the initial explosion occurred. Adajacent to this was the working house, with the first story of steel encased in concrete, supporting 95 concrete bins, 97 ft. high and 15 ft. in diameter, with 7-in. walls, these being surmounted by the 93-ft. steel-frame cupola, the height from ground to top of cupola being about 215 ft. Behind the working house was the storage house with 182 concrete bins 21 ft. 11 in. diameter and 104 ft. high, with 7-in. walls. Over this extended the steel frame conveyor gallery. The third unit was the river house, with a reinforced-concrete first story and 24 concrete bins similar to those of the storage house, but 95 ft. high. Above this was a steel-frame cupola, the total height of this building being 194 ft. At one corner was the marine tower, 153 ft. high.

Upper Works of Gunite

Light curtain walls of "gunite" concrete on wire mesh were used for the steel-frame cupolas, conveyor gallery, drier house and marine tower, as described in *Engineering News-Record*, April 25, 1918, p. 819. This light construction was adopted partly with a view to minimizing the effects of explosion, which is a hazard at all grain elevators. These walls were blown out almost completely, as shown by the accompanying photographs, especially Fig. 2, which is a view of the front of the working house and cupola. Much of the steel framing left in the cupolas is twisted and distorted but parts of it probably can be used in reconstruction. With heavier walls the damage to the steel work probably would have been greater. At the base of the working house is shown the wreckage of the drier house and car shed. Some of the bin foundations on the north side of the structure were damaged.

About fifteen bins at the southeast corner of the storage house were wrecked, and about half of the bins of the river house burst. In addition, a number of the bins of the working house, storage house and river house were more or less seriously cracked and damaged. The explosion in the corner bin of the river house pushed out the base of the vertical marine tower so that the tower dropped into the river in an inclined position. Damage was done also to the bin foundations, which rest on a heavy concrete slab or mattress, some of these foundations being blown out. At some places the bin structure appears to have been lifted bodily and then dropped. Complete investigation of structural damage cannot be made until after the removal of the steel wreckage and the quantities of grain which poured out at various points.

It appears evident that a first explosion occurred in the drier house, which was destroyed completely. This shock no doubt jarred loose quantities of settled dust, the dust clouds serving to propagate the main explosion, as has been observed in many explosions and tests. The main explosion swept both over and under the structure, the upper sweep extending through the steel-frame superstructure of the cupolas and conveyor gallery. The lower sweep was under the concrete bins, the weight of which increased the intensity of its force.

Dust Collectors Were Used

A dust-collecting installation was part of the mechanical equipment of the elevator to remove the dust resulting from the handling of the grain, but there would inevitably be a considerable amount lodged throughout the plant.

Retails or close-up views are shown in four of the photographs. In Fig. 4 are shown the foundations blown out at the northeast end of the storage house, with one corner block overturned; some of the bins are burst and others show horizontal cracks. Fig. 6 is a view of the southeast corner of the storage house, where the fifteen bins were destroyed. At the right is the rear of the river house. Fig. 5 shows the northeast corner of the river house, with walls blown from under

FIG. 2. WEST SIDE OF ELEVATOR AFTER EXPLOSION

FIG. 3. GRAIN BINS DEMOLISHED AND MARINE TOWER DISPLACED LATERALLY

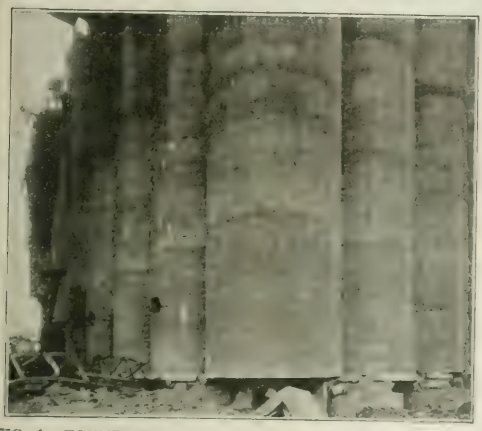


FIG. 4. FOUNDATIONS BLOWN FROM UNDER STORAGE HOUSE BINS

FIG. 5. WRECKAGE OF BASE AT RIVER-HOUSE BINS

FIG. 6 WHERE FIFTEEN BINS OF STORAGE HOUSE WERE BLOWN OUT

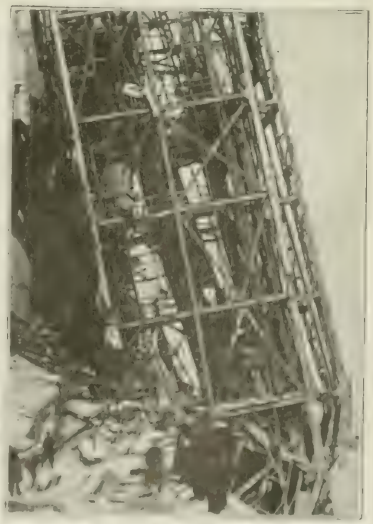


FIG. 7. WRECKED BIN AND MARINE TOWER, RIVER HOUSE

VIEWS SHOWING DAMAGE OCCASIONED BY DUST EXPLOSION IN CALUMET GRAIN ELEVATOR

the bins. Fig. 7 is the southeast corner of the same house, with a blown-out bin and the marine tower pushed laterally off its foundations so that it dropped into the river.

Hudson River Vehicle Tunnel Contracts To Be Ready May 15

CONTRACTS, plans and specifications for the construction of the subaqueous portion of the Hudson River vehicular tunnel between New York and New Jersey will be ready May 15 if the schedule announced in the annual report for 1920 of the New York-New Jersey Bridge and Tunnel Commissions, made public this week, is followed. Chief Engineer Clifford M. Holland has fixed Dec. 31, 1924, as the date on which the pair of tubes will be completed, provided with the necessary ventilating equipment and ready to receive traffic.

The tunnels, consisting of twin tubes each 29 ft. in external diameter and about 8,300 ft. between portals, are estimated to cost $28,669,000. They will be built of cast-iron rings by the shield method, for it is definitely announced in Mr. Holland's report that the trench method of construction, which had been under consideration as an alternative during the past year, has been abandoned on the grounds of not being adapted to Hudson River conditions.

It is announced in the report that Lewis F. Pilcher, state architect, has been named consulting architect to the commissions and will have charge of the treatment of the tunnel approaches and portals. Traffic studies on bridges and ferries, supplementing those discussed in the commission's previous report, were made during the year. The year's operations also have included a complete system of surveys across the river to establish the tunnel alignment and base lines 5,000 and 3,400 ft. long have been laid out on the New York and Jersey sides of the river.

Tunnel Design

The preliminary design of the 29-ft. cast-iron tunnel has been investigated in detail for various conditions of loading during and after construction, and the report contains an appendix summarizing these investigations.

The design which was adopted involves the use of 14 segments and one key section. The width of each segment is 30 in., the thickness of the metal, 2 in., and the depth at the flanges, 14 in. This design has the same depth of flange and thickness of metal as that provided for in the preliminary studies of last year and differs only in details. Changes have been made to increase the strength of the joints by increasing the thickness of the metal at the four corners of the segment a maximum of ½ in. and relocating the bolts in the horizontal joints.

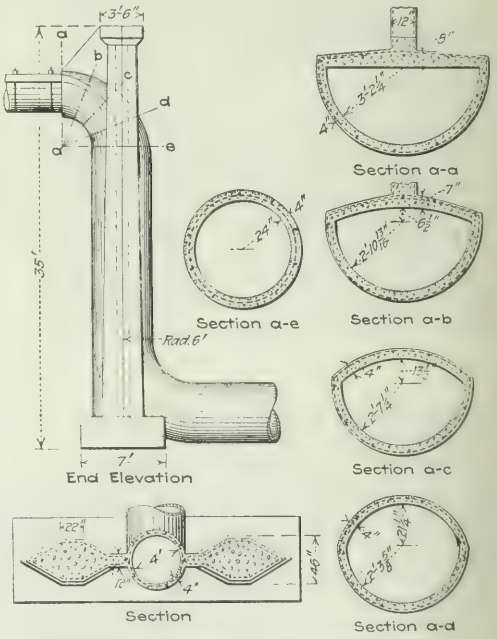
During the year progress has been made in the investigation of ventilation problems under three main divisions: (1) Amount and composition of exhaust gases from motor vehicles; (2) dilution necessary to render exhaust gases harmless; (3) method and equipment necessary for adequate ventilation. Appendices to the report contain a detailed account of this research work.

Up to the present time a contract has been let for the ventilating shafts on the New York side. According to the chief engineer's schedule, the contracts for the subaqueous tunneling work will be ready May 15 and for the approaches, Nov. 15. It is planned to have the contracts for the ventilating equipment buildings ready Nov. 15, 1922, and to call for the installation of the equipment not later than May 15, 1923. As stated, the tunnels should be ready for operation Dec. 31, 1924.

During the year there have been no important changes in organization. C. M. Holland continues as chief engineer and the following report directly to him: Jesse B. Snow, principal assistant engineer; Milton H. Freeman, division engineer; and Ole Singstad, designing engineer.

Inverted Siphon Terminates in Riser on Bridge Pier

IN THE ORIGINAL scheme for serving that part of the Anderson Cottonwood Irrigation District in California which lies on the east side of the Sacramento River, the plan was to bring water across from the west bank by means of an inverted siphon consisting of 4,000 ft. of 48-in. concrete pipe and 600 ft. of 42-in.



RISER AND TRANSITION CURVE SECTIONS

cast-iron pipe. The cast-iron pipe was selected for convenience in constructing that portion of the siphon that would be under water at low levels of the stream. Because of the weight of pipe of this size, however, decision was made at the last moment to make the 600-ft. stream crossing of 36-in. pipe, adding another line later when more water was needed. On this basis construction was commenced, the concrete conduit section was completed and the iron pipe for a single 36-in. river crossing was delivered on the job.

At this juncture estimates were revised, a new engineer was retained and the work was resumed on a new basis. Decision was then made that the 36-in. pipe was

CONCRETE CONDUIT AND RISER TO THE BRIDGE FLUME

inadequate and it was decided that a method more certain and less expensive would be to terminate the concrete conduit, as already laid, in a riser from which the water could be carried across to the east bank in a flume supported by a bridge. This plan was adopted and successfully carried out.

A standard design, through-truss, steel bridge, consisting of three 133-ft. spans, was purchased for $10,000. Piers for this bridge were built to such a height that a flume hung from the bottom chords would, on 1:1,000 grade, meet the flume grade on the far side of the river. To the floor-beams of the truss a pair of 10-in., 15-lb. channels were attached by stirrups, and from these were hung 1-in. suspension rods, spaced 6 ft. apart. These rods supported parallel runs of 4 x 6-in. stringers to which a No. 120 Lennon flume was fastened in the usual manner. By this plan considerable clearance above high water is afforded, and even in the event of a flood high enough to carry away the flume, it is pointed out that the bridge, representing the major part of the investment in the crossing, would still remain.

The timber stringers were cut in 12-ft. lengths so that the joints, which were scarfed, always came at a suspension rod. Every other suspension rod was made long enough to be continued on through 4 x 8-in. corbels placed below the joints. The flume size chosen was slightly larger than that required for the 60-sec.-ft. capacity of the conduit. Thus it will be possible to operate the inverted siphon under a slight head, if desirable to increase its capacity.

The problem of design in the riser was to deliver water from the concrete pipe at flume velocity and in such way that there would be no standing wave or other disturbance of the current in pipe or flume. The riser was continued as a circular section up to the beginning of the elbow and, in the course of making the right-angle turn, the section was uniformly changed from a circle to the exact shape of the flume. The shape of the transition from the circular to the flume section was worked out by methods similar to those applied to hydraulic turbine draft tubes.

The end bridge pier, to which the riser is attached, is the same in design and construction as the other piers of the bridge. Piles were first driven in two clusters and cut off below low water. Two 6-ft. corrugated-iron pipes were then put down over the pile tops and filled with concrete. A concrete web to connect the cylinders in a single monolith was put in as low as wood forms could be conveniently used. The web is 2 ft. thick below ground and 1 ft. thick above. The riser is bonded to the web and passes through it at flume level.

The work has been completed according to designs prepared by Thomas H. Means who was employed by the Anderson cottonwood irrigation district as consulting engineer just before the change in plans was decided upon.

Educational Plan for Engineers on Great Northern

A PLAN for the education of professional engineers in railroading on the Great Northern Railway has been put into effect following a proposal made to the management by the Great Northern section of the American Association of Engineers. It was described at the recent railroad conference of the association by W. L. Lewis and briefly is as follows:

An educational bureau was established composed of the executive head of each department of the railway and three members of the A. A. E. section. Its duty is to outline and conduct the courses. There are three standing committees, program, service and progress. The first prepares the lesson sheets for study, the second conducts the details of the bureau business and the third records data regarding the student body and notes the effect on the operation of the road. Students are divided into ten sections according to departments. Sections are headed by a chief who selects lieutenants and assistants, so that classes may be organized over the entire line under the supervision of competent men. Department heads furnish the lesson sheets, which are in the students' hands two weeks prior to the class night, and are in the nature of critiques conducted outside of business hours by the author of the lesson sheets. The courses now being conducted relate (1) to railway matters, (2) accounting offices, (3) shop mathematics and drafting. A special course will soon be conducted for training engineers of the company along executive lines.

The Design of Sanitary Lateral Sewers and House Connections

By Milton J. Rurak and C. E. Keefer

Division Engineer of Sewers, Baltimore, Md.

Assistant Designing Engineer, Sewer Division, Highways Department

ONE of the first things to determine before designing lateral sewers for a district is the character of the subsoil to be encountered. This investigation may mean the simple process of reviewing old records of the kinds of materials found in the construction of water mains, gas pipes, etc., or it may involve the more expensive procedure of digging test pits and sinking borings. Frequently a sanitary sewer can be built in an alley in the rear of a row of houses much cheaper than in the front street, or vice versa, due entirely to the difference in the cost of excavation. Alleys often provide the best location, as fewer substructures are encountered, and there is less interference to traffic.

Contrary to the designs of many sanitary engineers, lateral sewers should not be built in the center of the street. They should be constructed preferably on that side that has the greater number of houses in order to make the total length of house connections as short as possible. In many cases one side of a street is lower than the other, and if the sewers are built on this side, there will be no need of cutting as deep a trench to serve the houses on the downhill side. Moreover, sewers built in the center of a street cut off the traffic from the whole street if it happens to be very narrow. If an up-to-date pavement is opened at or near the center of the street, little better than a patch job can be obtained after it is repaved, and in rural sections space will often be found along the side of the road where the paving will not have to be disturbed.

It is not always good policy to build sanitary sewers very close to the curb line. Where sanitary manholes are built in the gutters, and the sewage is collected by the separate system, and treated at a disposal plant, large quantities of rain water will enter the manhole covers, and add considerably to the quantity of sewage to be treated. Sanitary sewers near the curbs are also liable to become stopped up with tree roots if trees exist or are planted along the sidewalk.

Storm Sewers First

In cities where the separate system is in use, storm sewers should always be designed before sanitary sewers. Where these sewers interfere with each other, the sanitary sewers should be built at a lower elevation, because it is cheaper to lay them in deep trenches than the larger storm-water drains. When the Baltimore Sewerage Commission (1906-1916), which built fully 90 per cent of the sewers in Baltimore, started to work, it planned to lay very shallow storm-water drains, but so many underground structures were encountered that it was soon found to be cheaper to build these drains at least 5 or 6 ft. deep, with the sanitary sewers still deeper, than to go to the great expense of either raising or lowering the various obstructions that were encountered.

In residential sections in Baltimore the house connections were built from 7 to 9 ft. deep, and in business sections from 10 to 13 ft. Experience soon demonstrated that in business districts it was much cheaper to construct sanitary sewers in tunnels than in trenches. In one case a merchant lost a thousand dollars due to the diverting of traffic from the street on which his store was situated to another street because of the deep sewer trench which was dug in front of his property.

Where interceptors or trunk sewers are built in a street at a considerable depth it is often better to serve the adjacent houses with a lateral sewer than to build vertical standpipes to connect each house with the larger sewer. Large pipes with "Y" connections are expensive; vertical standpipes are difficult to construct and maintain; a large sewer with many house connections on it is hard and unpleasant to inspect; and the multitude of flows from these house connections entering the large sewers at many points cause considerable eddying.

House Connections

In Baltimore two types of house connections are used: single and twin. The single house connection consists of a 6-in. pipe, running from the lateral sewer to the house. The twin house connection has a 6-in. pipe running from the sewer to the curb line, with two 5-in. branches to the two adjacent houses. It might seem that there would be an excessive number of stoppages in twin house connections but in Baltimore there have been fewer in these than in single house connections. Twin house connections considerably reduce the length of pipe to be laid, and where rock is encountered their use is to be especially recommended. When excavation is difficult, it is also a good plan to dig one trench from the lateral sewer to the building line, and lay two house connections in it.

No outside running traps are permitted on house connections in Baltimore except on a few combined sewers. This ruling was made effective some years ago in spite of a vigorous protest from the Master Plumbers' Association—which, later on, saw the advantages of not using running traps and withdrew its protest. The money saved has amounted to several hundred thousand dollars. Every house is provided with a vertical stack running a few feet above the top of the building and joining the house connection. Each stack permits an efficient means of ventilating the sanitary sewers. All of these sewers in Baltimore are free of gases, and, as a result, there have been no explosions in any of them. It has not been necessary to rely upon getting ventilation through manhole covers; so the number of holes in these covers have been reduced from six to two. A considerable quantity of storm water is thus kept out of the sanitary sewers, and the cost of pumping and treating the sewage is much less than it would be under other conditions.

Every large municipality should have a department where the locations and the depth of all proposed subsurface improvements are approximately determined. If the different city departments and the public service corporations, such as telephone and gas companies would agree before hand as to the locations of their proposed work, large sums of money would be saved. As it now is in many cities, various underground structures are so situated that much additional money has to be spent in either moving these improveemnts or in digging deep trenches to get under them. The above mentioned department should be under the supervision of a man familiar with the design of sewers, for of all the subsurface improvements the layout of a sewerage system requires the most knowledge and study.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Does Licensing Make For Responsibility

Sir—In a recent issue of your periodical, I read with some interest of the collapse of a dome on a church at Long Beach. In your editorial comments you state as follows: "So far as it rests on engineers, we are making progress in fixing such responsibility and making sure that they are competent to bear it. License laws and joint action through societies will accomplish this result."

I have never yet seen any reason to suppose that license laws will accomplish any such results as you seem to think they will. I have had some experience in license laws in regard to engineers and architects in various states, and so far as I have been able to determine they have never accomplished anything except bothering competent engineers.

Springfield, Mass., March 17. SAMUEL M. GREEN CO., S. M. Green, President.

Elastic Soil Again

Sir—I dislike to renew or prolong a controversy with my friend Lazarus White, but there are certain statements in his letter in *Engineering News-Record* of March 10, p. 439, that appear to me to be partly due to a careless interpretation of my own of Jan. 27, p. 185, and partly to jumping at conclusions from his own observations of soil phenomena. First, I want to say that I heartily endorse, as I have heretofore done, the method of holding the rebound by wedging or otherwise as devised by Mr. White. I do say, however—and I ask that this be not misunderstood—that if I have to choose between a supertest of 50 to 100 per cent in excess of the load and not hold it, and a test of the actual load and hold it, I prefer the supertest. It would be absurd, however, to say that both factors should not be had if possible, and therein, as I have observed in many cases, lies the value of Mr. White's pretest method. He gets both factors, though he inadvertently gives the impression that the supertest is not important. My only criticism of the wedging-and-holding factor is that, as Mr. White himself claims, he only holds a percentage of the test load by wedging, i.e., he does not attain perfection but approaches it some 32 to 50 per cent nearer than with the supertest alone.

As to appreciable elasticity of soil, I am willing to be shown. I do not, of course, deny the existence of elasticity, but I do not believe that it is a sufficiently large factor to be observed in ordinary working conditions. Mr. White would have us believe (if I read him understandingly) that the elasticity of soil is very many times greater than that of steel. I quote from his letter of Mar. 10, "Rebounds of ⅜ in. have been observed for piles 10 ft. long where the elasticity of the pile itself would account for only 1/50 inch." Let us analyze this. Take his own diagram illustrating the bulb of pressure, in his article of Dec. 30, 1920, p. 1268. The radius of ultimate area stressed is about 5 ft.; then with a 10-ft. pile showing an elastic reaction of 1/50 in. and 5 ft. of soil accounting for the balance of the ⅜-in. elastic rebound we find the elasticity of the soil roughly 40 times that of the steel shell pile. This method of getting at the elasticity of the soil is like the good old method of measuring skin friction: if a pile of the equivalent area of 1 sq.ft. carries 20 tons, and 4 tons is all the soil should stand, then 16 tons are ascribable to skin friction—the deduction is perfect.

Now I don't think Mr. White intends to imply just what he seems to say and I may have misinterpreted him, and if so I am willing to be corrected, but what he did not consider is the main factor of the rebound of the pile; that is, the slight but cumulative tendency to distortion the elasticity of which could easily account for the whole of the ⅜ in. in the rebound.

Just a further word as to practical considerations. Except in bogs or the like, where the reinforcement of the soil by fibrous matter gave it a tensile strength and an elastic factor, I have never noted in observations of soil in tunnels, trenches and foundations any visible evidence of elasticity. I have always observed that when anythings drops into or on ground or yielding soil with a dull sickening thud it "stays put" and if removed from a hole made by it the hole does not change observedly in dimensions. If we take a ½-in. bar and drive it into a sandy soil with the swinging blow of a 20-lb. sledge (my own limit is about a 10-lb. one) we will find I think there is no appreciable rebound, and yet the load in the soil, taking the blow at 200 lb., is equivalent to a load of 75 tons per square foot. It seems to me that if the soil is as elastic as some of our friends would have us believe that we would have more ordinary piles bounding out of holes under hammer blows than would stay in place.

In our early experiments with sectional shields in tunneling we sometimes found that a cobble not larger than a man's two fists would stop the shield section, and I have seen the pressure as measured by gauge run up to 10,000 or 12,000 lb. on a 3½-in. ram. Then when the cobble was found and dislodged with the ram still under pressure, I have seen the shield jump ahead ½ in. from the elasticity of the reaction blocking. In other cases I have seen the piston of the ram run back 1¼ in. when released from 10,000 lb. pressure while the reaction blocking expanded and straightened some 20 ft. back with much creaking and groaning and the head of the shield stood absolutely still.

J. C. MEEM,
Engineer for Frederick L. Cranford, Inc.
Brooklyn, March 15.

Stresses in Reinforced-Concrete Chimneys

Sir—Referring to the letter from Frank S. Bailey in your issue of March 3, 1921, p. 393, calling attention to the difference in results obtained from Mr. Wolfe's graphical method and Turneaure & Maurer's analytical method for the analysis of the cylindrical section given on p. 408 of Hool & Johnson's "Concrete Engineers' Handbook," please note that at the close of Mr. Wolfe's analysis he states that the maximum steel stress is the distance $rY = 710 \times 15 = 10{,}650$ lb. per square inch. Obviously, this should be the distance dY, which, as nearly as can be read from the very small scale shown, is $546 \times 15 = 8{,}200$ lb., the correct steel stress. The maximum concrete stress is, as stated, 479 lb. These results vary about 7 per cent or 8 per cent from those obtained from an analysis using the Turneaure & Maurer curves and the variation is consistent for both the steel and concrete stresses. Analyzing the same section by the method given in Taylor & Thompson we find the stress in the concrete to be 536 lb. and in the steel 8,860 lb., which agrees very closely with Turneaure & Maurer.

In Taylor & Thompson's method the reinforcing steel is assumed to be placed at the center of the concrete ring and for this particular section with an inside diameter of only 4 ft. and shell thickness of 1 ft., this assumption probably accounts for the difference in results between the graphical and analytical methods. For most reinforced-concrete chimneys where the diameter is four or five times as great and the shell thickness approximately the same the error in the analytical method is negligible.

Referring to the much greater discrepancies between the results of the various methods in the case of a 200-ft. chimney with a diameter of 20 ft., which Mr. Bailey mentions, I believe the discrepancy will be found to lie in an error in the application of Mr. Wolfe's graphical method, as such an error with its resultant discrepancy puzzled the writer for some time. In Mr. Wolfe's method the neutral axis of the chimney as a reinforced-concrete beam is first found, a maximum stress in the concrete is assumed and

the resisting moment of the chimney determined. The actual stress in the concrete is then determined by proportion between the resisting moment thus found and the moment of the eccentric load about the *neutral axis*, after which the effect of the direct load and the remainder of the bending is determined. It is therefore necessary to the application of this method that the line of action of the normal component of all loads lie farther from the tension side of the chimney than the neutral axis of the chimney as a beam, in order that its bending moment about the neutral axis may be determined. When this normal component acts between the neutral axis and the tension side of the section, Mr. Wolfe's graphical method does not apply.

The common error in this case and one that is easily made in using the graphical method is to take the moment of the normal component of the loads about the center of the chimney section and then proceed with the graphical solution, in which case the resulting stresses will be in error and much in excess of the true stresses. Of course, I do not know the section of the 200-ft. chimney to which Mr. Bailey refers, but since he states that the resultant falls close to the edge of the kern I have little doubt that the graphical method will not apply and was probably used erroneously to obtain the results to which Mr. Bailey refers.

For actual reinforced-concrete chimney sections to which the graphical method will apply, and this is seldom the case, the results should agree closely with both Turneaure & Maurer and Taylor & Thompson's analytical methods.

E. A. DOCKSTADER.

Boston, Mass., March 15.

Sir—Mr. Bailey may be interested to know that I once attempted to apply the graphic method cited to round columns in buildings and concluded upon examination that the method is in fundamental error, in that at the outset the bending is calculated from the neutral axis, whereas it is the geometric central axis from which the eccentricity must be measured as in the preceding examples, pp. 387 and 394, of Hood & Johnson. Otherwise we might assume the special case of the normal force or load along the neutral axis, and get no bending moment, although such a position of the load is eccentric.

The second error is in combining stresses derived from considering the load alone, and then flexure alone. This can only be done without error when there is no resulting tension in the section. This error, however, is mentioned but it is not brought out that the effect of it is to change the slope of the stressed plane section and thereby vitiate the results.

When tension exists over part of the section and tension in the concrete is neglected relations are too complicated when expressed in a formula for round columns or chimneys, and the only workable, quick solution is by a diagram, such as given on p. 816, Hool & Johnson.

Toronto, Ont., March 11, 1921. E. S. MARTIN.

Protective Coatings for Sea-Water Concrete

Sir—In connection with the articles in *Engineering News-Record*, March 25, 1920, p. 621, and Jan. 20, 1921, p. 121, on the subject of the deterioration of reinforced-concrete piles in sea-water in California, I would like to present the following remarks:

It seems to be well established that deterioration takes place only between high and low water, and when the concrete is permeable, because on each tide the concrete soaks up new sea-water which renews the chemical attack on the concrete. Under these conditions, no matter how weak is this attack, its renewal by new sea-water twice a day finally results in producing lamentable results.

The remedy is to make concrete impermeable. M. Voisin, chief engineer, Ponts et Chaussees at Boulogne-sur-Mer, has devised the following method: (1) The concrete is mixed 450 kg. of cement to 800 liters of gravel and 400 liters of sand. (2) This concrete is covered with a thin coating of pure cement paste. (3) On this coating is then applied two coatings of boiling coal tar, the second not being applied until the first is perfectly dry.

This method has given perfect results without any trace of decomposition observable in the concrete after ten years, and imitating the work at Boulogne-sur-mer, the method has been adopted in other French ports. I believe that this proceeding may be adopted with success in the United States and notably on the Pacific Coast.

I think that one might advantageously replace the coal tar by paraffin which will not melt except at a temperature much higher than that which is common in that region in the warmest days in summer. For work in California already built, I think that its life can undoubtedly be prolonged by the application to the concrete from low to high water in the following process: (1) A covering of pure or almost pure cement paste applied perhaps by the cement gun. (2) Two coatings of boiling paraffin, the first not being applied until a month after the cement coat, the second two or more days after the first, and both of them in dry weather.

LOUIS RAVIER.

Paris, France, March 7.

Bridge Paneling and Ruggedness

Sir—A. W. Buel's article on page 463 of your issue of March 17, discussing the Georges Creek bridge accident, and your editorial in connection therewith, will, I hope, bring forth some useful discussion on this matter, which is one of great importance in bridge design.

Your editorial statement that "The relative service resistance of simple and subdivided systems is in the last analysis not a theoretical question but a question of fact, to be determined by service experience," may be granted, I think, by everyone. However, the case discussed does not prove that had the Georges Creek bridge been of simple-panel design the bridge would not have withstood the punishment it received equally well, if not better.

It is generally accepted by bridge engineers that panel subdivision complicates the detailing with an attendant pound-price increase, and renders the span subject to considerably more vibration, owing to the comparatively light truss members. Consequently, with a higher vibration percentage (other things being equal), we have an increased impact effect upon members, and it would therefore appear that the heavier members of a simple system are more capable of withstanding the punishment from derailment.

In my opinion Mr. Buel accounts for some of the principal reasons why the Georges Creek bridge made such a good showing in this accident when he describes the heaviness of the gusset plates, the planing of sheared edges, and the otherwise stringent fabrication specifications.

One point frequently lost sight of is that the relative ruggedness of simple and subdivided panel trusses varies with the amount of section loss through corrosion, there being a larger area of metal per ton exposed to the elements with the subdivided system, and an increased difficulty of properly protecting inaccessible parts when repainting. Other points in favor of a simple system are apparent; for instance, the desirability of making the shipwork as simple as possible so as to reduce the possibility of doubtful workmanship, and the reduction of secondary stresses in the truss members. It should be remembered that live load is approximately twice as destructive as dead load on account of the stretching and relaxing of the metal. This element certainly favors a simple truss system.

The writer is from Missouri when it comes to believing that a subdivided panel system is best for 150-ft. railroad spans, but hopes, as stated before, that the matter will be thoroughly discussed.

F. H. FRANKLAND,
Consulting Engineer.

New York City, March 21.

Fire Loss in Terms of New Construction

According to reports published in the Jan. 15 and Feb. 12 issues of *Bradstreet's* (New York), the value of new buildings reported in 1920 by 163 leading cities is $1,408,610,000. The insurance adjustments on account of fire losses in 1920 amounted to $330,853,925, or 23.5 per cent of the value of new buildings. This is not an exceptional case, as shown by data for other years.

HINTS FOR THE CONTRACTOR

Monthly Suppers Stimulate Enthusiastic Spirit at Wilson Dam

MONTHLY suppers of the leading men in the supply division of the Wilson Dam, being built by the Government across the Tennessee River at Muscle Shoals, Ala., were an important factor in developing enthusiasm and effective service in that division. At the request of *Engineering News-Record*, Major S. C. Godfrey, Corps of Engineers, U. S. A., chief of the supply division, has written a brief statement of the reason for holding these suppers and their effect upon the work of the division. Major Godfrey's story is as follows:

In the spring of 1920 the problem of securing equipment, material and supplies for the Wilson Dam was a critical one. The construction work was being pushed vigorously, but the market for engineering material was so congested and the railroad facilities were so inadequate to handle the heavy demands being made, that the construction bid fair to be seriously hampered. It was exceedingly difficult, for instance, to secure cement in quantities adequate for concreting needs. The railroads at that time could not move the cement that was offered and available at certain mills. This problem was solved by the purchase of seventy-five box cars which were put into service between the cement mills and Wilson Dam, and which proved during the summer and early fall of 1920 practically the only resource that the government had in order to procure cement. In full operation the needs for concreting aggregated about ten cars of cement daily.

Another vital problem of supply consisted in the procurement of sand and gravel from the Tennessee River for concrete aggregate. The sand and gravel is dredged by two 15-in. suction dredges at a point 12 miles below the dam. It is pumped to the top of two screening and washing plants adjacent to the dredges. After being separated it is deposited on barges and hauled by towboats to an unloading dock three miles from the dam, where it is unloaded by two gantry cranes into the cars which convey it to the mixers. The entire dredging and handling plant had to be assembled and put into smoothly running order under the adverse conditions above referred to and to build up to a production basis of 2,000 cu.yd. of material a day.

Need for Co-operative Effort

Under these conditions it was extremely desirable to instill into the members of the supply division who had all of these problems in hand, a realization of the magnitude of their task, and a spirit that would overcome obstacles. The heads of the various departments, therefore, in conference with the chief of the division, agreed upon a plan of holding monthly suppers of a semi-official and semi-social nature.

These suppers were attended by some thirty or more of the employees holding responsible positions. They were held in different mess-halls on various parts of the work, at a charge to the employees of the actual cost of the food. At the first suppers a plan was carried out for each department of the supply division to explain, informally, its organization and problems to the other departments, in order that all branches—purchasing, traffic, storage, finance, sand and gravel procurement, etc.—might work together more effectively through a better understanding of their respective functions.

Later on chiefs of other divisions and departments were invited to meet with the supply division, and in the same informal way the needs of the construction divisions, which the supply division was endeavoring to meet, were taken up and discussed from the point of view of more effective service. In these talks various engineers told of the design of the dam, described the units which would furnish the power, and in other ways gave members of the supply division a more intelligent conception of the problems that they were helping to solve.

Throughout these discussions it was emphasized that the supply division had a function like that of the S. O. S. in France—to adapt itself to the "front-line" needs, to help the construction men foresee their own requirements for material and supplies, and to make every effort to get those necessary supplies to the job on time.

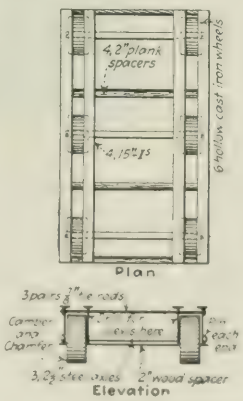
At the eighth supper employees were invited to bring their wives and immediate relatives. The attendance at this supper was over one hundred, and included superintendents, clerks, dredge operators, foremen, steamboat masters, storekeepers, typewriters, electricians, laborers, in fact an assembly representative of the entire work.

As a whole these suppers are believed to have contributed materially to the effectiveness of the service rendered by the supply division and to the morale of its employees.

All-Steel Truck for Heavy-Duty Transfer Work

By D. H. Fleming
Town Engineer, Owen Sound, Ontario

FOR moving heavy machinery such as contractors' hoists, boilers, etc., the heavy-duty trailer shown herewith has been used. It can be drawn by team, tractor or truck. Its special feature is the wheel arrangement, making turns at street corners easy. The middle pair of wheels is placed from one-half inch to an inch above the other two pair so that the whole teeters on the two opposite wheels at the middle of the truck. For freedom of movement, none of the wheels are secured to the axles so that they may turn backward while others turn forward.



Water Sewerage and Wastes in Wisconsin

A classification of water supplies, sewerage systems and industrial wastes in Wisconsin has been made by the state sanitary engineer, C. M. Baker. Of the 46 surface supplies 10 are filtered and chlorinated, 12 are chlorinated only and 24 are untreated. Of the 224 ground water supplies 100 are shallow wells, springs and infiltration galleries and 124 are artesian or deep wells. There are 163 sewerage systems of which 13 have the tank-and-filter system, 49 have tanks only and 101 have no treatment. Of the 4,390 plants producing industrial wastes 139 are canneries, 40 coal tar or gas plants, 3,901 milk products, 52 packing or rendering plants, 63 paper and pulp mills and 195 miscellaneous.

NEWS OF THE WEEK

New York, March 31, 1921

Mayor Shakes Up Pittsburgh Engineering Bureaus

Drops Experienced Men—Chief Engineer Sprague Dismissed—Swan and Others Resign

Norman S. Sprague, chief engineer of the Department of Public Works of Pittsburgh, was removed from office by Mayor E. V. Babcock on March 17 through a letter of dismissal charging that Mr. Sprague had lost the confidence of the city council as well as that of the public, and that not enough progress has been made on the public improvements provided for by a bond-issue referendum passed in July, 1919. At the same time John Swan, director of the department, resigned his office; a day later John F. O'Toole, superintendent of the Bureau of Highways and Sewers of the same department, and S. A. Dies, superintendent of building inspection, also resigned. Mr. Sprague had been with the Department of Public Works for fourteen years, Mr. O'Toole had served for the same length of time, and Mr. Dies held his position for eighteen years. Mr. Swan had been director for four years past, having been appointed late in 1916 to succeed the late Robert Swan, his brother.

Politics Responsible

Politics is believed to be responsible for the shake-up. At a meeting of the Pittsburgh Section of the American Society of Civil Engineers, held March 20, resolutions were passed expressing the confidence of the section in Mr. Sprague's ability and integrity, and asserting that his dismissal should not be construed as reflecting upon his professional ability and reputation.

It is stated by the mayor that the Bigelow Boulevard landslide of last November and the council's investigation of the responsibility for the slide played no part in Mr. Sprague's removal. As concerns the charge of slow progress in initiating and carrying out already authorized public improvements, Mr. Sprague, in a public statement, has stated that bond-issue contract work to the amount of $1,034,000 was completed during the past year, and that nearly $1,500,000 of contract work is in progress, in addition to a larger amount of tax and special assessment improvements; and that plans are completed and ready for advertisement for bids upon bond-issue improvements totaling more than $1,000,000, while plans for an equal amount of work are in preparation. However, it is said to be the Mayor's purpose to put the 1919 bond-issue improvements in the hands of a special engineer, instead of the public-works department, in order to have the work completed as soon as possible.

Colonel Sherrill Named as President Harding's Military Aide

President Harding has selected Lieut.-Col. Clarence O. Sherrill, Corps of Engineers, as his military aide and as superintendent of public buildings and grounds. Col. Sherrill is a native of North Carolina. He was an honor graduate of the U. S. Military Academy in 1901. He also was graduated with honors from the School of the Line and from the Staff College. For several years following his graduation, he was instructor at the Army schools.

LIEUT.-COL. C. O. SHERRILL

From 1910 to 1914 Col. Sherrill was stationed at New Orleans on river and harbor work, after which he spent a year in the Philippines on fortification work. He then was sent to Panama where he spent two years in charge of the fortification construction.

With the outbreak of the war Col. Sherrill was assigned to the command of the 302nd Engineers. During the Argonne offensive he served as chief of staff of the 77th Division. Later he went to Germany as assistant chief of staff of the Third Army.

Since his return to the United States Col. Sherrill has been in charge of fortification work in the office of the Chief of Engineers. He is a member of the Board of Surveys and Maps and of the Interdepartmental Board on Alaskan affairs.

Col. Sherrill was aide to President Roosevelt in 1903 and 1904 and to Gen. J. Franklin Bell in 1904 and 1905. He was decorated by the French with a Croix de Guerre, with palm, for services rendered the French army during the fighting on the Vesle.

Federal Highway Policies Under Consideration

New MacArthur Bill to Be Introduced —Many Members of Congress Preparing Bills

(Washington Correspondence)

With the necessity facing Congress of evolving a new highway policy or putting its stamp of approval on the existing federal-aid plan, various legislative ideas now are taking shape. To attract the maximum support any bill proposing a continuation of federal-aid must embody a provision that states, rather than their subdivisions, are to meet the federal appropriation. Exceptions probably will be allowed in cases where a large local program is necessary.

It is admitted that such a measure must make it mandatory that maintenance be carried on only by the state highway departments. Most of the state highway officials are understood to stand with Thomas H. MacDonald, chief of the U. S. Bureau of Roads, in his declaration that "the present plan of allowing maintenance funds to be provided by localities will not prove satisfactory in maintaining the projects which are built with the use of federal aid, and this condition can be prevented if the maintenance funds are supplied by the state and administered by the state highway departments."

MacArthur Bill Revised

Representative MacArthur, of Oregon, is expected to introduce at the opening of the extra session a bill which will embody the ideas of the state highway officials. The bill will follow the general lines of the measure introduced by Mr. MacArthur at the last session, but it will be revised in a number of particulars. The new bill will not carry an appropriation, but will simply authorize such sum as may be agreed upon by the appropriations committee. There is every reason to think, however, that an appropriation of $100,000,000 per year will be forthcoming if a federal-aid bill becomes a law.

Other features of the original MacArthur bill which probably will remain are as follows:

A modification of the present equal ratio of co-operation between the Federal Government and the States, whereby the portion of the total cost of the road project borne by the Federal Government is increased in proportion to the amount of publicly owned land within those States more than 10 percent of whose area consists of public land; the provisions for a road program in the national forests; the extension of federal-aid to Alaska and to Hawaii; the extension of preference in the construction of roads which will expedite

the completion of a national highway system.

A number of members of Congress are known to be preparing bills. All of these measures will go before the Committee on Roads where the ideas meeting with approval will be merged.

Mechanical Water Filtration for Cambridge, Mass.

Bids for a mechanical water filtration plant for Cambridge, Mass., are to be received by the city April 12. The work includes a concrete sedimentation basin 97 x 137 ft. x 17 deep, 10 concrete filters, each to give a net area of about 480 sq.ft.; a concrete clear-water basin about 148 x 276 ft., x 16 ft. deep; a wash-water receiving basin about 38 ft. in diameter by 12 ft. deep; four electric-driven centrifugal low-lift pumps with a total capacity of 26 m.g.d.; a 29 x 34-ft. steel wash-water tank; filter accessories, piping, etc.; and a two-story concrete and brick building, 77 x 216 ft. in plan. George A. Johnson, New York City, is consulting engineer.

Iowa and Illinois Water-Works Men Hold Joint Meeting

Five Middle West states were represented March 23 and 24 at the meeting of the Illinois and Iowa Sections of the American Water-Works Association. Combined annual meetings of sections suggested by Charles R. Henderson are planned beginning in the fall of 1922, leaving the spring open for individual section meetings and the summer for the large general meeting.

Seven technical papers were presented and an excursion to Chicago pumping stations was made. R. Edman Greenfield, chemist, Illinois State Water Survey, explained by demonstration the term hydrogen-ion concentration. S. A. Greeley, consulting engineer, gave comparative operating data of the Evanston, East Chicago and Whiting rapid sand filters.

Walter A. Shaw, former commissioner, Public Utility Commission of Illinois, read an extended paper on "Fixing Rates for Public Utilities by Contract," and C. M. Roos, superintendent, Cairo (Ill.) Water Co., followed with views of the same problem from the utility standpoint. F. H. Mathews, of the Utility Commission, discussed the grading of utilities from the layman standpoint. "Take the public into your confidence," was the burden of both his talk and that of Mr. Roos.

D. H. Maxwell, with Alvord & Burdick, outlined the geological difficulties Bloomington, Ind., has in finding a reservoir site that will hold water. John Ericson, consulting engineer to the city of Chicago, indicated that Chicago could not afford to filter its supply until it reduced its waste. The daily consumption is 265 gal. per capita.

The newly elected officers of the Illinois Section are as follows: Chairman, John W. Alvord; vice-chairman, Henry R. Ringness; treasurer, H. E. Keeler; new trustee, Dr. A. M. Buswell.

To Tax Gasoline in California

A bill was recently introduced into the California Legislature providing for a tax of one cent per gallon of gasoline, distillates, and fuel oils used in motor vehicles.

New Head to Wind Up Railroad Administration Affairs

President Harding has named James C. Davis of Iowa, who has served as general counsel to the Railroad Administration, to succeed John Barton Payne, who resigned a short time ago as Director General. Mr. Davis' duties will be concerned largely in winding up the affairs of the Railroad Administration.

Federal Power Commission Issues New Rules

Effective Feb. 28, 1921, the Federal Power Commission issued orders No. 9 which embody rules and regulations of the commission. Any one doing business before the commission, making application for permits or licenses, etc., must do so under the rules laid down in this book, which can be obtained from the Federal Power Commission.

Manchester Building Three School Structures

The city of Manchester, N. H., is carrying on a school building program, included in which is the construction of two high schools and a grammar school, the total cost of the three buildings to be in the neighborhood of $2,000,000. The largest of these buildings is the Practical Arts High School, 180 x 70 ft. with an ell 80 x 70 ft. and costing in the neighborhood of $1,000,000. The work is under way, I. S. Woodbury & Sons Co., general contractors of Boston, being in charge.

Legislature to Investigate Illinois Roads

Full investigation of the highway situation in Illinois is contemplated in a joint resolution of the State Legislature. The resolution provides that a committee of three from the Senate and three from the House be appointed to investigate and report to the present general assembly union: The establishment of a permanent, uniform and efficient system of road improvement and maintenance throughout the state; the promotion of a county system of road improvements and maintenance by extending dirt road improvement and the use of gravel, or similar material where advisable; the establishment of the so-called Wisconsin patrol system; the sentiment for and advisability of changing the construction to be used on bond issue roads from cement or brick to some other construction; the best methods of treatment of dirt roads with oil or other material and the subsequent proper care of such roads. The joint committee is directed to report to this session of the general assembly, and an appropriation of $7,500 is made to cover the expense of the investigation.

Molasses Tank Trial Resumed

After a recess of several months the trial of the famous molasses tank case in Boston has been resumed and rebuttal testimony of the plaintiffs is being presented. The case put in by the defendants, the United States Industrial Alcohol Co., to show that the failure of the tank on Jan. 15, 1919, was caused by a bomb explosion, was summarized in *Engineering News-Record*, Oct. 7, 1920, p. 691.

Flat-Slab Reservoir Roof at Canton, O., Collapses

A section of the roof of the equalizing reservoir being constructed for the City of Canton, Ohio, collapsed sometime during the night of March 2. The reservoir is a reinforced-concrete structure approximately 283 x 360 ft. in plan, with an average depth of 22 ft., and a capacity of 15,000,000 gal.

The roof of the reservoir, which is of the flat-slab type, was poured between Oct. 1, 1920, and Jan. 14, 1921. Centers were constructed for the entire roof slab, and allowed to remain in place for approximately 60 days. In fact, a large part of the inside forms have not as yet been removed. About Feb. 1 work was started placing the earth cover over the reservoir. On Feb. 15 the resident engineer noticed some small checks or cracks in that part of the slab on which the earth cover had been placed and ordered the contractor to stop placing the earth.

On the morning of March 3 it was found that sometime during the preceding night a large part of the section on which the earth cover had been placed had collapsed. An investigation was immediately started to determine the cause of the failure and the James H. Herron Co., of Cleveland, Ohio, and Sanford Thompson of Boston, Mass., have been retained by the consulting engineers, Morris Knowles, Inc., to make an investigation and report. In addition, the city of Canton has retained the Pittsburgh Testing Laboratories. The tentative conclusions reached by the James H. Herron Co. and Mr. Thompson agree that the failure was caused chiefly by the slow hardening of concrete, due to cold weather; that, however, the balance of the slab, if given sufficient time, will develop enough strength to carry the load for which it was designed.

Reclamation Service Program Must Be Curtailed

Because of indications that receipts from oil land leases payable to the reclamation fund will be nearer $12,000,000 than the $20,000,000 estimated, the U. S. Reclamation Service will not be able to carry out the entire construction program authorized at the last session of Congress. Director Davis has authorized, however, the early inauguration of the work of building the Tieton reservoir in the Yakima valley. This reservoir is an extension of the storage system in that valley. It will provide 185,000 acre-ft. of additional storage.

New York Legislature Passes Port Treaty Bill

The New York Port Treaty Bill was passed by the Senate of the New York Legislature, March 23, by a vote of 31 to 11, following its passage by the Assembly the week before. At this writing it is in the hands of Governor Miller for his signature. The Governor had previously urged passage of the bill.

The New York State bill authorizes any two of the three New York members of the New York, New Jersey Port and Harbor Development Commission to enter into negotiations with commissioners from the State of New Jersey to draw a compact between the two states in the form of a Port Treaty, the terms of which are included in the bill and which provide for the creation of the New York port authority. A similar bill has already passed the Senate of the New Jersey Legislature, but at this writing has not yet been acted on by the lower house. The New Jersey Senate bill provides for the appointment of commissioners by the Senate. The democratic Governor of New Jersey is said to oppose the port treaty measure and it has largely become a party issue. Republicans predominate in both branches of the New Jersey Legislature.

A second bill was passed by the New Jersey Senate, March 28, naming the present three New Jersey members of the bi-state commission to membership on the port authority when the port treaty is signed. No votes were cast against the measure.

In New Jersey opposition to the Port Treaty continues from Jersey City organizations, but the measure has received the support of the chambers of commerce of other port municipalities including that of Newark.

A. A. E. Railroad Conference

Questions of education and co-operation with the management rather than those of compensation were predominant in the reports of delegates to the third annual railroad conference of the American Association of Engineers held March 14 in Chicago. About 65 roads were represented with 100 members present. No changes were offered in the 1920 salary schedule. A resolution asked for two weeks' notice of the managements in case of reduction of force.

The change in activity away from compensation was marked in the brief reports made by delegates from the various sections. Regular meetings, where established, have had for discussion methods of increasing the ability of members based on the principal that the engineer, like everybody else, in the long run gets what he deserves. Many of the A. A. E. sections are therefore learning other phases of railroading than engineering so that they will be better fitted to be promoted into executive positions. W. L. Lewis of the Great Northern read a paper giving the details of a plan in operation on that road which was being carried out by classes in conjunction with the management. Most of the sections reported close contact and co-operation with the management and expressions of loyalty to it were numerous.

A paper by J. D. Trueblood, Chicago & Northwestern Ry. analyzed the statistics as to the attendance of civil engineers in seven universities in the Middle West. Both enrollment and graduates have fallen off as compared with the numbers taking other courses.

Indiana Conservation Department Gets Money for Engineers

The Indiana State Department of Conservation was established in 1919 with five divisions: fish and game, geology, entomology, land and waters, and forestry. This year a division of engineering has been provided for with an appropriation of $15,000, which becomes available April 1. While the main feature of the work to be undertaken will be drainage and land reclamation, some attention will be paid to stream pollution. In fact, work on the problem of disposing of sugar factory wastes at Decatur has been under way for some time. In this work there is to be co-operation with the activities of the State Board of Health.

The Conservation Department will work in conjunction with Purdue University, appointing a member of the engineering department as state engineer. Prof. W. K. Hatt is acting temporarily in this capacity. It is planned to have an assistant in Indianapolis to carry out details.

The powers of the new engineering division under the law provide for (1) investigations and recommendations relative to drainage and land reclamation, (2) surveys and mapping to enable more intelligent procedure of land drainage and reclamation, (3) recommendation and enforcement of drainage laws, (4) designation of natural drainage areas so that systems may be established economically and scientifically as an integrated whole, (5) computations of probable discharge and necessary capacities of channels and ditches and levee systems. Richard Lieber is director of the Department of Conservation.

Research Department Organized by Automotive Engineers

Organization of a research department is announced by the Society of Automotive Engineers in the March issue of its journal. The department will not conduct a laboratory or do research work directly, but will coordinate the work in outside laboratories, direct investigations at the Bureau of Standards and Bureau of Mines on fuels and other subjects in automotive engineering, supervise comparative tests in industrial laboratories, guide research programs to definite commercial ends, collect all available data on the important automotive subjects.

Chief of Engineers Allots Harbor and River Work

Allotments of river and harbor work for the coming year have been made by Major-General Lansing H. Beach, Chief of Engineers, U. S. A., carrying out the provisions of the $15,000,000 lump sum river and harbor appropriation bill approved March 1. An expenditure of $2,500,000 is provided for locks and dams on the Ohio River; $700,000 for Southwest Pass, New Orleans, and $500,000 each for Savannah Harbor, Ga., river and mouth of Wiscon River, Detroit River, and Portland, Ore. For the Hudson River channel, New York Harbor, $450,000 is allotted, $100,000 for the Hudson River.

Allotments of $400,000 each are made for St. Johns River, Fla., from Jacksonville to the ocean; Hillsboro Bay, Fla.; Mississippi River between Ohio and Missouri Rivers, and for San Juan Harbor, Porto Rico. Other items over $100,000 are:

Mobile Harbor, Ala., $300,000; Galveston, Tex., Harbor, $100,000; Galveston Channel, $100,000; channel from Galveston Harbor to Texas City, $125,000; Houston ship channel, $260,000; Freeport Harbor, Tex., $150,000; Port Aransas, Tex., $230,000; harbor at Sabine Pass and Port Arthur canal, Tex., $160,000; Sabine-Neches canal, including Sabine River to Orange, and the Neches River to Beaumont, Tex., $125,000; Mississippi River, between St. Paul-Minneapolis and Wisconsin River, $200,000; Missouri River, Kansas City to mouth, $200,000; Cumberland River, below Nashville, $200,000; Tennessee River, below Riverton, $100,000; Ohio River, general open-channel work, $285,000; Ludington Harbor, Mich., $166,000; Calumet River, Ill. and Ind., $186,000; Coos Bay, Ore., $144,000; Yaquina Bay and Harbor, Ore., $145,000.

Various other smaller items are specifically included in the allotments. The amount reserved for contingencies is $2,361,700.

In allotting the river and harbor appropriation a year ago $1,484,118.99 was left for contingencies. It was not necessary to draw upon that sum. It now has been allotted as follows: Pollock Rip Shoals, Nantucket Sound, Mass., $150,000; Harbor of Refuge at Nantucket, Mass., $5,000; Ambrose Channel, Craven Shoal and Anchorage Channel, New York Harbor, $300,000; Woodbridge Creek, N. J., $9,000; Keyport Harbor, N. J., $20,000; Delaware River, Pa., N. J. and Del., Philadelphia to the sea, $1,000,000.

Illuminating Engineers to Meet

The annual convention of the Illuminating Engineering Society will be held in Rochester, N. Y., during the week of Sept. 26, 1921.

Sanitary Survey for Duluth

The Minnesota State Board of Health, at the request of the Duluth City Council, is about to undertake a sanitary survey of the water supply and sewerage. The distribution of sewage in the lake will be ascertained by a series of sampling stations. Recent complaint against the water supply, which is protected by chlorination, led the city to ask the State Board of Health to undertake the study.

Camden Bridge Report Expected by Early Summer

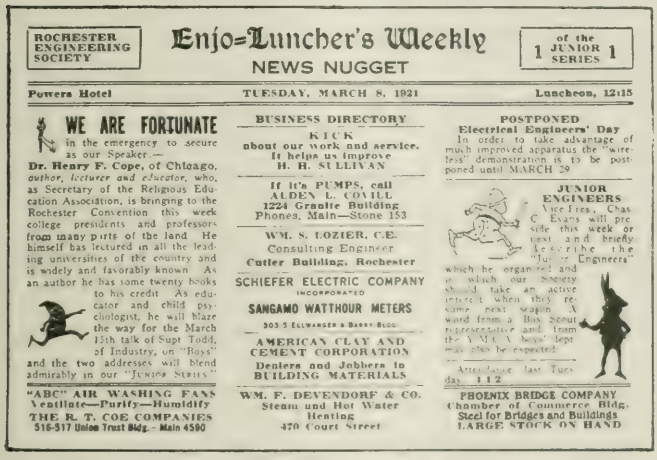
Present progress in the engineering investigations for the bridge across the Delaware River between Philadelphia and Camden is such that predictions are made by engineers close to the work that the report on best site and type and probable cost of the bridge will be rendered by early summer. Borings at the northern, middle and southern locations have reached rock on the Philadelphia side, all of them at practicable depths (80 to 110 ft.), while those on the Camden side are not yet completed. Work on superstructure studies is concerned both with the river span and with the approaches. Main spans of between 1,700 and 1,800 ft. will be required at the three sites, and the local conditions governing the choice of type are substantially the same. Designs of cantilever and suspension spans are under preparation, to serve as a basis for comparative cost estimates. In the approaches, the desirability of laying out ample entrance and exit facilities and yet avoid cutting off any of the already overcrowded streets of Philadelphia is considered essential.

Hearings held before representatives of the Corps of Engineers of the War Department with respect to clearance height for navigation were made the occasion for a strong argument by the engineers for the bridge in favor of a 135-ft. clearance height on a width of 800 ft., and against a requirement of 150 ft. height. This will give more ample navigation passageway than the Brooklyn bridge (which lies below the New York Navy Yard). Only a small amount of opposition from navigation interests developed. A decision on clearance height is looked for soon. Because of the vital dependence of the bridge layout upon the vertical clearance required by the War Department, progress in the planning may be delayed if a decision is long deferred.

Acting on conclusions of its engineers, the commission in its report to the Pennsylvania legislature, just rendered, states that if sufficient funds are provided the bridge can be completed by July 4, 1926, the sesquicentennial of the signing of the Declaration of Independence. An appropriation of $5,000,000 was asked, as Pennsylvania's share of the requirements of construction prior to the next legislative session in March, 1923.

Getting Society Members to Lunch

Every week the Rochester (N. Y.) Engineering Society sends out to its members a post card announcement of the weekly luncheon. A reduced copy of one of the cards is shown herewith. Notices of the meeting and timely facts are featured and advertisements help pay the expense.



ROCHESTER ENGINEERING SOCIETY

Enjo-Luncher's Weekly

NEWS NUGGET

1 of the JUNIOR SERIES 1

Powers Hotel — TUESDAY, MARCH 8, 1921 — Luncheon, 12:15

WE ARE FORTUNATE in the emergency to secure as our Speaker.—

Dr. Henry F. Cope, of Chicago, author, lecturer and educator, who, as Secretary of the Religious Education Association, is bringing to the Rochester Convention this week college presidents and professors from many parts of the land. He himself has lectured in all the leading universities of the country and is widely and favorably known. As an author he has some twenty books to his credit. As educator and child psychologist, he will blaze the way for the March 15th talk of Supt. Todd, of Industry, on "Boys" and the two addresses will blend admirably in our "JUNIOR SERIES."

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POSTPONED
Electrical Engineers' Day
In order to take advantage of much improved apparatus the "wireless" demonstration is to be postponed until MARCH 29

JUNIOR ENGINEERS
Vice Pres. Chas. C. Evans will preside this week or next and briefly describe the "Junior Engineers" which he organized and in which our Society should take an active interest when they resume next season. A word from a Boy Scout representative and team the Y.M.C.A. boys' dept. may also be expected.

Attendance last Tuesday 112

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WEEKLY POSTCARD SENT TO MEMBERS OF ROCHESTER ENGINEERING SOCIETY

Maine Contemplates State Water Power Control

A proposed constitutional amendment which would give the State of Maine authority to control and develop water power was submitted to the Legislature recently in a message by Governor Baxter. The amendment will provide also for the taxation of all water powers and water power fees and hydro-electric energy generated therefrom. The Governor stated that by the terms of the Federal Water Power Bill the water powers of Maine are in danger of passing under Federal control and it well may be that the only method of preventing this is to levy a tax upon hydro-electric energy generated within the state and shipped beyond its borders. The Governor further stated that the constitutional amendment proposed would give the people an opportunity to decide for themselves whether the state should control and develop water power storage basins and undeveloped water powers.

Bill Fixes $4,500 as Salary for County Surveyors

A bill introduced in the Indiana General Assembly fixing the salaries of county surveyors in counties having a population of more than 200,000 at $4,500 a year has passed the lower House by a vote of 71 to 12. The bill provides that all fees now charged and collected by them shall be paid into the county treasury and they shall receive no additional compensation whatsoever as county engineer. The salaries of deputy surveyors and qualified assistants will be fixed by the Board of County Commissioners and will not exceed $200 a month for the first deputy nor $150 a month for each of the other deputies or qualified assistants. Rodmen, chainmen and other unqualified assistants shall not be paid more than $4 a day.

Surveys Board Names Officers

Officers of the Board of Surveys and Maps of the federal government for the ensuing year have been elected as follows: O. C. Merrill, Federal Power Commission, chairman; William Bowie, Coast and Geodetic Survey, vice-chairman; C. H. Birdseye, Geological Survey, secretary.

Indiana's Legislation Affects Engineer Interests

Numerous bills have been introduced during the present session of the Indiana General Assembly which have direct bearing either upon the construction industry or engineers as a profession. It is doubtful if such a volume of engineering legislation has ever been introduced in a previous Indiana Assembly.

A bill providing for the registration of civil engineers and surveyors and the establishment of a state registration board recently became law.

A bill to permit South Bend to come in under existing track elevation statutes and to aid in the consummation of track elevation plans now under way has been passed by the House unanimously.

A bill has been introduced in the Senate and referred to committee which would provide for the codification of all the drainage laws of the state. Senator Van Orman of Evansville has introduced a bill which would create a commission to investigate the advisability of constructing a bridge to cross the Ohio River at Evansville. The Senator will make an attempt to have the Kentucky Legislature to do the same at its next session in the hope of having the 1923 Indiana Legislature pass a bill to aid in financing the construction.

A Senate joint resolution appropriating $25,000 for a preliminary survey of a proposed inner harbor at Wolf Lake in Lake County and the appointment of a commission of two by the Governor to meet with a similar commission from Illinois, passed unanimously.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Chief Draftsman (aeronautical). Vacancy in the Naval Aircraft Factory, Navy Yard, Philadelphia, Pa., at $15.04 per diem and other vacancies requiring similar qualifications will be filled from this examination. Applications received until April 26, 1921.

Civil Engineer for vacancies in the Philippine Service, at salaries ranging from $2,500 to $3,000 a year, and in positions requiring similar qualifications.

Engineer, $2,400, or over, a year; Assistant Engineer, $1,800 to $2,340 a year; Junior Engineer, $1,440 to $1,740 a year. Vacancies in the Water Resources Branch of the Geological Survey. Applications rated as received until July 1, 1921.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27-30.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, Boston; Convention, Cleveland, June 6-10.

The American Specification Institute has been incorporated and a permanent organization was effected March 18 with the first board of governors consisting of the following: Chairman, Ralph W. Yardley, of Perkins, Fellows & Hamilton, architects; executive secretary, Gardner C. Coughlen, of Weary & Alford, architects; other members, C. L. Post, of the Condron Co., consulting engineers, Frank A. Randall, of Berlin, Swern & Randall, architects, and A. T. North, engineer. The organization will function as originally planned. (See *Engineering News-Record*, Feb. 17, p. 318). Headquarters have been established in Chicago.

The Vermont Society of Engineers, at its annual meeting March 9, elected the following officers: President, M. E. Carpenter; vice-president, holding over, G. R. Varnum; vice-president, C. A. Slayton; secretary, G. A. Reed; treasurer, T. W. Dix. The evening session was addressed by Governor James Hartness on the proposed affiliation of the society with the Federated American Engineering Societies, and by Alfred Patche of the Aberthaw Construction Co., Boston, who gave an illustrated lecture on ancient and modern engineering in Syria.

A Kansas City Section, Am. Soc. C. E. has been organized with the following officers: President, Alexander Maitland; vice-presidents, John V. Hanna and Col. E. M. Stayton; director, Louis R. Ash; secretary and treasurer, Henry C. Tammen.

The Providence Engineering Society (Structural Section), at a joint meeting with the **Providence Section, Am. Soc. C. E.**, was addressed March 22 by E. J. Mehren, editor of *Engineering News-Record* on "An Engineer's Observations of Economic and Engineering Conditions in Europe."

The Pittsburgh Section, Am. Soc. C. E., at a meeting March 20, discussed the subject of engineer licensing. C. S. Davis was delegated to appear on behalf of the section before a committee of the State Legislature March 23. The section passed a resolution of confidence in N. S. Sprague recently dismissed as head of the city's Bureau of Engineering.

The Southern Pine Association announces that there will be no postponement of its annual convention to be held in New Orleans, April 4-6. J. E. Rhodes of New Orleans is secretary-manager.

Personal Notes

J. H. ANDERTON has resigned his position as electrical engineer with the Stone & Webster Corporation to become a member of the firm of Thebo, Starr & Anderton, engineers and constructors, Sharon Bldg., San Francisco.

F. M. THEBO, of the firm of Thebo, Starr & Anderton, engineers and constructors of San Francisco, sailed for Japan March 19. The firm has been retained as consultant by a Japanese company that plans to construct a series of hydro-electric developments. Mr. Thebo will be gone for several months, during which time he expects to investigate field conditions, advise with officials of the Japanese company and organize the field forces.

W. D. SIMPSON has been appointed division engineer of the Florida division, Seaboard Air Line.

S. P. LONGSTREET, recently in charge of the Scranton district, Pennsylvania State Highway Department, has been appointed chief engineer of the Philadelphia district.

C. J. SWIFT has been appointed highway engineer of Blue Earth County, Minn.

E. F. MOORE, former business agent of the Hoisting and Portable Engineers' Union, has been appointed assistant chief engineer of the Sanitary District of Chicago. For the last five years he has been a member of the city board of examining engineers, which looks into the qualifications for stationary engineers. He has been in the employ of the various contractors in Chicago including the Foundation Company of Chicago, John Griffiths & Son Co., George B. Swift and W. J. Newman Co. For two years he was in charge of all mechanical equipment at the Mayfair shaft of the Wilson Avenue tunnel, which was built by day labor by the City of Chicago. He studied at Pauw University and also took a course in steam and electricity with the International Correspondence School.

EVERETT W. JENKINS, who has been connected with the engineering department of Worcester, Mass., for six years, has been appointed superintendent of streets in Quincy, Mass.

H. H. THURSTON, for the past year county highway engineer, Winona County, Minn., has resigned to enter business as a road contractor at Anoka, Minn.

FRANCIS M. HOWELL has been appointed special research assistant in engineering materials on the investigation of the fatigue of metals, College of Engineering, University of Illinois. From 1918 to 1920 he was assistant materials engineer with the Bureau of Construction and Repair of the Navy Department.

O. H. AMMANN, principal assistant engineer with Gustav Lindenthal, consulting engineer, has assumed the duties of assistant chief engineer of the Hudson River Bridge Co., of which Mr. Lindenthal is chief engineer.

CHADWICK & PIERCE is a firm of engineers and architects recently organized by Stanley H. Chadwick and Chauncey A. Pierce with offices in New York City.

JAMES ALLEN has been appointed supervisor of highways for the State of Washington.

R. C. SEMPLE, structural engineer, has opened offices in Seattle to engage in the designing, detailing, estimating and superintending of concrete and steel buildings. He was formerly with the Hofius Steel & Equipment Co., Seattle.

P. M. NICOLETT, recently engaged in supervising the construction of about 35 miles of federal and state aid road in Taylor County, Tex., has been appointed city engineer of Graham, Tex.

F. G. HERLIHY, formerly construction engineer with Winston Bros. Co., Minneapolis, Minn., has become general manager of the White Construction Co., Chicago. Under Mr. Herlihy's direction the White Construction Co., will extend its business from paving contracting to general contracting, giving particular attention to municipal work.

J. C. McElherne, for the past two years assistant engineer with the state highway commission at Rochester, Minn., has been appointed engineer of Rice County, Minn.

Frederick W. Sarr has been appointed first deputy highway commissioner, New York State Highway Department, by State Highway Commissioner Herbert S. Sisson. He was second deputy during Edwin Duffey's administration.

H. G. Hotchkiss, recently assistant engineer in the Rochester Division, New York State Highway Department for several years, has been appointed second deputy commissioner.

Ira Dye, formerly with the American Frog & Switch Co., Hamilton, Ohio, has opened an office for the practice of industrial engineering in Seattle, Wash

A. D. Perkins, Jr., for nine and one-half years in the construction department, Southern Ry. Co., and recently assistant engineer North Carolina State Highway Commission, has again entered the employ of the Southern Ry. Co. in charge of some survey work at the completion of which he will be located at Washington, D. C., headquarters.

Jacobson & Manske is a firm recently organized by F. H. Manske, contractor and engineer, and M. C. Jacobson, designer, to engage in contracting, engineering and designing work with offices in Wisconsin Rapids, Wis.

Wolf, Sexton, Harper & Truax is the name of a new partnership of engineers and architects in Chicago, organized by A. M. Wolf, civil and structural engineer, formerly with the Condron Co., F. A. Sexton, architect, L. M. Harper, mechanical engineer, and C. P. Truax, electrical engineer. The organization is prepared to handle all parts of the design of various types of structures.

B. L. Taylor has resigned as engineer of Woodbury County, Iowa, to enter general civil engineering practice, with offices in Sioux City, Iowa.

P. J. Preston, project manager U. S. Reclamation Service, Uncompahgre Project, Montrose, Col., has been transferred to the Yuma Project, succeeding W. W. Schlecht, resigned.

L. J. Foster, office engineer of the Denver office, U. S. Reclamation Service, has been appointed project manager U. S. Reclamation Service, Uncompahgre Project, Montrose, Col.

F. C. Dugan has been appointed state sanitary engineer of Kentucky, with headquarters at Louisville.

J. R. Bibbins, supervising engineer The Arnold Co., Chicago, has been appointed director of the new department of transportation and communication of the U. S. Chamber of Commerce in Washington, D. C., and will conclude his work in Chicago this month.

Lester C. Walker, from 1910 to 1920 with the Idaho Irrigation Co., Richfield, Idaho, as chief engineer in charge of all maintenance and operation, and recently with the U. S. Reclamation Service at American Falls, Idaho, is now watermaster for the Aberdeen-Springfield Canal Co., Aberdeen, Idaho, and has charge of all maintenance, operation and construction work for the company on a project of 65,000 acres.

R. D. McGill has been transferred from the Lincoln office of the Department of Public Works of Nebraska to Kimball, Neb., as project engineer in charge of federal aid project No. 16, consisting of 27 miles of earth road construction on the Kimball-Harrisburg highway.

C. C. McCamy has been appointed city engineer of Dalton, Ga.

E. Paul Ford, recently associated with David H. Ryan in the construction of county highways, has been appointed city engineer of East San Diego, Cal.

E. A. Moritz, engineer U. S. Reclamation Service, has resigned and his future address will be Effingham, Ill. He has been with the Reclamation Service since 1907 and his last assignment was project manager of the Flathead Project, Montana.

Lieut.-Col. Creswell Garlington, Corps of Engineers, U. S. A., has been designated to succeed Lieut.-Col. C. O. Sherrill as officer in charge of the fortification work in the office of the Chief of Engineers.

Y. M. Karekin has established temporary offices as consulting engineer in New York City. He was associated with the Westinghouse, Church, Kerr & Co. for fifteen years and with Dwight P. Robinson & Co. in the capacity of engineer in charge of industrial developments, especially railroad and terminal construction.

N. A. Eckart, formerly construction engineer in charge of the mountain division of the Hetch Hetchy Water Supply, with headquarters at Groveland, Cal., has been appointed chief assistant city engineer under City Engineer M. M. O'Shaughnessy.

Obituary

Charles W. Root, civil engineer, died Feb. 16 in Ashland, Ore. He was born in Mantua, Ohio, 1850. From 1881 to 1886 he was in the employ of the Oregon & California R.R. Later he served as locating and construction engineer with the Northern Pacific R.R., the Oregon Ry. & Navigation Co., the Fairbanks & Southern R.R. and the Western Pacific R.R. During 1904, on reconnaissance for the Washington State Highway Commission and also served in an engineering capacity with the Portland (Ore.) City Water Works.

Dr. Frank W. Gunsaulus, president of Armour Institute of Technology since its foundation more than 20 years ago, died suddenly March 17 in Chicago at the age of 65. He was considered one of Chicago's most noted clergymen, lecturers and educators.

Business Notes

The Meriwether Pressure Pipe Co. has been incorporated by Coleman Meriwether and associates with offices in the Board of Trade Building, Louisville, Ky., to manufacture reinforced concrete water pipe.

The Erie Ball Engine Co., Pittsburgh, Pa., has taken over the manufacture of Erie Ball engines, formerly made by the Ball Engine Co., Erie, Pa.

The Contractors and Dealers Exchange, New Orleans, at its annual meeting held Dec. 13, elected the following officers for the ensuing year: President, Robley S. Syearnes; vice-president, J. A. Hasse, Jr.; treasurer, W. W. Carre; secretary, H. W. Bond.

R. B. Murdock has resigned as executive engineer of the Asphalt Association and represents the F. D. Cummer & Son Co., manufacturer of asphalt paving plants and dryers, of Cleveland and New York. Mr. Murdock has offices at New York.

Drifting Sand Filters, Ltd., with head offices in the Harbor Commission Building, Toronto, Ont., has been incorporated at Ottawa, Ont., to take over the Canadian patent rights of the John VerMehr Engineering Co. of Toronto and to promote drifting-sand filters such as were built a few years ago to treat a large part of the water supply of Toronto, and are in use in a few other places in Canada and elsewhere. The officials of the company include: President, E. L. Cousins, general manager Toronto Harbor Commission; general manager, Charles J. Townsend of the Russell-Townsend Co., contractors; consulting engineers, Gore, Nasmith & Storrie.

The Austin Machinery Corp. of Louisiana, Inc., announces its incorporation as sole distributor for Louisiana, Arkansas, Mississippi and Tennessee of the products of the Austin Machinery Corp., manufacturers of contractors' equipment.

The T. L. Smith Co., whose general sales offices have been located at Old Colony Bldg., Chicago, have moved their entire organization and the personnel to Milwaukee, Wis., at the factories, 1125 32nd St.

Calder Committee Reports on Reconstruction

Puts Trust in Future in Governmental Investigations, Tax Revision and Bank-Loan Reform

Last year the United States Senate authorized the appointment of a committee "to inquire into the general building situation and to report such measures as may be deemed necessary to stimulate and foster the development of construction work in all its forms." This committee, composed of Senator Calder, chairman, and Senators Edge and Kenyon, had many hearings throughout the country. Its final report has just been made public.

The committee premises its report with a statement of the great depression in all construction, but devotes statistical attention only to the shortage in houses. Here it recognizes the untrustworthy character of the figures on building construction, but concludes that at the present rate of construction the country will be 2,000,000 "habitations" short in 1926. It records the primary causes of the shortage as governmental intervention due to the war, the rise in price in coal and transportation, the diversion of credit and the rigors of taxation. As secondary factors it lists labor and material costs, though the latter is manifestly a result of the stated primary causes. In the discussion of these features it devotes considerable space to statistical data on price and wage fluctuations.

The solution of the difficulties, according to the committee, lie in certain federal legislation which may be outlined as follows:

(1) A bill to establish in the Department of Commerce a division for the gathering and dissemination of information as to the best construction practices and methods, technical and cost data, and matters relating to city planning, etc., in order to encourage standardization and improved building practices throughout the country.

(2) A bill to provide for the gathering and publication by existing governmental agencies of current facts as to production, distribution, available supplies, standards of quality, costs and realization of coal.

(3) An amendment to the transportation act directing the Interstate Commerce Commission not to declare without hearings an emergency which will give preference of priority in transportation.

(4) An amendment to the Federal Reserve act to permit the Federal Reserve Board to direct the use of savings and time deposits of national banks for long-time loans, thus giving such deposits greater security and supplying a source of long-term money for home building.

(5) A home loan bank bill to provide for district home loan banks which may sell, under federal supervision, bonds secured by the aggregated loans deposited by the member banks.

(6) An amendment, limited to five years, to the revenue act of 1918, to provide for the exemption from excess profits and income taxes of the profits on the sales of dwelling houses where such profits, plus an equal amount, are reinvested in dwelling house construction.

(7) An amendment to the revenue act of 1918 to exempt from taxation interest on loans up to $40,000 on improved real estate used for dwelling purposes, when such loans are held by an individual.

(8) An amendment to the revenue act of 1918 limiting the taxation of profits from the sale of capital assets by providing for their taxation as of the years of accrual rather than as of the year of their sale.

(9) An amendment to the revenue act of 1918 to limit the surtax upon saved income to an amount not in excess of 20 per cent of such income.

(10) An amendment to the postal savings law increasing the limitation on deposits as to amount and time and authorizing the rate of interest to be changed from time to time and providing for compensation of postmasters for the extra duties.

The report recognizes the present system of taxation as an important factor but takes a firm stand against national, state or local governments attempting to relieve the housing situation by the granting of subsidies or by the erection of structures at governmental expense.

Priority orders, the report declares, have delayed the carriage of structural material and through delay rendered more hazardous and expensive building construction. As a means of decreasing or abolishing priority orders the committee suggests the amendment whereby the Interstate Commerce Commission may not declare, without hearing, an emergency which would give preference or priority to shipments.

Building Investigation Authorized by New Jersey Law

Authority for the Governor to appoint a commission for the investigation of alleged illegal combines operating to restrict building operation is aimed at in a bill recently passed by the New Jersey House of Assembly. The authority is contained in what is known as the Taylor resolution.

St. Paul Labor Bodies Plan to Enter Contracting

Through the incorporation of the "Central Board of Trade," the St. Paul (Minn.) Trades and Labor Assembly plans to enter the contracting business. Articles of incorporation will include two subsidiary organizations: one to direct construction and the other to purchase materials. The new organization expects to be able to bid sucessfully on several municipal contracts to be let this summer, according to press dispatches.

Construction Probe in Illinois

The Illinois State Legislature has appointed a committee of seven Senators and seven Representatives, headed by Senator John M. Dailey, to investigate alleged secret agreements, price "rings" and "hold up labor tactics" in the building construction industry in Cook County. It has long been claimed that so-called labor agreements exist which effectually shut out all building materials not produced by members of the "ring" and that various abuses have been practiced rivaling or exceeding these disclosed by the Lockwood Committee in New York. Sittings of the committee began Friday, March 25.

It is planned for the work to proceed in co-operation with the States Attorney's office, the Chicago Police Department and the United States Department of Justice, that criminal proceedings may be taken at once should anything actionable be disclosed. The committee is armed with full authority to subpœna witnesses and compel the production of any records and papers it may wish to examine. Regardless of the ultimate findings of the investigation, it is intended to either give the industry a clean bill or eradicate any abuses, and thereby encourage prospective builders who may now be holding back because of reported wrongful practices in effect in the construction field.

Tug Strike in New York Called Off at Federal Request

At the solicitation of the United States Department of Labor the strike of the tugboat workers in the coastwise and Sound trade at New York City, a strike which was called by the unions of masters, mates, pilots and engineers as the result of a wage cut put into effect by the United Coast Tow Boat Association, was called off on March 25 by the union leaders. A committee on conciliation has been assigned by the Department of Labor to inquire into the differences between the association and the tugboat workers.

To Put New York Barge Canal on Businesslike Basis

A newly organized association entitled "Great Lakes-Hudson and Atlantic Waterways Association, Inc.," with offices at the National Marine League, 268 Pearl St., New York City, intends to educate the shipping public in the State of New York to the use of the New York State Barge Canal as a freight carrier. The association is made up of men interested in maritime and canal affairs in the state and has in it a number of the representatives of a number of the companies which operate barges on the canal. A committee is devising ways and means whereby barge lines can maintain regular schedules, issue through bills of lading to foreign ports from inland cities, adopt uniform rates, prepare official classifications of freight, and give shippers guarantees of good faith.

Canvass of Highway Bond Issues

State and county highway bond issues authorized between Jan. 1, 1919, and Dec. 31, 1920, including Illinois and Pennsylvania State bond issues voted in 1918, total $998,953,140, according to the results of a recent survey by the Portland Cement Association. Of the total amount, bonds in the sum of $594,132,072 were authorized prior to Dec. 31, 1919, and the remainder, $404,821,068 were authorized in 1920. Of all the states listed Minnesota leads with a total of $117,000,000 worth of bonds. Texas comes second with about $98,000,000, and Pennsylvania third with $81,000,000.

Jersey Shafts of Vehicle Tubes Held Up

The New York-New Jersey Tunnel Commissions have rescinded their call for bids for the Jersey ventilating shafts of the Hudson River vehicular tunnel, which were to have been opened March 29.

Builders Announce Wage Cuts in Many Localities

Wage cuts in the building trades, to become effective this spring, are being announced in many localities. The Building Trades Employers Association of Essex County, N. J., has announced a reduction averaging 10 to 20 per cent to take effect May 1, but wages of carpenters, painters, and decorators are to remain the same. Bricklayers, masons, plasterers, sheet metal workers, steamfitters' helpers, plumbers, metal lathers, wood lathers, mill workers, hod carriers and mason laborers will be subject to wage reductions, according to announcement of the association.

The general labor committee of the Associated Building Contractors of Indiana has proposed wage reductions in the building trades of 15 to 20 per cent. At Toledo, Ohio, the Contractors Association has outlined possible reductions of wages in the building trades of 35 per cent.

A statement issued by the Building Trades Employers Association of Worcester, Mass., last week indicates that the association intends to substantiate its original decision for a 20 per cent decrease in wages. At Rochester, N. Y., negotiations have been entered into between contractors and representatives of the building trades unions for a reduction of 15 per cent in wages.

The Master Builders Association at Denver, Col., has filed a notice of wage reductions averaging about 20 per cent. It is reported from Sacramento, Cal., that the Master Builders Association has undertaken to remove union restrictions and effect wage reductions.

At Harrisburg, Pa., the Building Trades Council [labor organization] has adopted resolutions demanding an increase in wages for plumbers, plumbers' helpers, carpenters and structural iron workers to take effect May 1.

Southern Pine Association Meeting in New Orleans

Announcement has been made that the sixth annual meeting of the Southern Pine Association will be held at the Grunewald Hotel, New Orleans, La., April 5-6. In addition to the usual trade subjects, the program will contain some matters of general industrial interest such as a paper entitled "Engineering Problems Affecting the Use of Southern Pine" by George E. Strehan, "The Architects Small House Service Bureau" by E. H. Brown, and "The Freight Rate Situation" by A. G. T. Moore. Considerable attention will be paid to the matter of governmental interference in business and the legality of the trade association.

California Bridge Contract Lower Than Estimate

Bids opened March 22 by the California State Highway Commission on the Feather River bridge showed a low bid of $157,647, which is about $92,000 less than the commission's estimate, $259,700, made about eight months ago. There were a great number of bidders on the job. Rumors were abroad at the letting that a number of the bidders put in figures only slightly above the actual net cost of the work at present prices. It is thought in California that the labor situation is clearing up. There is a very decided tendency toward lower wages, and an abundance of labor is in sight.

National Board Allocates Metal Sash and Door Work

Decisions allocating metal sash and door work between individual unions have been made by the National Board for Jurisdictional Awards as follows:

In the matter of the controversy between the International Association of Bridge and Structural Iron Workers and the Amalgamated Sheet Metal Workers' International Alliance relative to Hollow Metal Doors and Trim it is decided that the erection of hollow metal doors, made entirely of ten gage metal or lighter, except for local reinforcement, and the installation of the door frames and trim in direct connection with such doors is the work of the Sheet Metal Workers; except that in the case of sliding doors, street entrance and vestibule doors, elevator, shipping room and freight doors, and doors used exclusively for fire purposes the work is that of the Iron Workers. Kalamein or other wood-core doors are not covered by this decision.

The erection of metal partitions of ten gage metal or lighter, unless the structural [illegible] partitions consists of rolled shapes or drawn tubing, is the work of the Sheet Metal Workers. In other cases it is the work of the Iron Workers.

In the matter of the controversy between the Amalgamated Sheet Metal Workers' International Alliance and International Association of Bridge and Structural Iron Workers over Hollow Sheet Metal Window Frames and Sash it is decided that the [illegible] of hollow metal window frames and the hanging of hollow metal sash, when [illegible] is assigned to the Iron Workers.

In the matter of the controversy between the Amalgamated Sheet Metal Workers' International Alliance and International Association of Bridge and Structural Iron Workers over Hollow Metal Door Frames and Trim it is decided that the work in question is assigned to the Carpenters.

Conditions in the Northwest Lumber Industry

A wage reduction of 12½ per cent in all building trades in Oregon and Washington, to take effect beginning May 1, was agreed upon at a meeting early in March in Spokane attended by representatives of the Contractors' Association and the Master Builders' Association. This action is reported to have the approval of labor organizations in both Oregon and Washington. The Loyal Legion of Loggers and Lumbermen has also agreed to reduce the daily wage basis to $3.60 per 8 hours. These wage reductions are expected to increase the demands for lumber and to improve the situation in the lumber industry generally. Cedar lumber is being sold in the Northwest for $9.00 to $10.00 per thousand, which is said to be only one-third to one-quarter the cost of production. Many lumber mills are shut down. The West Coast Lumbermen's Association is now advertising the fact that 60 per cent of the wages in Oregon and Washington are paid by the lumber industry and that that industry is in the advantageous position of having already "taken its deflation to pre-war level."

When the lumber mills reopen and the industry resumes its normal tone, a brisk demand for equipment and machinery used is expected because of the many replacements which will be required. Boilers are mentioned particularly as an item in which there has been much trading in second-hand and inferior equipment that will require renewal. Only a very small percentage of the mills have thus far been equipped with hogs for working up the mill scrap, and there will be the usual demand for donkey engines, hoists, cable and rigging of all sorts.

On the whole, and despite the present period of comparative inactivity, it is notable that reports from the Northwest contain many notes of optimism and refer to a considerable number of inquiries and prospective industrial development.

Wage Cut Agreement Averts Packing Industry Strike

The strike in the packing industry, threatened by refusal of the unions to accept wage reductions proposed by the packers, has been averted by an agreement made in Washington March 28 through the mediation of Secretaries Hoover, Wallace and Davis. The agreement, issued in the form of letters from both sides addressed to Secretary Davis, provides wage cuts of 8 cents per hour and for piece work scales a cut of 12½ per cent. The eight-hour day is held to be the basic working period. The agreement is binding until Sept. 15, 1921, leaving in effect the agreement of Dec. 25, 1917, except as now modified by the committee holding both sides to the decisions of Judge Samuel Alschaler.

Following the agreement, Redmond S. Brennan, a representative of the em-

ployees, praised the efforts of the three cabinet members in bringing about conciliation. "In the past," said Mr. Brennan, "I have never considered Herbert Hoover friendly toward labor, but I was gratified at the way in which he grasped the justice of our claims. He showed a remarkable knowledge of industrial principles and an accurate acquaintance with economic conditions."

It is thought in some quarters that the agreement will be only temporary, and that either side may take advantage of the Sept. 1 time limit to push its claims further.

New Track Anchors

To prevent creeping of rails and ties a device is being introduced which consists of a flat steel bar long enough to extend over six or eight ties and having holes for spikes. The bar is placed outside the rails, with its front portion, in the direction of creeping, spiked to the two joint ties and the remainder spiked to the next ties behind the joint. Thus the six or eight ties are connected to form one unit. Tie spacers may be used also, the spacer being a ⅜-in. square bar bent to form a channel 20 x 3½ in. The ends of the 3½-in. legs are chisel pointed, to be driven into two adjacent ties. These devices are being introduced by the Track Specialties Co., New York.

Holding Companies May Be Barred From Louisiana

An ordinance has been introduced in the state constitutional convention in Louisiana which provides that corporations whose main business is to own stock in other corporations are prohibited from incorporating and doing business in the State of Louisiana and are declared to be illegal.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 3; the next, on April 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.58	$4.25	$3.75	$3 58	$3 86	$5 90	$4.70	$5.00	$5.00
Structural rivets, 100 lb	5.08	.....	7.05	5.08	5.50	6.90	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.48	3.75	3.85	3.48	3.88½	4.37½	3.00	4.50	4.25
Steel pipe, black, 2½ to 6 in. lap, discount	39%	45.65–5%	40@45%	53½%	46.9–5%	29@33%	36¾@42¾%	40%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	64.00	66.20	64.10	67.80	70.00	87.65	75.00	80.00
Concreting Material:									
Cement without bags, bbl	3 10 (del.)	3 00	2.85	2.17	2.60	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2 50	2 62½	1.75	2 75	2.00	2 50	2.50	1.50	1.50
Sand, cu.yd	1.25	1.52½	1.75	2.75	.75	1.10	1.65	1.50	1.50
Crushed stone, ¾ in., cu.yd	2.15	2.50	3.20	2.75	2.25	3.50	2.50	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	35.00	45.00	53.00	41.00	47.00	27.00	35.00	120.00
Lime, finished, hydrated, ton	21.00	18.00	25.00	20.00	29.00	32.00	25.40	27.00	30.00
Lime common, lump, 200 lb. bbl	3 30	2 00	2 50	1.65	2.00	3.20	2.25	3.25	16.00
Common brick, delivered, 1,000	21.70	12.00	25.00	15.00	18.00	16.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	0.14	0.21	.12	.06	.11	.12½	.13	.25
Hollow partition tile 4x12x12, block	....	.15	.19½	.108	.....	.11	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.73	.74	.88	.82	.78	.95	.79	.79	.98
Common labor, union, hour	.75%.80	.35	.60@1.00	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non union, hour	.....	.25	.40@.60	.50	.50	.37½@.50	.50@.55	.50	.30@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. **New York** quotations are at warehouse, except cement and brick, which are delivered, and tile, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses, except C. I. pipe, which is mill price, plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

While the net price of cement delivered in New York remains $3.10, the charge for bags has been reduced from $1 per bbl. to 40c. The full line of steel prices at warehouse is expected to change this week, the new schedule to be announced in *Engineering News-Record* of Apr. 7.

While, at present, the New Orleans market is not quoted weekly, reports show decreases in the prices of pine lumber, cement, brick, sand, gravel and wood blocks. Rough boards are down $10, the present level being $55 per M. ft. b.m.; 2-in. tongue-and-grooved is down $5; 8 x 8s down $3; 12 x 12s down $4. Small demand has caused this decrease, and a better market is not expected until July, according to a large dealer. Gravel is down 15c., to $2.85; sand down 10c., to $1.65; common brick down $2.50, to $21.50 per 1,000; cement down 24c., to $3.36, net. This general decline is attributed to "reduced costs." Wood blocks are off sharply: 3-in. now sells for $1.88 per sq.yd., against $2.99 a month ago; 3½-in., $2.24, against $3.42; 4-in., $2.56, against $3.85. The explanation is the reduced costs of lumber, creosote oil and labor.

Labor Conditions

San Francisco reports labor of all classes plentiful and a feeling in business circles that general conditions will soon improve. Unemployment in Denver has been reduced 10 per cent in the building trades; wage reductions generally accepted, except by bricklayers and carpenters, who threaten to strike on Apr. 1. A greatly reduced scale is expected to be announced in Montreal on Apr. 1. In New Orleans the present scale will be maintained until June. The controversy between the Metal Employers' Association and the metal Workers' Union was not decided on Mar. 15, as was expected, but was postponed until Apr. 1. The points at issue are: 48-hour week, instead of present 44-hour; 10 per cent wage reduction; elimination of double shift with extra pay. The workers have practically agreed to the first two conditions, but are contesting the third. No changes in construction-labor rates.

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E. J. MEHREN Editor

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Is Engineering a Business or a Profession?

IS ENGINEERING a business or a profession? That, as we see it, is the essence of the controversy in New York State regarding engineering practice by corporations and unrestricted partnerships (those having non-engineers as members).

If a corporation composed in part of non-engineers is permitted to use the designation "engineers," then non-engineers are legally given the status of engineers, which not only is a negation of the fundamental purpose of the licensing law but thwarts the efforts of more than two generations to put engineers on a professional plane. The law would not only refuse to restrict engineering practice to those qualified for it, but would explicitly sanction practice by non-engineers so long as they hired engineers to work for them.

Equally contradictory and destructive is legal sanction of practice by "B and C, engineers," a partnership in which B is an engineer and C is not. C would be given an engineer's status by the very law which forbids him to practice as an individual.

The legal profession has appreciated these contradictions and the law, therefore, permits only those legal partnerships in which *all* the members of the partnership are members of the bar, and forbids entirely practice by corporations.

In the New York controversy the opponents of corporative practice did not declare their approval of partnerships composed wholly of engineers and thus allowed an erroneous impression of their position to get abroad. Should corporations and unrestricted partnerships be prohibited from practicing, the law would require amendment explicitly permitting practice by wholly engineering partnerships.

The issue is plainly a fundamental one. As Colonel Wilgus said in his letter in the issue of March 24, we are "at the parting of the ways." To which side shall we go? The way to the left leads backward, against the direction in which engineers, with unselfish devotion, have been aspiring for generations.

Guessing at the Traffic Problem

TRAFFIC congestion held a prominent place at a recent meeting of the New York Section of the American Society of Civil Engineers. The character of the discussion furnished further corroboration of the views frequently urged by *Engineering News-Record*, that traffic control, regulation and facilitation are among the chief municipal engineering problems of the day.

The opening paper, read by Charles W. Leavitt, made the radical proposal that the dense north-and-south traffic of New York City be handled in part on elevated expressways cutting through the built-up blocks between the principal avenues, with vehicular tunnels under Central Park on certain of the lines. The proposal can hardly have been made seriously. We take it that Mr. Leavitt suggested a "shocker" to awaken New York to the growing seriousness of the problem. Amos Schaeffer, consulting engineer to the Borough President of Manhattan, estimated the cost of the Leavitt scheme at between $1,365,000,000 and $1,800,000,000, the higher figure being more than the city's bonded indebtedness of $1,589,000,000. Of course, the whole plan could not be taken in hand at once, but even so its proposal is so far ahead of the times as to warrant little consideration.

What is notable, though, and deserving of emphasis, is that Mr. Leavitt's paper and Mr. Schaeffer's rejoinder indicated that no adequate studies had been made either of the traffic or of means of providing for and controlling it. Under such circumstances it is not possible to propound a solution that will carry confidence. It will be a costly procedure to get the facts, but they must be obtained and the sooner the better. Some traffic studies have been made by the city on main avenues, by the vehicular tunnel commissions in lower Manhattan, by railroad agencies in connection with "store-door delivery." But these are fragmentary. A thorough study is needed.

What is the character and volume of traffic on each avenue? What changes on certain less-traveled avenues would tempt traffic from the heavily congested routes? Is there a large number of "light" trips that would be eliminated by "store-door" delivery, such as is being urged on the railways? What is the relation of traffic delay on the avenues to volume and character of cross-town traffic? These are but a few of the questions that need answer. When full data are in hand we may proceed to arrive at an intelligent solution of the traffic problem but not before. Engineers have a responsibility in advancing the day when the data will be secured.

Federal Inquiry on Roads

DUE to recent disclosures regarding highway conditions in Arkansas, made by the Federal Bureau of Public Roads and in articles in the New York *Times*, there is talk in Washington of a senatorial investigation of federal-aid roadbuilding. Senator King of Utah has announced that he will introduce an appropriate resolution.

While there will be objections to such an investigation we believe that in the sum total it would do much good. It would undoubtedly result in giving the Bureau of Public Roads greater authority in designating where the federal funds are to be spent. Despite the efforts of the bureau to put the money on important links of through routes, certain states have succeeded in having the funds spent on odd stretches of road. This has been due, in part, to the vicious system by which

some states have forced the counties to match the federal funds. That practice should be forbidden by law, and such prohibition would probably be one of the results of an investigation. Other benefits that could be counted on would be still greater federal authority to force the organization of adequate state highway departments and the beginning of that which the bureau has consistently advocated—the classification of roads in order that there may be a sure basis for the economical expenditure of federal and state funds.

Moreover, from the mere standpoint of satisfying the public that the government investment of over $200,000,000 in roads is wise, the inquiry might be worth while. It is, of course, too early to pass judgment on the disposition of the whole of that amount, but an idea of the soundness of policies can be gained.

The inquiry would necessarily involve, also, consideration of financing by states and counties to meet the federal funds. There is not a man with good financial sense who has not entertained doubt as to the wisdom of the epidemic of $50,000,000 bond issues. The construction efficiency of the expenditures is not the prime matter at stake, but whether, in view of the rapidly mounting tax rates of recent years, every part of the country is warranted in making heavy expenditures, even though there will be large transportation benefits. A $100,000,000 bond issue in one state may be thoroughly sound, while an issue of $25,000,000 in another may not be defensible.

We entertain no illusions as to the efficacy of senatorial investigations. They can be excellent mediums for the spreading of misinformation, but by and large the highway improvement program is so sound that it can afford to take the chances involved in exchange for the benefits that are quite certain to accrue.

Legislation Will Not Build Homes

BOTH the multiplicity and the indirection of the legislative remedies for the housing shortage proposed by the Calder Committee, as announced in these columns last week, point to the futility of trying to solve this problem by legislative means. Here was an able committee, with all the expert aid the government commands, which after months of study, travel and hearings, could only suggest a number of roundabout tax schemes to produce the millions of houses that would have been built had not the war wrecked the world. The plain fact that a number of people are trying to dodge is that home building will not speed up until prices and wages come down. There is no use blinking this fact nor to try to argue oneself out of the situation by resort to economic theory or psychologic imaginings.

The case of the residence is fairly simple. According to the sociologist and statistician a week's wages makes a fair month's housing charge for the individual, whatever his income. Before the war then, when money was around 5 per cent, taxes 1 per cent, and maintenance and repairs 2 per cent, and assuming heat, light and other current expenses to be 10 per cent of the building charges, a man could afford to own a house valued at 130 times his weekly salary—a $1,200 man could own a $3,000 house, a $5,000 man could own a $13,000 house. Today these same houses cost twice as much to build and the charges add up roughly to 12 per cent, say 6 per cent for interest, 2½ per cent for taxes, and 3½ per cent for maintenance, so that, sticking to the same standard of living—a week's salary for a month's rent—the rental has tripled and the man who would build or rent the $3,000 house of 1914 must have an income of $3,600 a year and he who builds or rents the $13,000 house of that time must now draw annually $15,000. Wages and salaries have gone up since 1914, to be sure, but in no such proportion as this for the average man. What has happened is that the average standard of housing has gone down and *must stay down* until costs fall.

The tax and loan reforms suggested by the Calder Committee and those put into force in some places, notably New York City, have some effect on group housing (such as apartment buildings), which is a matter of large financing, but they cannot solve the entire problem because all they do is to reduce by a small percentage the charges against the actual cost of housing. In other words they tend to lower the 12 per cent, which has been boosted from the 8 per cent of seven years ago, but they lower that only a small amount and they lower not at all the actual cost of building, which is the main item in the increased burden of housing. Until this actual cost begins to drop, so that the relation between income and house expense more nearly approaches the earlier figure, people will continue to live in their cramped quarters to which high rent charges have brought them. All the estimates of a shortage of a million houses, which is so often held to indicate, of itself, the necessary imminence of a building boom, will continue to mean nothing. The people of Austria and China are short of food, but that deplorable fact does not automatically feed them.

Proposed Constitution of Civil Engineers

FOR some weeks the proposed revised constitution of the American Society of Civil Engineers has been in the hands of the members for study. The important revisions are confined to a relatively few items. This is a wise course, and in the interest of an early termination of discussion on internal affairs.

It became apparent last year that there were two points upon which the majority of members were agreed: (1) That the local sections should be strengthened, and (2) that directors be elected by districts. With the latter was coupled in many quarters a demand that (3) there be a proportionate representation in the directorate. These three points have been, wholly or in part, met in the proposed revision.

The locals have been given a constitutional status, and the board is authorized to contribute up to $3 per member to their support. The provisions do not seem wholly to meet the situation. The local sections in the past have been step-children. Their position is changed somewhat by the proposed revision, but to assure constant and adequate thought on their development, there must be explicit machinery for considering their problems. The least that could be done would be to establish a standing committee on local sections. An amendment to that effect is called for. The authorization of such a committee should not be left to the discretion of the board, but be made mandatory.

Representation on the board would, under the revision, be in proportion to district membership, a proposal to be heartily commended. New York's nine members would be reduced to four. The constant shifting of district boundaries, however, is not desirable.

The method of nomination proposed is a primary system with two letter ballots. This is in accord with

the principle, which has widespread support, that there should be a more democratic method of selecting officers. The primary system, while it would seem to have the disadvantage of not affording discussion of the qualifications of candidates, does not, in reality, bar such discussion. It would throw it into the sections. Without a doubt some systematic method of section functioning in nominations would develop as an extra-constitutional procedure.

The proposed election procedure departs sharply from the clearly expressed demand that directors be elected by their respective districts. That demand, however, cannot, under the society's charter, be satisfied and must be dismissed as impossible, unless the trustees and directors be made separate bodies, obviously a cumbersome arrangement. But the law does not forbid the *nomination* of directors by the respective districts. The proposed constitution says that corporate members in zones and districts are "expected" to submit names for the respective vice-presidential and directorship nominees. This is not sufficient. The constitution should state explicitly that only members of a district may participate in the nomination of a director for that district and only members of a given zone for the vice-presidential representative of that zone.

An obvious objection to the method of nomination is that it spreads the election of officers of the society over 9½ months. One election would be concluded in January, and the machinery for the next election would start 2½ months later. However, if a primary system by letter ballot be accepted, it does not seem feasible to shorten this to a material extent. The months of July and August are not conducive to effective society activity. This long drawn out procedure may eventually cause the elimination of one of the primary ballots and the substitution therefor of suggestions by the sections. This would also tend to strengthen the position of the sections.

Within the limits set by adherence to the present fundamental conception of the society, the revisions strike us, on the whole, as being satisfactory. In the essential points they touch only on matters on which thought has been crystallized. In thus limiting the revision, the committee has sensed the need for getting the constitution out of the way quickly and allowing the society to settle down to technical work.

Work Ahead

BEFORE the country's highway system will be adjusted to the loads and speeds of modern power-vehicle traffic, hundreds of thousands of road bridges will have to be made strong enough to carry this traffic. It is going to be an undertaking of tremendous size, mainly in point of money an time required, though it has also many engineering difficulties. Something has been done during the last ten or a dozen years, but it is little in comparison with the total to be accomplished. The bulk of the work is ahead of us.

Some states have been far-seeing and fairly active in bridge modernization, but the larger number have spent almost all of their available road moneys on hard surfacing. At best only the structures on main roads have been dealt with, the byroad being left practically out of the reckoning. Unfortunately the motor truck does not stick to the main roads but goes where its business calls it. The problem grows out of this fact and out of the impossibility of carrying twelve to twenty-ton traffic on five or ten-ton bridges. With insignificant exceptions the bridges are a generation behind the road itself.

Amid the general clamor for extension of hard surfacing, it has not seemed possible to get a hearing for demands that great sums ought to be spent on the bridges. Citizens and legislators can hardly be expected to understand such demands until a succession of disastrous wrecks convinces them—or until engineers, who know the situation, make organized effort to bring the facts home. When the wrecks come it will be too late. Bridge improvement is a matter of years. Hence the necessity for awakening the public without further delay; and hence also an opportunity and a responsibility for our profession.

Evidence that engineers are thinking about the highway bridge problems is found in several articles in this issue, dealing with loads, impact and reinforcement. Such thinking means progress in preparing for the big program ahead. It means also that the subordination of the highway bridge to the railway bridge is nearing its end, and the individuality of the former recognized.

Considered as a transportation machine the highway system differs from the railway in this important respect, among others: roadbed and rolling stock of the highway are under separate control, while those of the railway are under unified control. In the case of the highway thousands of independent highway users play a part in fixing the future of the traffic, not merely as to amount and distribution but also as to loads, types of vehicle and motive power. In consequence, there has been constant flux in the technical fundamentals of pavement construction. For the same reason the bridge problem, which involves safety to life and limb, is a matter of wise judgment, and a fair amount of prophetic gift must be brought into play in dealing with it. Paraphrasing what Mr. Moore says (on page 580), those who build or rebuild with too little vision will see their successors do their work over.

Months ago *Engineering News-Record* pointed out the critical nature of the existing situation, and urged the need of concerted, purposeful action. We proposed that action be taken to set a limit on loads and speeds of power vehicles, in order to maintain conditions within reasonable bounds of safety, pending more thoroughgoing steps to co-ordinate bridges and traffic. The argument is similar to that so frequently urged here and elsewhere for traffic regulation. It is essential that, by systematic effort, the public be awakened to an understanding of highway bridge facts, and thereby stirred to action.

Through their widespread organization in technical and professional societies, engineers have a potential influence larger than they have perhaps realized as yet, large enough, in any event, to enable them to make a first step in the direction indicated. They can, we feel sure, by clear and convincing presentment of facts to the authorities secure the official designation of an engineering commission which, in co-operation with the state highway authorities, would survey the actual condition of bridges and traffic and determine in plain view of the public what dangers and what needs exist. Public service of this kind would supply a broad foundation for further efforts in many directions, extending if need be even to appeal to the authorities for closing of bridges or restriction of traffic, until bridge modernization becomes part of the public program.

Making Highway Bridges Safe for Modern Traffic

A Discussion of Loads, Impact Allowance, Floor Strength and Other Factors of Safe Design and Maintenance, with Emphasis on Need for Developing By-Roads and Providing for Future

By Lewis E. Moore
Bridge and Signal Engineer, Massachusetts Department of Public Utilities, Boston, Mass.

UNDER the changing traffic conditions created by the increase of motor vehicles, the problem of making our highway bridges adequately safe is an exceedingly live one. Despite its financial and engineering difficulties it demands prompt attention; we cannot continue to neglect it in the comfortable hope of getting by somehow and shifting the responsibility to succeeding generations.

There has been considerable divergence of publicly expressed opinion on many of the engineering questions involved, and therefore I offer the following comments from the standpoint of eighteen years' experience in both civil and military practice, the former largely in Massachusetts, covering railroad, street railway and highway bridges, the latter principally in France; with the intention of indicating the features which appear to possess paramount importance.

Loadings for Design

Loading is a primary problem. In 1915, when rewriting the "Specifications for Highway Bridges Carrying Electric Railways" issued by the Massachusetts Public Service Commission, I abandoned the 15-ton traction engine formerly used in favor of a 20-ton (gross weight) truck with 14 tons on one axle, wheels 6 ft. apart, axles 12 ft. apart. These specifications were so drawn that they could be used for purely highway bridges, and all experience since then has shown their value for present-day bridge service. The truck specified was required for all localities, even outlying territory on secondary roads, because it was felt that railroads and street railways would not build new branch lines to any extent in the future (at least in New England) and that the motor truck would be used for heavy transportation into remote districts. Trucks weighing 18 tons have been operated on the highways of Massachusetts within my own experience.

The need of good bridges on by-roads should be emphasized, as it is entirely possible that good bridges, by making it possible to drag heavy loads into remote places, may actually aid in the useful development of unused localities. Further, when repairs to main roads are under way, the by-road, used as a detour, must carry the heavy main-road traffic. Travel on one of the two main east-and-west roads in Massachusetts was greatly discommoded not long since because, while a bridge on the main road over a railroad was being replaced, an inadequate bridge on the most available detour failed under a truck.

Motor traffic loads give heavy concentrations on individual trucks, but owing to the dimensions of the trucks and to traffic conditions these concentrations are not as a rule unduly close together. The 20-ton truck above mentioned, if assumed to occupy a width of 10 ft. and a length extending 10 ft. both in front of the front axle and behind the rear axle, or, in other words, an area of 10 x 32 ft., will cover 320 sq.ft. of roadway. The average load over this area is only 125 lb. per sq.ft. Herein lies the explanation of the relative frequency of floor failures and infrequency of truss failures in old bridges. The design loading, then, should comprise a heavy concentration or concentrations for the flooring, stringers and floorbeams, and a uniform load, say of 100 or 125 lb. per sq.ft., for the trusses, *using also*, however, a single excess load for the trusses, which may be placed anywhere and which is equal to the difference between the end shear on the floorbeam produced by the concentrated live loading and that produced by the uniform live loading. The use of this excess load will insure that all the details of the truss, such as hangers, will support the maximum load which the floor can carry; and at the same time will avoid the needlessly heavy truss which would result from using maximum floorbeam reactions at all panel points at once.

The importance of military loads should not be underestimated; we must not dismiss possible military necessity completely from our calculations as we did before the existing war. Axle loads up to 40 tons are now contemplated. Such a load can safely be carried on a bridge designed for a 20-ton auto truck with 14 tons on one axle, if the design is made with 50 per cent impact allowance.

Will Loads Increase?

It seems possible that the trailer will come into greater use in the future; such extension is the natural consequence of a desire for more economical transportation. Tractive force is a necessity if trailers are to be hauled and it can only be gained by weight on the driving wheels of the tractor. This fact will exert its influence toward increasing wheel loads. Whether the caterpillar tractor, which distributes its load over a considerable area, will prove to have a very wide field of usefulness on surfaced roads is an open question, and discussion of it is beyond the scope of the present article.

To say that the limit of weight has been reached would be as rash a prophecy as the one made in some quarters ten years or more ago that the locomotives and cars on the railroads had reached their maximum size and weight. Heavier unit loads have proved more economical on the railroads, and it is very likely that the same will hold true on the highways. Highway surfaces will continue to improve and loads will continue to increase. Restrictive legislation will be repealed as transportation demands increase, and the man who designs bridges today for light loads will see someone else rebuild them tomorrow because of their inadequacy. Inadequate bridges were not permitted to hinder the development of the full capacity of the railroads, and neither will they be allowed to block similar development of the highways.

Fortunately there have been no bridge failures due

to structural weakness in bridges under the jurisdiction of this department since its organization in 1887. The fact that other classes of highway accidents are more numerous than bridge accidents does not condone or excuse the latter, and inspection to maintain safe conditions is of prime importance.

Wooden bridges can be inspected as effectively as those of other types by taking sufficient pains. I take decided issue with the statement made by one writer that it is beyond the power of any man to say whether or not an old timber truss bridge is safe. Any experienced bridge man of good judgment, with a hammer, a ¼-in. auger, reasonable patience and some elbow-grease can determine that matter without any doubt whatever.

Generally, the weak part of the floor under modern truck loads is as a rule the floorbeam. Wooden plank floors of the ordinary construction are proving to be inadequate to sustain the heavy concentrated loads now met with. Cases of the breaking of such flooring are increasing in frequency. Owing to the increasing cost of lumber, its decreasing longevity, its perishable character and its continual decrease of strength during its life, it is very doubtful if plank floors are now economical, at any rate east of the Rocky Mountains. The wooden stringer, for similar reasons, is giving way to the steel I-beam.

Failures of steel I-beams are generally due to crippling of the web, and I have seen beams bent to an S-shaped cross-section by overloading. A point to be kept in mind in designing I-beam stringers is that they need stiffeners at points of concentrated loading and at reactions just as much as plate girders do. Many designers seem to assume that because the flange and web are rolled out of the same material with no riveting, stiffeners at once become unnecessary. Frequent cases of crippled I-beams indicate the fallaciousness of this convenient lack of reasoning.

Preferable Types

For truss bridges a 6-in. concrete slab floor, heavy steel stringers and floorbeams and a moderate truss give an entirely adequate and reasonably economical structure.

The masonry (I include reinforced concrete) arch is a structure whose real possibilities are not generally realized. The distributed live-load capacity of an arch ring with sound abutments is practically unlimited. It seems therefore undesirable, whenever it can be avoided, to place a superstructure of beams whose capacity is decidedly limited on top of an arch ring of practically unlimited strength. European engineers would probably use an arch superstructure in such a case, and we may profitably learn from them.

When *financially* practicable, I always recommend an earth-filled concrete arch, because of its unlimited live-load capacity and because it needs no maintenance other than that given to the highway surface. Most highway bridges get no maintenance anyway, so it is just as well to build a type that can safely be neglected.

The idea that smooth rubber tires tend very much to decrease impact is, I believe, erroneous. The development of the theory of impact today is away from the single-blow idea and toward that of vibration. The great vibration of bridges under rubber-tired traffic is a matter to which I have given close attention for the past five or six years. The result of my observation has been that an ordinary pleasure automobile weighing perhaps two tons will produce far more severe vibration in a bridge than will a 30-ton trolley car. I have spent days in the field verifying this observation and am sure of the correctness of the conclusion.

While no actual measurements of the amount of the impact were made, the study led to the use of a 50 per cent impact allowance for trucks in the above-mentioned specifications and a continuance of the 25 per cent impact allowance formerly used for trolley cars.

While abroad I found that some British engineers had reached the same impact allowance (50 per cent) at practically the same time and by substantially the same course of reasoning.

Repair and Reinforcement

The matter of repairing and strengthening corroded and weak structures is bound to be of increasing importance in the future. Many methods need to be employed, and the subject is worth detail treatment in a separate discussion.

To illustrate the fact that simple expedients often suffice, it may be mentioned that in three cases, one of them a wooden truss, wooden stringers which rested on top of the floorbeams were replaced at my suggestion by Bethlehem H-sections extending continuously through the whole span and of sufficient strength to sustain their proportion of the live load for the full span even if all the rest of the bridge should fall away from them. In one of these cases two successive 55-ft. spans of very light steel construction were reinforced in this way, with the result that the life of the old bridge has been indefinitely prolonged.

Sometimes a center truss under the floorbeams will cheaply reinforce weak beams. It is easy to say "new bridge" in such a case but proper study and the exercise of a little ingenuity may economically prolong the life of an old structure very considerably at far less than the cost of a new bridge.

Federal-Aid Highway Work in Missouri

Thirty-nine contracts aggregating in value approximately $6,500,000 and entailing the construction of 351 mi. of highway have been entered into by the Missouri State Highway Department for the construction of Federal-aid projects. The largest number of projects involving the greatest expense in construction are located in Division 1. In this division, eleven projects total $2,687,616 for 81.1 mi. The above table is a tabulation by divisions of details referring to the construction of the thirty-nine projects.

TABLE I—MISSOURI FEDERAL-AID PROJECTS ON WHICH CONTRACTS HAVE BEEN AWARDED TO SEPTEMBER 15, 1920

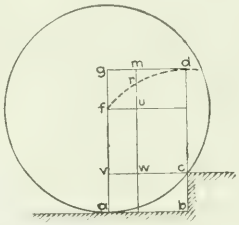
Div.	No. Proj	Length Miles	Contract Price	Federal Aid	State Aid
1	11	81.10	$2,687,616.18	$1,022,035.89	$261,995.36
2	1	10.26	122,889.14	61,444.57	6,360.00
3	8	71.80	560,038.11	237,174.45	68,972.36
4	5	33.77	803,348.43	335,020.02	33,464.90
5	9	80.43	1,174,512.20	550,026.09	72,142.10
6	5	74.04	1,132,645.62	314,268.18	99,196.88
Totals	39	351.40	$6,481,050.38	$2,519,969.20	$542,131.60

Analysis of Roughness Impact on Highway Bridges

Floor Irregularities the Principal Source of Impact—Formula Derived From Study of Motion of Wheel When Striking an Obstacle Indicates an Increase of Two-thirds the Load for Three-Inch Roughness

By Willis Whited
Consulting Bridge Engineer, Pennsylvania Highway Department, Harrisburg

Twenty-five years ago an elaborate investigation of the centrifugal force developed by the passage of a load over a beam, the beam deflecting under the load so that the path of the latter is a curve, was carried out by H. Zimmermann. It may be found in "Handbuch der Ingenieurwissenschaften," 4th ed., Part 2, vol. 3, p. 39. The centrifugal force in question is evidently proportional to the square of the speed of the load. But Zimmermann found it to be quite small even for railroad trains. In the study of highway bridge impact it may therefore be ignored as being a factor of no practical consequence.



WHEEL STRIKING OBSTACLE

In the "Handbuch" there appears also (p. 44) a discussion by Professor Melan of an approximate method for determining the stresses due to the rapid application of a load to the various members of a truss bridge. Calculations based on his formula show that for the maximum speeds of heavy trucks the impact due to this cause may be neglected.

The impact on bridges due to the roughness of the road, however, has not been discussed from a scientific standpoint by any writer, so far as I know. Many tests and much study have been devoted to the impact on roadway slabs, but the results would require much modification to be applicable to bridges. An attempt will now be made to discuss this subject on the basis of the ordinary principles of dynamics. Two phases will be taken up: first, the impact produced when a truck wheel strikes an obstacle, and second, the impact when it jumps off the obstacle.

We will assume that the deflection of the springs, tires, and framework of a truck, as well as that of the bridge structure, is proportional to the load, and that the total amount of this deflection is D_1 under the full assumed static load. In the sketch herewith ab is level roadway and bc is the face of an obstacle. The wheel moves through distance ab in time t_1 seconds, which is the time from the instant the tire touches the obstacle to the instant the vertical through the axle reaches the obstacle. We will denote the distance ab by K, the total load on the wheel by W, the height of the obstacle bc by h, the radius of the wheel by R, and the variable height of the load measured vertically above ab by s.

When a truck wheel strikes the obstacle the tire is first compressed at c about as much as at a, and then the center of the axle describes an arc fd about c in the time t. A force in addition to the static reaction is required to lift the axle in this process. It is a force of acceleration, which we will call U. It is shown in works on mechanics that velocity equals $\frac{ds}{dt}$ and acceleration equal $\frac{d^2s}{dt^2}$, or in this case gU/W, where g is the force of gravity, 32.2 ft. or 386 in. per second per second. The force U compresses the springs and framework of the truck so that the sprung load of the truck does not describe an arc parallel to fd but describes a curve, each point of which is below the corresponding point of fd a distance equal to UD_1/W. As will be seen, $fg = bc$ and $gd = ab$. The horizontal velocity of the axle is uniform and equal to t_1/ab. The time required to pass from f to any point r of the path will be denoted by t, the variable time.

From the figure,

$$fv = \sqrt{R^2 - K^2};\ wr = \sqrt{R^2 - (md)^2} = \sqrt{R^2 - \left(\frac{t_1 - t}{t_1} K\right)^2}$$

The height ur through which the axle rises in time t is $wr - fv$, or

$$ur = \sqrt{R^2 - \left(\frac{t_1 - t}{t_1} K\right)^2} - \sqrt{R^2 - K^2}$$

The height through which the sprung load rises is s, and the total compression of the springs, etc., at the end of time t is

$$ur - s = \frac{UD_1}{W} = \sqrt{R^2 - \left(\frac{t_1 - t}{t_1} K\right)^2} - \sqrt{R^2 - K^2} - s$$

whence we have the differential equation

$$\frac{d^2s}{dt^2} = \frac{gU}{W} = \frac{g}{D_1}(ur - s)$$

$$= \frac{386}{D_1}\left[\sqrt{R^2 - \left(\frac{t_1 - t}{t_1} K\right)^2} - \sqrt{R^2 - K^2} - s\right]$$

If we place $386/D_1 = a^2$, and $ur = T$, we shall have

$$\frac{d^2s}{dt^2} + a^2 s = T$$

which may be solved by the method given in Johnson's "Differential Calculus," Art. 82, with the following result:

$$as = \sin at \int T \cos at\, dt - \cos at \int T \sin at\, dt + C_1 \sin at + C_2 \cos at$$

$$\frac{ds}{dt} = \cos at \int T \cos at\, dt + \sin at \int T \sin at\, dt + C_1 \cos at - C_2 \sin at.$$

A complete solution of this equation is very difficult but an approximate solution can be obtained for any given numerical values of the constants by placing t equal to zero, $\frac{1}{2}t_1$, t_1, successively for the quantities under the integral sign, adding by Simpson's rule and multiplying by sin at and cos at, respectively; the constants C will be found to vanish. The same procedure may be followed in obtaining the value of $\frac{ds}{dt}$, the upward velocity of the load when the axle reaches d.

The value of D_1 for ordinary heavy trucks will not vary greatly from 4 in. At speeds of 15 miles per hour and upward, and obstacles in the neighborhood of 3 in. high, the value of s when the axle reaches d will be found to be less than $\frac{1}{4}$ in., and $\frac{ds}{dt}$ at the same instant

will be small, so that the spring will be compressed an amount nearly equal to the height of the obstacle.

A little consideration will show that the impact is somewhat less than the force required to compress the springs, etc., an amount equal to the height of the obstacle. The tire is much more rigid than the springs, and if, as usual, we consider everything below the springs as unsprung load we will find that the force required to lift the unsprung load is greatest when the tire first strikes the obstacle, steadily diminishing till the axle reaches *d*, when it becomes zero. It is therefore not necessary to add the two impacts together, as they do not occur at the same time.

If the motion of the load is analyzed after the axle reaches *d* its equation of motion will be found to be the same as that of a vibrating spring, which would indicate that the load will rise above its first position a distance somewhat less than twice the height of the obstacle. If the obstacle is of sufficient length to catch the load as it falls the maximum impact will be caused by the load striking the obstacle, but if the obstacle is short so that it lands on the same level as *ab* the maximum impact will occur at that time. Personally, I hardly think it wise to provide for an impact as great as that would give.

If we base our impact allowance on the impact developed when a wheel mounts an obstacle 3 in. high the proper allowance will be about ⅔ the sprung load, assuming the speed to be about 15 miles per hour. If a 4-in. obstacle is assumed the proper allowance may reach about 0.8 of the sprung load.

When a truck wheel passes off from an obstacle the motions are somewhat complicated. The center of gravity of the vehicle will describe a parabola, but, as the springs are rapidly released, a vibratory motion will be produced, in which the sprung load will vibrate in a direction opposite to that of the unsprung load, the amplitude of the two vibrations being inversely proportional to the two loads. If the speed exceeds about 15 miles per hour the vibration of the wheels will be checked but little, if any, by striking the obstacle. The effect will be that the impact of the unsprung load striking the floor will be greater than that of the sprung load. The amount of this impact will depend upon the compressibility of the tire, which is much greater in the case of a pneumatic than of a solid tire. Pneumatic tires are not used on the heaviest trucks and solid tires vary quite widely in compressibility, but in the majority of cases the impact will be less than that due to the truck striking an obstacle of equal height, as discussed above.

I therefore feel that the most logical basis for computing impact in any member of a highway bridge would be to add to the maximum stress due to the assumed maximum static load a stress equal to that due to a single load about two-thirds the sprung load on any wheel, applied at whatever point on the bridge floor will give the maximum stress in the given member.

City Faces Damage Suits After Typhoid Epidemic

As a result of a typhoid outbreak in Pittsburg, Cal., ascribed to a poluted water supply, reference to which apepars in *Engineering News-Record*, Dec. 30, 1920, p. 1288, in the Letters to the Editor column, this issue, 21 suits have been filed against the city by persons who were sick during the outbreak. Damage claims are reported to total about $140,000.

Impact Under High-Speed Traffic on Highway Bridges

Addition of Twenty Per Cent of Four-Wheel Load Found Sufficient to Allow for Maximum Roughness of Foor

By W. D. Uhler
Chief Engineer, Pennsylvania State Highway Department, Harrisburg

IMPACT on highway bridges may be analyzed by applying well established principles of mechanics to the actions involved and the particular values of the disturbing elements assumed. The quantities on which impact will depend are: the speed of the vehicle, the roughness of the roadway, and the amount of deflection of springs, tires, etc., of the maximum-weight truck under its maximum load.

We can but forecast or assume the possible changes in the elasticity, the speed and the maximum loading of trucks that will be used a generation or two from now, at which time many of the bridges we are now building will still be in good and serviceable condition. Assumptions as to the factors of impact can be made only with considerable hazard at this time, inasmuch as the truck business is still in its infancy, and inasmuch as it is fair to presume that it will grow as rapidly as the improvements in our road system will permit. The assumptions are further hazardous because we do not as yet know whether the future economy of truck transportation will be in the direction of higher speeds, heavier loading or the increased use of trailers.

It would seem that highway bridge impact is due to the following causes:

1. Increase or decrease of the load due to centrifugal force when the bridge floor has a sag or camber.
2. The hammer action caused by a rigid body striking the bridge.
3. Roughness of the road surface.
4. The dynamical effect of a load passing over the bridge independent of the curvature or roughness of the roadway.

These points will be discussed in order.

Camber and Hammer Action Negligible

As to (1): A bridge is rarely built with an appreciable sag. Camber reduces the load on a bridge, but as the curve of camber rarely has a radius of less than 3,000 ft., the centrifugal force due to which is only 2.7 per cent at a speed of 50 mi. per hour and 0.4 per cent at 20 mi. per hour, the effect can properly be neglected.

As to (2): Hammer action may be defined as the effect of a load applied so rapidly that the parts adjacent to the point of application of the load receive its full effect before any large proportion of the final stress reaches the more remote portions of the member under consideration. As will be seen later on, the effect of impact increases very rapidly with the rigidity of the striking body and the stiffness of the body struck.

A stress due to an applied load passes through a body with a velocity approximately equal to that of sound, which, in the case of concrete is at least 8,000 ft. per second. A truck wheel passing over an obstacle and striking a bridge floor will hardly exert its full effect on the floor in less than 0.1 sec. In that time the stress could be carried through a very long span. Following this reasoning it would seem that the only hammer action that could damage the floor of a bridge would

be due to explosives, collisions or break-downs. It would seem that the hammer action may be ignored in designing bridges.

Effect of Roughness of Road

As to (3): Impact due to the roughness of the road is the most important point under consideration.

An easy calculation will show that it requires about ⅓ sec. for a body to fall through the first 3 in. A truck moving at the rate of 15 mi. per hour will travel 33 in. in that time. It is safe, therefore, to consider that a truck passing over an obstacle at the speed mentioned strikes the floor with the velocity due to the height of its fall from obstacles. This height multiplied by the weight on the truck wheel is the kinetic energy of the load at the instant it strikes the bridge floor. The elastic resistance to the fall is composed of the compression of the tires, springs, etc., of the vehicle combined with the deflection of the bridge due to the load. This resistance is zero at the instant of contact with the floor, increasing at a rate which is sensibly uniform until the motion is arrested. The total work of the load consists of the kinetic energy mentioned above, together with the work done in overcoming this resistance, this work being equal to the product of the load into the total deflection of the bridge and of the springs, tires, etc., of the vehicle. The total work of the load must equal the total work of resistanc

The height of fall will be reduced by the amount the tires and springs recover between the time the wheel clears the obstacle and the instant the tire touches the floor. The recovery of the tires will be practically instantaneous. The recovery of the springs will be equal to the time required for a body to fall freely through a height equal to the amount of the compression of the springs multiplied by the ratio of the weight of the whole truck and load to the weight of the portion of the truck below the springs. It would seem that if the height of the obstacle is about 3 in. and the total compression of the tires and springs of the vehicle under full load is an equal amount, the actual height through which the vehicle falls before contact is made between the tire and the floor will not exceed ½ in., which makes the additional stress due to impact equal to 1.15 times the wheel load. If a truck wheel weighing 15,000 lb., moving at a rate of 15 mi. per hour, strikes an obstacle 3 in. high, the tire being 40 in. in diameter, the impact will lift the vehicle 3 in., producing additional stress on the bridge floor of 14,000 lb. due to impact.

As to (4): A load passing over a bridge has a dynamic effect on the bridge independent of the roughness or curvature of the roadway. This is due to the fact that the stress in any given member is increased from zero to a maximum in a certain limited time. At the instant at which the stress reaches its maximum it is increasing at a certain rate, which imparts a certain amount of kinetic energy to the member, which, of course, produces additional stress. In the case of short beam spans a load of 15,000 lb. moving at 15 mi. per hour will have an impact effect of 10 per cent on a 5-ft. span I-beam, decreasing to about 4 per cent on a 40-ft. span. In truss spans the stress increase due to this cause is rarely more than 2 per cent on counters and diagonals near the middle of the span and much less for other members.

It would, therefore, appear that for heavy trucks on highway bridges, Causes 1, 2 and 4 can safely be ignored, and that as to Cause 3 an obstacle 3 in. high is sufficient to provide for. As the duration of the impact does not exceed one-tenth of a second, it is sufficient to assume that only one wheel load is acting at a time, so that if bridges are designed for the specified load applied statically with an additional impact load of one specified wheel load plus about 20 per cent applied at whatever point on the bridge will produce a maximum stress in the member under consideration, ample allowance will be made for all impact stresses, and 20 per cent impact on all wheels will give a wide margin of safety.

If higher-geared trucks are built in the future, it will be largely because the roads are smooth enough to justify the increased speed. Excessive speed of a truck over a bridge of present-day design with 20 per cent impact factor on floor which has become rough is more likely to result in a localized floor-slab failure or damage to the truck istelf than in failure of a main member.

Service Test Methods and Record of Ties in Track

METHODS for conducting service tests of ties in track and for keeping records of the results are included in the recommendations of the Committee on Ties, American Railway Engineering Association, submitted at the recent annual convention. A brief outline of present practice, indicating non-uniformity in methods, observation and record keeping, appeared in *Engineering News-Record*, Mar. 17, 1921, p. 461, indicating the findings of the committee. It is stated, however, that the work of the Forest Products Laboratory is tending toward more uniform methods of reporting but that the principal criticism of the test section method is in often giving abnormal results, due to special selection of ties and unusually good maintenance. Briefly, the committee's recommendations follow:

Recommendations—In locating test sections, it is of importance that a piece of track be selected that has no switches and is not likely to be disturbed by new construction or abnormal rail renewals. All the test ties should be put in at once, or "out of face," as this accelerates the gathering of the information and without greatly increasing the expense, the good ties removed being used elsewhere. All the different kinds of ties should be installed, so far as possible, under the same conditions of curvature, grade and drainage.

Not less than 100 ties of each kind should be installed. If installed in multiples of 100, the percentages are readily obtained. If too few ties are put in, a few abnormal failures may make the test misleading. Each tie should be numbered and if a reliable record is kept in the office it scarcely seems necessary to mark the tie with the kind of wood or date of placing. The test sections should be marked by suitable monuments at each end.

Installation and records of the test sections should be under the supervision of an experienced technical man, qualified to make accurate observations and keep good records, so that the tests will be continuous and not affected by changes in the personnel. Regular inspection should be made at least once a year. Ties should not be removed from the test sections, except in emergencies, without the approval of the official responsible for the record and should never be destroyed until inspected by him or his representative.

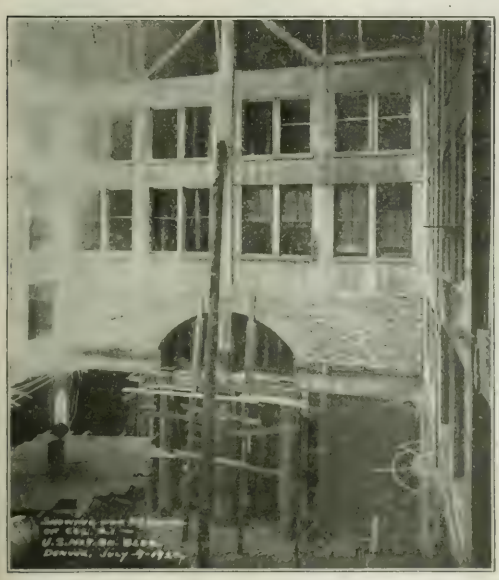
The essentials of the record are covered by two report forms: One giving the location and such data as traffic, weight of rail, kind of ballast, kind of tie, treatment, etc., and the other showing the conditions of each tie at each inspection. If many kinds of ties are under test in the test sections, a chart showing the location of the different kinds will be helpful. It is necessary to have a full record of the treatment of each different lot of ties under test.

Six Stories Added to Reinforced-Concrete Building

Connections of Old Four-Story Office Building to Ten-Story Extension Required Structural Steelwork

By Walter H. Wheeler
Consulting Engineer, Minneapolis, Minn.

REMODELING work of an extensive character was required in the erection last summer of the new United States National Bank Building at Denver, Col., a ten-story reinforced-concrete flat-slab structure erected on and around a four-story building of the same general design. It has sometimes been felt that the remodelling of a concrete building, and particularly of one with flat slabs, would be extremely difficult and

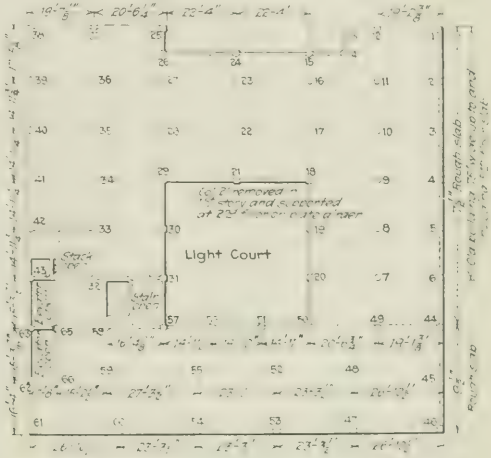


SHORING AND TEMPORARY BRICK ARCH UNDER COLUMN 21

Column 21 is shown cut off above the second floor and hanging free and upper part of first story column 21 is removed. Columns 21a and 21b are in place to receive new steel girder to support column 21 at second floor level. Old roof slab over light court shown removed.

expensive. In this case, however, the work was carried out expeditiously and economically, although some careful structural steel underpinning was required. It is of value, too, to note that the old building was of slag-aggregate concrete and that the embedded steel showed no signs of rusting.

The new building covers a ground area of 125 ft. square and is ten stories and basement in height with mezzanine in first story and a two-story pent house. Included in this structure is the reinforced-concrete frame of the old Century Building, constructed in 1908-09 by the Jones Wheeler Cranmer Engineering Co. on the Turner "mushroom" system flat-slab reinforced-concrete, with standard column capitals without depressions. The Century Building was 125 x 75 ft., four stories and basement with columns and column footings designed to carry four additional stories. The building was used for retail stores on the first floor and offices above. In one of the stores, under the wall of the east light court four cast-iron columns were used. The vertical column bars for these columns were concreted into the cast-iron columns and bent out at the



PLAN OF UPPER FLOORS OF REMODELED CONCRETE BUILDING

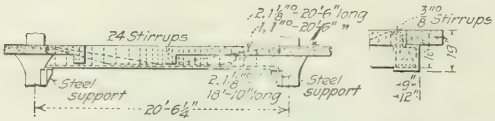
top for the slab reinforcing and the spandrel beam supporting the light-court wall was turned above the slab to eliminate the beams from the ceiling.

In the new building the ground area was increased to 125 ft. square and the whole structure carried up the full ten stories. The old columns and column footings were found to be safe for the extra stories, if hollow tile backing was used for the outside walls above the fourth story on the old part of the building.

The concrete in the old building was made from pit-run gravel, a considerable part of which was taken from the excavation for the old building. To bring up the percentage of coarse aggregate to the proper proportion, smelter slag was mixed with the gravel in charging the mixer and an excellent grade of concrete secured. The use of this slag was condemned at the time by some engineers, as they feared the sulphur might combine with the water used in mixing the concrete and form sulphuric acid which would attack the reinforcing. Chemical analysis of this slag convinced the builders that this danger was remote. The old steel exposed in remodelling the old building showed no corrosion. The concrete in the old structure was also found to be in very good condition, being sound and hard. The first floor slab of the old building was tested very severely by the building department during construction of the old building with what is known as the load, fire and water test, which it passed successfully.

This test consisted of placing pig iron over a rectangular area at the center of one floor panel equal to more than twice the design load of the whole panel. A large wood fire was built under this panel with flame striking the bottom of the slab for 20 minutes and a fire hose then turned on the bottom of the slab. After the fire and before the load was removed the deflection was $\frac{1}{32}$ in.

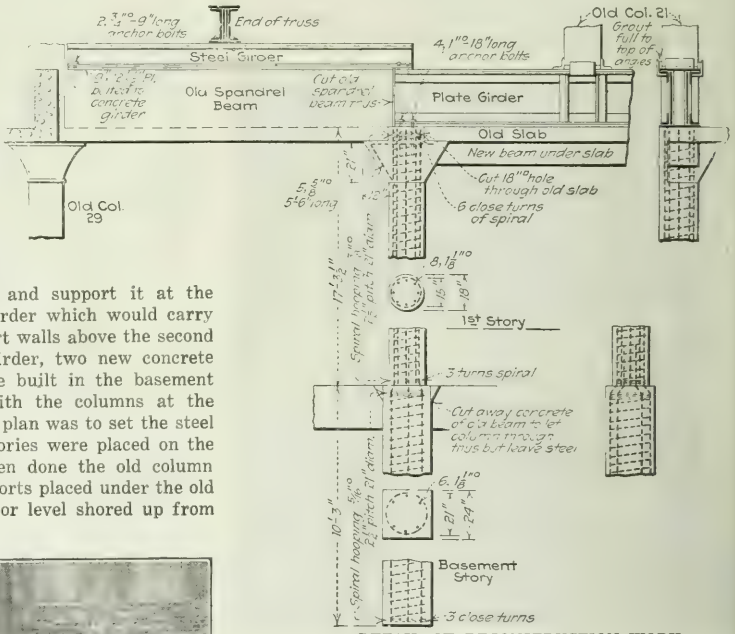
In constructing the new building it was found nece-



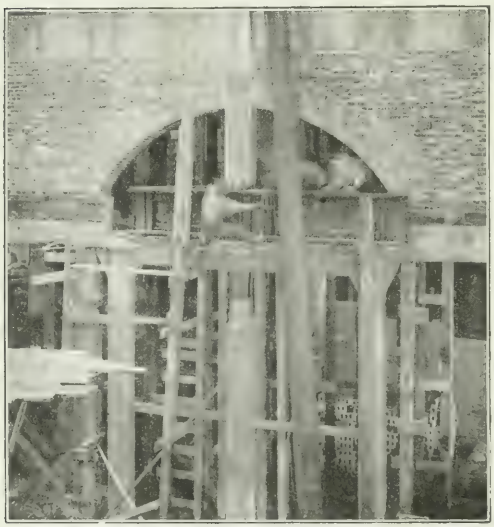
DETAIL OF BEAM SUPPORT OF JOINT BETWEEN OLD AND NEW FLOOR SLABS

sary to make extensive alterations in the old concrete structure to harmonize with the plans for the new building. The old concrete roof of the interior light court which is about 45 ft. square, was all removed and steel trusses placed spanning the light court to form a large central skylight over the banking room, about 30 ft. square. The roof of the skylight was raised to the level of the third floor, and the space around the skylight roofed over with a new concrete slab on a level with the second story window sills. One of the main columns (column 21 as shown in the plan) in the first story of the old building supporting the walls of this interior light court interfered with the plan of the banking room and it was decided to cut this column out in the first story and support it at the second floor level on a plate girder which would carry the nine slabs and the light court walls above the second floor. To support the plate girder, two new concrete columns of special design were built in the basement and first story to conform with the columns at the opposite side of the court. The plan was to set the steel girder before any additional stories were placed on the old structure. If this had been done the old column could have been carried by supports placed under the old spandrel beams at the third floor level shored up from the basement. Delivery of the girder was delayed, so that in order not to hold back the construction of the building, arrangements had to be made for cutting off the old column and placing the girder under it after the floors above had all been poured and the forms for the roof and reinforcing for the roof in place. The load on the old column, including its own dead weight, which had to be supported while cutting off the old column and placing the girder, was about 130 tons.

The method used to support the old column and place the girder is shown in the views. Wood shoring was placed under the slabs around the old column from the basement floor to the fifth floor. Above the fifth floor the forms were left in place and reinforced with some



DETAIL OF RECONSTRUCTION WORK AT COLUMN 21



SWINGING STEEL GIRDER SUPPORT FOR COLUMN 21 INTO PLACE

additional shores. A temporary brick arch was built on top of the old second-floor spandrel up to the bottom of the third-floor slab to support the weight of the column itself and that part of the floor and wall loads which was not taken by the shoring. In cutting off the old column a hacksaw was used to cut out one of the vertical column bars and after the column was cut through and swinging free this section of the old bar was set back on the stub from which it was cut and it was found that the space between the upper end of this bar and the stub above was just equal to the width of the cuts made by the hacksaw, which indicated no settlement whatever in the old column. Much credit is due the contractors for the care with which they performed this delicate task.

The columns and footings of the old building along the line of connection with the new part of the structure were originally designed with a view to possible future extension of the building. The slabs along this line were built without spandrel beams, the floor load

and tile enclosing walls being carried solely by the slabs. No settlement was found in these slabs when the tile walls were removed, which would indicate that where this system of construction is used, the spandrel beams may be designed to carry a much smaller proportion of the floor and wall loads than has been the custom, or is permitted by building ordinances. To connect the new slabs to the old and support the joints shallow concrete beams were cast along the edge of the new slabs, and projecting half their width under the edge

CONNECTION OF NEW SECOND FLOOR SLAB TO OLD

Shows also connection of new second floor light court spandrel beam to old column, where old column capital furnishes support for this beam. Also steel channel in place for support of new floor beam along edge of old slab where new third floor slab joins old

of the old slabs. These concrete beams were in turn supported by steel brackets carried on light steel channels strapped to the old concrete columns with steel bands, as shown in one of the views. It was not permissible to place new columns against the old columns or to increase the size of the old columns, as these are encased in marble of such a size that no margin was left to work in. Steel channels were selected of such a width that the flanges would fit around the face of the octagon columns by cutting a shallow groove in the old concrete column and allow the inner face of the channels to fit snug against the concrete face of the columns.

Where the spandrel beams of the inner light court connect with the old concrete columns, there was a full concrete capital on the old columns at the second floor, and above the second floor there were no capitals. The spandrel beams in the light court all turn above the floor slabs. To connect the new spandrels to the old columns heavy steel straps were placed around the old columns at the proper elevation to receive the hooked ends of the bent-up beam bars and pockets dug in the face of the old columns to receive these bars. To support the ends of the spandrel beams at the third, fourth and fifth floors, steel stirrups were concreted into the ends of the beams and these floors hung from the sixth-floor spandrels. These stirrups were buried in the walls of the light court to protect them against fire and corrosion.

To accommodate the stairway to the safe deposit vaults in the basement and also the main stairway from first to second floors it was necessary to remove one entire panel of the first floor slab and reconstruct it at two new levels. To support the edges of this new opening new concrete beams were cast under the old slab, some of these beams being supported on the old columns and others supported by and connected to old concrete beams in the first floor. The problem was complicated by the boiler breeching which was under this new slab and prevented the use of stub columns or walls for supporting this new slab. It was also necessary to move the stack and fill the old openings in the second, third, fourth and fifth-floor slabs and cut new openings in these slabs and place new concrete beams under the old slabs. At the second floor it was also necessary to provide a new opening for the main stairway. Above the second floor the stair is in the new part of the building. It was also necessary to fill quite a number of old openings in the first-floor slab, most of which had no beam framing around them. Wherever new beams were to be cast under old slabs, holes were cut through the old slabs at intervals and the concrete in the new beams poured through these openings.

To insure the required strength in the old cast-iron columns in the first story of the old building, they were encased in concrete and hooped with expanded metal mesh well lapped and tied. As these columns had been filled with concrete in constructing the old building the result of this operation was to produce hooped reinforced-concrete columns with cast-iron cores.

To support the new mezzanine floor in the first story of the old building, the diameter of the old columns was increased 4 in. from the first floor up to the mezzanine, and this casing of concrete was reinforced with ties and vertical bars. This method was permissible at this point as there was no marble casing to go on these columns, and the enlarged diameter is not an important consideration. Several of the old columns in the basement story under the mezzanine floor were also strengthened by a similar casing of concrete reinforced in a similar manner.

The general contractors on the work were the S. C. Lambie Co. of Denver. The architects for the building were W. E. & A. A. Fisher, of Denver, and the architects for the bank interior and vaults were Weary & Alford Co. of Chicago. The writer was consulting engineer on the reinforced-concrete and structural steelwork. The new part of the building is all Turner "Spiral Mushroom" system flat-slab construction with standard column capitals and no depressions. The spans range from 14 to 26 ft. The first floor is designed for 125 lb. live load and the floors [illegible] 70 lb. live load per sq.ft.

The Prediction of Probable Rainfall Intensities

A Study Based on Records at Central Park, New York City, for the Fifty-one Years, 1869 to 1920—Proposed Curves for 5, 10, 15, 25 and 50 Years and a Proposed Maximum Curve

By Kenneth Allen
Sanitary Engineer, Board of Estimate and Apportionment, New York City

In a paper presented to the American Society of Civil Engineers in 1915 Allen Hazen outlines the development and use of "probability paper" for forecasting the probable storage requirements of reservoirs. Applying this paper to the solution of rainfall problems the scales of ordinates and abscissas are so related that if x represents the percentage of years and y the intensities of rainfall the resulting curve for a downpour of a given duration is reduced to a straight line. Therefore if

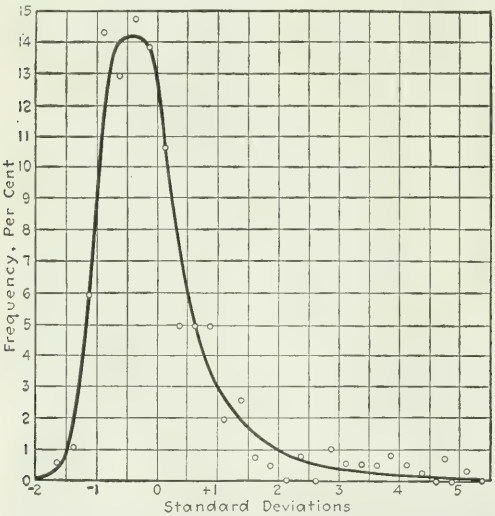


FIG. 1. RELATION BETWEEN STANDARD DEVIATIONS CORRESPONDING TO DIFFERENT RAINFALL INTENSITIES AND FREQUENCY OF OCCURENCE AS EXPRESSED IN PERCENTAGES OF YEARS

two points of the line are determined by observations extending over a comparatively short series of years the curve may be extended so as to serve for a much longer period. In fact, the period of forecast may be extended practically to infinity.

This "probability paper" is only applicable when there is an equal probability that an occurrence will have a value greater or less than the mean.

In throwing dice, in the distribution of raindrops on a small surface or in the deviation of the caliber of a gun from a true circle at different points of the circumference, the distribution of error above or below the mean will produce a symmetrical curve; but in rainfall intensities, wind velocities, expectancy of life, etc., there is a fixed limit to the departure of the minimum from the mean, while the departure of the maximum may greatly exceed this. Such distributions graphically expressed will therefore result in an unsymmetrical curve.

W. P. Elderton, in his treatise on "Frequency Curves and Correlation," classifies six typical curves of this kind, for which he deduces general formulas, and, following out his general method and those outlined by Harold G. McGee in an article on "A Diagram Adaptation of the Rational Method of Storm-Water Drain Design" (*Engineering News-Record*, Nov. 13-20, 1919, p. 868), the writer's assistant, W. T. Carpenter, has suggested and developed the series of curves of probable rainfall intensities shown herewith in Fig. 3. The method of developing these curves, being somewhat elaborate, is described hereafter in detail.

An unusually favorable series of intensity observations is available from the records of the self-registering gage established in Central Park in 1869 by Dr. Daniel Draper. This furnishes a nearly continuous record covering 51 years, from which the intensities for durations of from 5 to 120 minutes have been tabulated. From these records Table I has been prepared, giving the number and percentage of years in which a given rate of precipitation has not been exceeded. For instance, a rate of 3 in. per hour lasting 30 minutes was not exceeded in 45 years or 92 per cent of the 49 years in which 30-minute observations were noted.

With this table as a basis the several steps in the development of the intensity curves shown on Fig. 3 are as follows:

In order to simplify the matter we will first confine our attention to the 15-minute curve or to downpours of 15 minutes' duration. From the original tabulation (not

TABLE I. NUMBER AND PERCENTAGE OF YEARS IN WHICH CERTAIN MAXIMUM RAINFALL INTENSITIES WERE NOT EXCEEDED

	Duration in Minutes																							
	5		10		15		20		30		40		50		60		80		100		120	
	No	%	No.	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
1.0	..		..		..						3	7	6	13	12	26	7	32	7	37	8	50
1.5	..						2	4	9	18	18	39	30	65	34	74	20	91	18	95	16	100
2.0	..		1	2	4	8	13	26	28	57	36	78	41	89	43	93	21	95	19	100	.	
2.5	.		4	8	15	31	31	62	42	86	43	93	43	93	43	93	21	95		..	.	
3.0	6	12	18	36	30	61	37	74	45	92	43	93	43	93	44	96	22	100	.	.	.	
3.5	11	22	29	58	39	80	44	88	46	94	43	93	45	98	46	100	..	..	..	...	.	...
4.0	19	39	38	76	40	82	46	92	46	94	45	98	46	100			.	...	..	..	.	
4.5	27	55	40	80	43	88	48	96	47	96	46	100		.		.	.	...	..	..	..	
5.0	31	63	43	86	47	96	48	96	47	96				.		..	.	...	..	...	..	..
5.5	35	71	47	94	47	96	48	96	49	100		.	.	.	.	..	..	...	..	..	..	..
6.0	41	84	48	96	47	96	49	98			.		..	..	.	..	..	...	..	..	..	..
6.5	44	90	48	96	48	98	49	98			..	.	.	..	..	..	..	...	..	..	..	...
7.0	46	94	48	96	48	98	50	100		.	..	..	..	...	..	...	..	...	..	..	..	...
7.5	47	96	49	98	48	98	.	..	.	..	..	..	..	...	..	...	..	...	..	..	..	...
8.0	47	96	49	98	49	100	..	...	..	...	..	...	..	...	..	...	..	...	..	..	..	...
8.5	48	98	50	100	..	...			..	...	..	...	..	.		...		...	..	...	..	.
9.0	49	100	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...

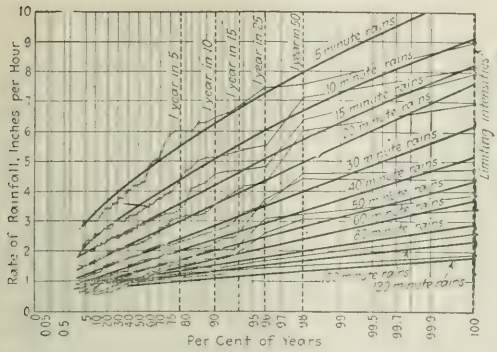


FIG. 2. PROBABLE PERCENTAGES OF YEARS IN WHICH A GIVEN INTENSITY OF RAINFALL, CONTINUING FOR A GIVEN NUMBER OF MINUTES, WILL NOT BE EXCEEDED

reproduced) it is seen that there were four years in which the maximum intensity varied from 1.51 to 2 in. per hour, the average being 1.98 in. Similarly, the average for 11 years having maximum intensities of from 2.01 to 2.5 in. per hour was 2.23 in. The sum of all these averages for the 49 years of observation was 152.68 in., giving an annual mean of 3.11 inches.

The "standard deviation"—hereafter referred to as SD—is then determined by finding the deviation from the above mean for each series of intensities, squaring, multiplying by the number of occurrences—hereafter designated as "frequencies"—adding the products, dividing by the number of years and extracting the square root.

Let m = the mean intensity in those years in which a given range of maximum intensities was observed.

M = the mean intensity for a given duration, determined as described above.

D = the deviation from M for the average obtained for a given intensity.

F = the frequency.

N = the number of years in the series.

Then

$$D = M - m$$

$$SD = \sqrt{\frac{F_1D_1^2 + F_2D_2^2 + F_3D_3^2 + \ldots + F_xD_x^2}{N}}$$

Thus, for 15-minute storms:

$D = 3.11 - 1.98 = 1.13$

$D = 3.11 - 2.23 = 0.88$, etc.

and

$$SD = \sqrt{\frac{(1.13^2 \times 4) + (0.88^2 \times 11) + \ldots \text{ etc.}}{49}} = 63.98$$

$$= 1.144$$

The next step is to prepare a table of frequencies in terms of *SD*. Starting with the assumption that for M the value of D is 0, the intensities for each quarter of an *SD* above and below M are determined with their corresponding frequencies. This is illustrated in Table II.

To harmonize the resulting frequency curves for downpours of different durations, as well as to utilize as large a number of observations as possible, the average of all percentages corresponding to each assumed range of *SD* is obtained (Table III) and plotted as a dot on Fig. 1; and using these dots as a guide a curve is drawn in and so adjusted that the sum of the percents corresponding to ¼ *SD's* will equal 100.

This curve, unlike the normal "curve of error," is seen to be unsymmetrical, the *SD's* of appreciable magnitude extending from 2 below to 5 above the mean, with the "mode," or point of maximum frequency, corresponding to a *SD* of about —0.4. This lack of symmetry is characteristic of other natural phenomena, as already mentioned, probability curves for which can be worked out in a similar manner.

Assuming that this curve is tangent to, or cuts, the axis of x at —2.0 and at +5.0 — which for all intents and purposes is correct—the ordinates cutting off 1 per cent, 2 per cent, etc., of the area comprised between the axis of x and the curve to the left are located, and these ordinates, transferred with the axes of x and y to a clean sheet, furnish a "probability sheet" upon which we may then construct a series of curves indicating the percentage of years in which a given rainfall intensity will not be exceeded. (Fig. 2.)

Table IV gives the abscissas for the ordinates of the

TABLE II. DISTRIBUTION OF ANNUAL MAXIMUM INTENSITIES FOR FIFTEEN MINUTES IN TERMS OF STANDARD DEVIATION

Standard Deviation	Intensity, In. per Hr.	Frequency, Years	Per Cent of Years
—1 25	1 69		
—1 00	1 97	1	2 0
—0 75	2 26	8	16 3
—0 50	2 54	7	14 3
—0 25	2 83	8	16 4
0 00	3 11	7	14 3
+0 25	3 40	7	14 3
+0 50	3 68	2	4 1
0 75	3 97	0	0 0
1 00	4 25	2	4 1
1 25	4 54	1	2 0
1 50	4 82	4	8 2
1 75	5 11	0	0 0
2 00	5 40	0	0 0
2 25	5 68	0	0 0
2 50	5 97	0	0 0
2 75	6 25	0	0 0
3 00	6 54	1	2 0
3 25	6 82	0	0 0
3 50	7 11	0	0 0
3 75	7 40	0	0 0
4 00	7 68	0	0 0
4 25	7 97	0	0 0
4 50	8 25	1	2 0
Total		49	100.0

probability sheet corresponding to different percentages. The result of this spacing of ordinates is that if, for storms of a given duration, the rates are plotted on the ordinates corresponding to the frequency the line connecting these points will theoretically be straight. Therefore if but two points are determined by observations the line can be extended so as to cover an infinite series.

In practice the actual frequency of each intensity is plotted. For example, for 15-min. storms with rates of from 1.51 to 2.0 in. per hour, there occurred one of 1.92 in. and 3 of 2 in. in 49 years. Therefore:

Plot intensity 1.92 on ordinate representing 1/49 = 2.0 per cent
Plot intensity 3.00 on ordinate representing 2/49 = 4.08 per cent
Plot intensity 3.00 on ordinate representing 3/49 = 6.12 per cent
Plot intensity 3.00 on ordinate representing 4/49 = 8.16 per cent

Continue this process with the 11 storms of from 2.01 to 2.50 in. per hour; 15 storms of from 2.51 to 3 in.

TABLE III. ILLUSTRATION OF METHOD OF COMPUTING AVERAGE FREQUENCIES CORRESPONDING TO ¼ STANDARD DEVIATIONS

SD =	0 25 to 0 50 Per Cent	0 to 0 25, etc. Per Cent
5 min. rains	6	10 2
10 min. rains	2	10 0
15 min. rains	6	14 3
30 min. rains	6	6 0
60 min. rains	0	18 4
45 min. rains	2 2	8 7
30 min. rains	0	13 0
60 min. rains	6	4 3
Average	0 5250	10 0225

results in a line approximately straight. And this represents, to the nearest practicable degree, the probable frequency of 15-min. downpours (Fig. 2).

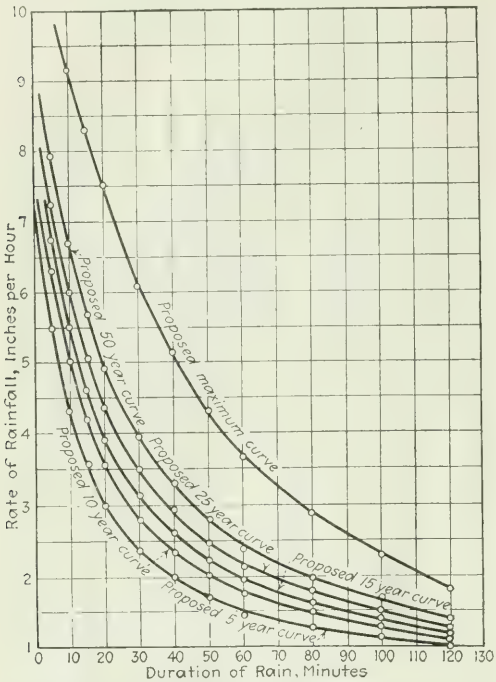


FIG. 3. MAXIMUM RAINFALL INTENSITIES, CENTRAL PARK RAIN GAGE, NEW YORK CITY, 1869 TO 1920

Loci platted from diagram, showing percentage of years in which a given intensity will not be exceeded.

From Fig. 2 the intensity curves shown on Fig. 3 are plotted for convenient use. For the 5-year curve, for storms not exceeded in 80 per cent of the years, the intensities corresponding to durations are taken from the ordinate marked 80; for the 25-year curve, or that for storms not exceeded but four times in a century, the intensities are taken from the 96 ordinate, and for storms which we may presume will never be exceeded the intensities are taken from the 100 ordinate, etc.

TABLE IV. ABSCISSAS FOR VARIOUS FREQUENCIES

Frequency.....	0.05	0.1	0.5	1	5	10	
Abscissa...	0.298	0.386	0.670	0.810	1.178	1.385	
Frequency.....	20	40	60	70	80	90	
Abscissa...	1.665	2.135	2.613	2.863	3.315	4.110	
Frequency.....	94	96	98	99	99.6	99.9	
Abscissa...	4.740	5.240	6.105	6.950	7.910	9.020	100

These curves are in the usual form for convenient use. Their derivation is laborious and not readily grasped, but the actual work is not difficult, and having been once done need not be repeated.

The advantage claimed by the adoption of this method is that it is believed to furnish the nearest practicable approach to the true probability, and the ability to secure this with reasonable reliability without recourse to a very extended series of observations.

Practical Results in Piloting Ships by Electrified Channel Cables

PILOTING OF VESSELS through harbor channels in foggy weather by means of cables energized by audio frequency current has proven a success from the standpoint of navigation in practical tests and demonstrations of piloting ships by this means through the Ambrose Channel into New York Harbor according to a paper by A. Crossley, expert radio aid, Navy Department, Washington, D. C., before the Institute of Radio Engineers. The ships were equipped with special double coil receiving devices, each connected with collector coils rigged out from the opposite side of the vessel. The tests demonstrated that in single channel operation a single cable could guide ships entering and leaving a harbor on the proper side of the channel.

The New York Harbor cable was laid July, 1920, extending from Fort Lafayette to the Ambrose lightship, a distance of 16 miles, the work being accomplished in 6 hr., after three days had been spent in underrunning existing cables. The cable was charged by a 1 kw. Navy standard 500-cycle, 120-volt generator obtaining a current flow of 3.5 amp. with pressure stepped up to 400 volts by a transformer. The destroyer "Semmes" was selected for a public demonstration, equipped with double coil audible receiving device, registering different degrees of intensity on either starboard or port side according to the ship's relative position to the cable. In October, 1920, demonstrations were conducted for navigational interests. In one test, with the pilot house ports closed with canvas, Captain Battle, of the Cunard liner "Virgilia," after brief instruction, piloted the "Semmes" on the correct side of the channel at a distance of 50 yd. from the cable by obtaining a certain signal strength from the port coil.

In extension of the system it is proposed to pick up a cable further out at sea, aided by wireless direction signals, and follow it to the light vessel from which point, by means of stop-watch and speed charts, warning of approach to turns in the channel may be given to aid in following the cable. Many improvements are to be made in the design of electrical equipment and there is a demand for some kind of a visual device to indicate directly the location of the cable, development of which is now being undertaken by the New York Navy Yard. It is understood, upon completion of the New York experiments, that the Bureau of Lighthouses, Department of Commerce, will take over the work of installing and maintaining cables in the important harbors of the country. Arrangements are also being made by the International Communication Conference to internationalize the use of audio frequency cables as an aid to navigation.

While the total cost of the New York Harbor installation will not exceed $50,000, the hourly maintenance and operation cost per vessel held outside of harbors during inclement weather is so great that the installation would pay for itself very quickly.

Three wireless fog signals will immediately be installed at the entrance of New York Harbor through the Lighthouse Service according to the announcement of Secretary of Commerce Hoover. Each of the stations is equipped with an automatic radio set sending out signals continuously during fog or thick weather. They may be picked up on shipboard by means of the new radio compass developed by the Bureau of Standards

The compass indicates the direction from which the radio signals are sent out, and by taking observations on the different stations the captain of a vessel may determine his exact position without being obliged to rely on the former unsatisfactory method of locating the position of his ship by the sound and apparent direction of whistles and fog horns.

It is understood that radio signals will operate to aid ships in picking up the cable. The signals have been developed as the result of co-operative experiments by the Bureau of Standards and the Lighthouse Service, and more especially through the research work of the Bureau of Standards in improving the radio compass. Bearings from the compass can be determined without depending upon expert radio operators. The sending apparatus can be operated by regular light keepers without skilled personnel. The signals have been installed on Ambrose Channel and Fire Island lightships and at Sea Girt lighthouse, and will operate on a wave length of 1,000 m., the international standard for such signals. The Lighthouse Service plans to establish other stations near the entrances to the principal ports and at other important points on the Atlantic and Pacific coasts as rapidly as necessary funds are provided.

Tests Show Thin Solid Partition Best Sound Insulator

IN A SERIES of tests recently made by Prof. F. R. Watson, of the University of Illinois, in a specially fitted room so as to obtain comparable results, it was shown that greater sound insulation resides in a solid plaster wall than in one of so-called hollow block units of the same material and that a thin plaster wall on a metal lath base has the best insulating qualities of any of the types tested. The partitions tested were set up successively in a wall between two test rooms and the surrounding conditions maintained as constant as possible so that the only changing factors were the partitions themselves. An organ pipe under constant air pressure was placed on one side of the partition and the sound directed to the partition. The sound passing through was measured on the other side with a Rayleigh "resonator," an extremely delicate sound measuring instrument.

Tests were made on metal lath with plaster coating on one side only, on partitions having cracks in the walls and threshold clearances at the base of the doors, on 2-in. metal lath and plaster partition and 2-in. plaster board partition, and on 3-in. plaster block partition plastered on both sides, and 3-in. plaster block partition plastered on both sides with the air holes in the plaster block filled with plaster.

It was shown definitely that sound transmission increased with the size of the cracks in the partition of whatever sort and that the transmission under thresholds and around doors was quite large. The relative intensities of transmitted sound as measured by the different tests are expressed numerically as follows:

	Relative Intensities
2 in. solid metal lath and plaster partition...	0.93
2 in. plaster board and plaster partition.....	2.35
3 in. plaster block partition plastered on both sides with plaster filled in holes	1.16
3 in. plaster block partition plastered on both sides with open air holes.....	3.85

Prof. Watson states as a conclusion of the experiments that the transmission of sound through partitions is a complex phenomenon and that it is not a simple matter to judge the relative merits of partitions unless all the conditions are considered. Two partitions should not be compared in efficiency on the basis of quality unless the other qualities are the same. Thus a partition to which a coat of plaster is added will transmit less sound not only because of the increased weight, but also because it becomes more rigid. All the partitions in this test because of their weight stop a large part of the incident sound, though vibration of the walls played some part in the transmission, as shown markedly by the comparatively thin ½-in. partition. The thicker partitions because of their greater rigidity would have smaller amplitudes of vibration.

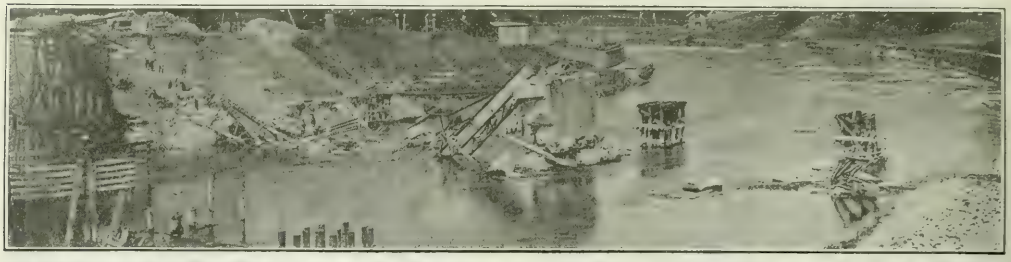
The superiority of the metal lath and plaster partition, according to the report, is doubtless due to several qualities. The metal lath core because of its open mesh not only allows the construction of a homogeneous plaster medium that is continuous from one face through the metal lath to the opposite face, but it also reinforces the partition. It has therefore a desirable quality of inertia with increased rigidity. The superiority of the plaster block partition with the plaster filled air holes over a similar partition with open air spaces would appear to be due to increased weight or inertia. Both of these partitions appear at a disadvantage because of the lack of homogeneous structure. Buttering the joints with plaster, particularly at the ends of the blocks, may not always insure continuity of plaster and thus leave possible cracks or channels through which sound may pass. This would also tend to weaken the partition compared with one in which the joints were completely filled.

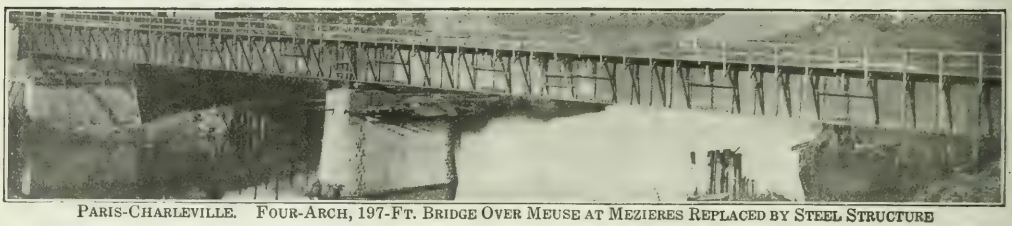
Railroad Reconstruction in France

RECONSTRUCTION of the French railroads since the Armistice, according to a statement of the French Commission in the United States, progressed with such rapidity that the entire 2,404 km. of double-track line totally destroyed during the war have been completely rebuilt. Of the 2,785 km. of single-track line destroyed, 1,810 have been entirely reconstruced and opened to traffic, and work on the remainder is now being carried out. Some idea of the extent and difficulty of the work involved may be gained from the following two pages of photographs depicting typical reconstruction of bridges and destroyed lines.

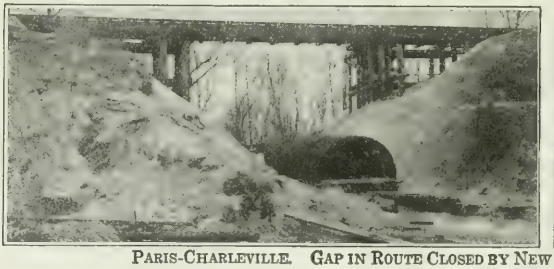
The work of electrifying certain French roads, which started in 1920, has made considerable progress. The Midi Company has 150 km. of double-track electric line in operation and the work of electrifying a further 3,000 km. of track belonging to this road is under way. The reconstruction of two hydro-electric plants, which will furnish 150,000 hp. each to this road, is nearly complete. The road has placed orders for 50 new electric locomotives of the type used by the Chicago, Milwaukee and St. Paul Ry. Two other French railroads have undertaken the electrification of sections of their line, the Orleans, which is electrifying 3,000 km., and the Paris-Lyon-Mediterranée, which also is electrifying 3,000 km. of road. The electric power for the Orleans road will be furnished by the water falls of the Upper-Dordogne, and for the Paris-Lyon-Mediterranée by the falls of the French Alps. The cost of electrifying these roads will be in the neighborhood of 5,000,000,000 fr.

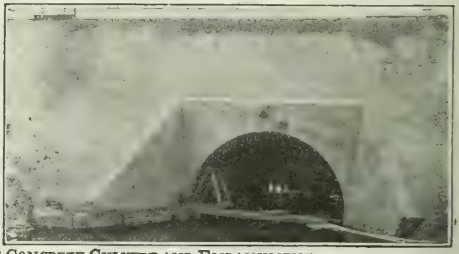
After Two Years of Peace—*How France Has Repaired*



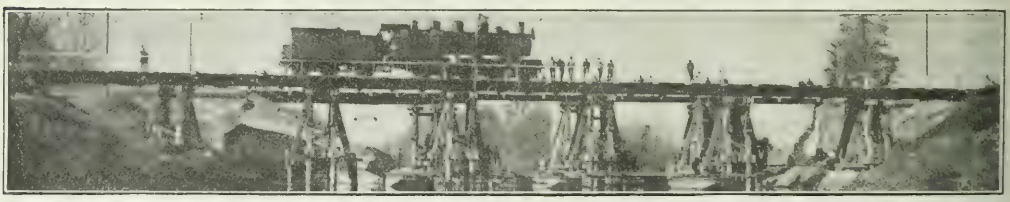


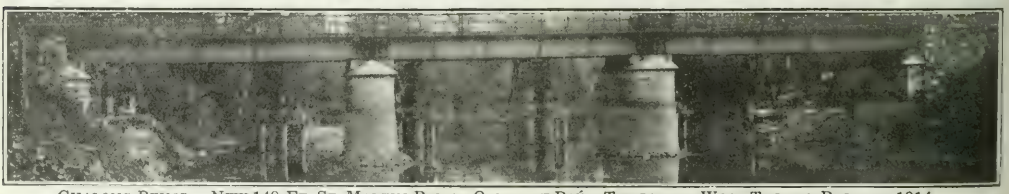
PARIS-CHARLEVILLE. FOUR-ARCH, 197-FT. BRIDGE OVER MEUSE AT MEZIERES REPLACED BY STEEL STRUCTURE





PARIS-CHARLEVILLE. GAP IN ROUTE CLOSED BY NEW CONCRETE CULVERT AND EMBANKMENT

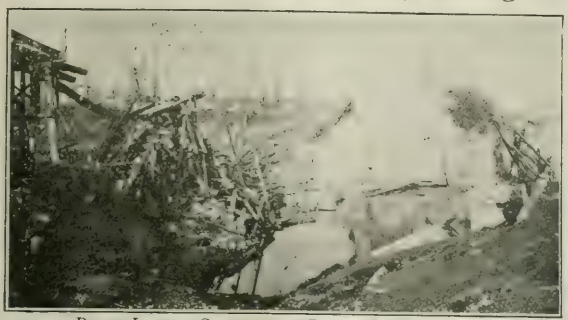


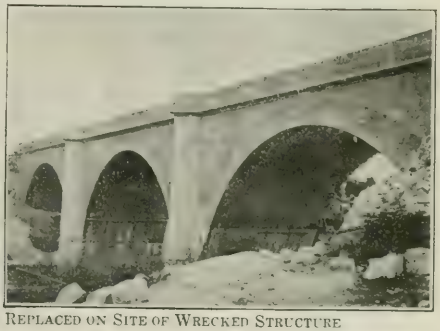


CHALONS-REIMS. NEW 148-FT. ST. MARTIN BRIDGE OVER THE PRÉ—TEMPORARY WOOD TRESTLE BUILT IN 1914

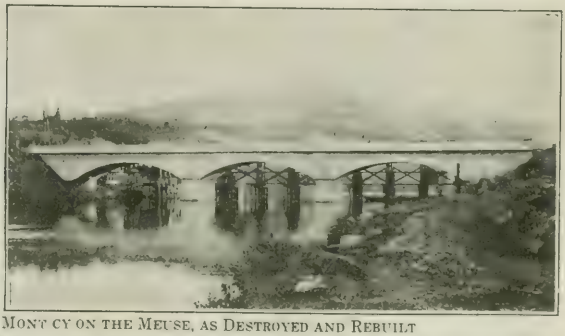
PARIS-STRASBOURG. CHALIFERT BRIDGE, SHOWING DEMOLITION IN 1914 AND RECONSTRUCTION; LENGTH, 230 FT.

War's Damage to Railway Bridges on Old Battle Front





REIMS-LAON. GUIGNICOURT BRIDGE, 216 FT., OVER THE AISNE REPLACED ON SITE OF WRECKED STRUCTURE



CHARLEVILLE-GIVET. 216-FT. BRIDGE AT MONT CY ON THE MEUSE, AS DESTROYED AND REBUILT

CHARLEVILLE-LONGUYON. AT LUMES ON THE MEUSE — TEMPORARY REPLACEMENT OF 295-FT. BRIDGE

REIMS-LAON. NO MAN'S LAND GRADED TO FORM NEW ROADBED NEAR LOIVRE

Engineering Education at Harvard

Industrial Co-operative Work and Course in Engineering Administration Features of Re-established School

MUCH interest was aroused in 1914 in the co-operative agreement between Harvard University and Massachusetts Institute of Technology by which the engineering work of Harvard was largely transferred to the institute's plant. This plan had to be terminated in 1917, due to a decision of the Massachusetts Supreme Judicial Court, which held that Harvard could not legally use the Gordon McKay bequest, the nucleus of the funds for the engineering school, in carrying out the agreement. The affiliation was therefore terminated and in the fall of 1919 engineering instruction was re-inaugurated at Harvard, the new school being styled the Harvard Engineering School.

Unlike its predecessor, which when the co-operation with the institute was inaugurated was a graduate institution, the re-established school is primarily an undergraduate engineering college, though larger provision is made than in other institutions for graduate and research work. It will be remembered that the Graduate School of Applied Science was, in turn, the successor of the Lawrence Scientific School, the original undergraduate college established in 1847.

In the re-established school four-year undergraduate courses are offered in mechanical, electrical, electric communication, civil, sanitary and municipal engineering; sanitry chemistry; mining, metallurgy, and industrial chemistry.

In addition, co-operation with the industries has been introduced as a variant for those who elect it in the four-year courses in mechanical, electrical, civil and sanitary engineering. There has also been established a five-year course in engineering administration.

Co-operative Instruction

Co-operative instruction was inaugurated last September. The students electing such work alternate between school, on the one hand, and industrial plants, public service companies, and engineering and contracting firms, on the other, during the third year of their course. This is provided for by a rearrangement of the courses and by the use of one whole summer's vacation and part of another, without increasing the number of years required to obtain a degree or diminishing the classroom instruction.

At the end of the second year the students are divided into two equal sections in June. One section studies from the first of July to the middle of August and has vacation for the remainder of the summer. The other section has vacation during the first half of the summer and studies from the middle of August to the end of September. At the beginning of the college year one section reports for classroom work for two months and the other section for work in the various industries for two months. The classroom work and outside work are then alternated in two-month periods from September to September, giving each student three periods of two months each in the industries and, including the work of the previous summer, a full year of college studies.

The industries in which the students are placed are selected in accordance with the preferences expressed by the students and with the character of the courses they are taking. The object of their experience is to give them a broad vision for business. To get this they are placed in three or four major departments and are given in advance a list of questions relating to the functioning of the department. In order to be able to answer the questions the students must cultivate a careful habit of observation, must ask questions in the shop and in the school, and must look up references. Finally they write a detailed technical report, accompanied by sketches and photographs, of some particular phase of the work. During the classroom period of the alternation, the students report at least twice a week to a class on industrial engineering and relate to their fellow students what they have learned on the job. As the other students may not agree with the statements, discussion follows. An instructor in industrial work is present in order to guide the students. The young men thus learn to think on their feet, to speak to their equals, and by combining their experiences with those of others in different lines of activity get a practical background with which the classroom work can be co-ordinated. It would be difficult to obtain such experience and co-ordination in any other way.

The industries of Massachusetts and nearby states are heartily co-operating with the school in this co-operative work.

Engineering-Administration

The new course in engineering administration is given jointly by the Engineering School and the Graduate School of Business Administration. It talks five years to complete, and includes all the scientific training given in the four-year programs in mechanical, electrical or civil engineering, or in mining or metallurgy, and also a well-rounded course of study in the fundamentals of business administration.

The first two years of the program are identical with the first and second years of the engineering courses; the third year is that of a student in engineering who elects the industrial work previously described, while the fourth and fifth years are devoted to concurrent instruction in engineering and business. During the last two years all the fourth year work of the regular engineering program is covered and a group of courses in business, which will include in substance all the studies of the industrial management group as offered by the business school, namely, the principles of accounting, factory management, shop accounting, marketing, industrial finance, business policy, labor problems, business economics, and a thesis on a combined engineering and business subject.

It is expected that these two groups of courses, together with the training acquired by means of experience in the industries during the work of the third year, will in five years give men who take these programs not only a thorough grounding in the principles of engineering science, but also sound training in business methods.

The buildings devoted to the use of the school include Pierce Hall, the Cruft High Tension Laboratory, the Rotch Building (for mining and metallurgy), and the new Gordon McKay Engineering Laboratory (for the larger engineering experimental and test equipment, such as gas, oil and hot-air engines, air compressors, hydraulic machinery, materials testing equipment, etc.). The latter is a one-story building with a floor area of about 30,000 sq.ft., erected for the use of the Navy

during the war and now transformed into a modern laboratory.

The registration in the school this year is 232, not including first and second-year engineering students who are registered in Harvard College, the relation between the school and the college permitting students of engineering to register in the college if they choose for their first two years.

Concrete Road Mix Proportioned at Central Plant

Clamshell Bucket and Belt Conveyor Load Bins and Three-Compartment Motor Trucks Deliver to Mixer

By H. T. Tuthill
County Assistant Engineer, New York Highway Commission, Sayville, N. Y.

A CENTRAL proportioning plant from which three-compartment motor trucks delivered aggregates and cement to the mixer prevented wastage of materials, facilitated the checking of the contents of each batch and insured continuity of construction operations on the concrete highway in Suffolk County, N. Y., built between Cold Spring, Huntington and Fort Solonga, a distance of 5.86 miles, In the design and layout of the plant the reduction of labor costs by the application of machinery was the chief consideration.

The pavement was 20 ft. wide, 8 in. thick at the center and 6 in. thick at the sides with a parabolic crown. It was reinforced longitudinally with two ⅜-in. square twisted bars placed 6 in. from the edges and 2 in. above the finished subgrade. The mix was 1 : 1½ : 3. Transverse expansion joints of the premolded type, ⅜ in. thick, were provided every 33 ft. These joints were formed to fit the section of the pavement and extended from the base to within ¼ in. of the top—in other words they were submerged joints. At the end of the day's run, joints ¾ in. thick were placed the full depth of the pavement. Finishing was done by the roller and belt method. Sand obtained locally and imported limestone were used.

FIG. 1. TWO-COMPARTMENT HOPPER BIN FOR SAND AND STONE, SHOWING SAND CONVEYOR BELT

Central Proportioning Plant—At the central material proportioning plant cement, sand and stone in their proper proportions were dumped into motor trucks having three compartments, each compartment holding a 5½-bag batch.

This plant was located on Huntington Harbor with docking facilities to accomodate deep draft scows, all cement and stone being received by boat. Adjacent to the dock, where the bins were located, was a bank of sand of excellent quality.

FIG. 2. THREE-COMPARTMENT TRUCK AFTER DISCHARGING FIRST BATCH TO MIXER SKIP

The equipment consisted of a hopper bin (Fig. 1) divided into two compartments, one for sand and one for stone, in the bottom of which were six gates, three for sand and three for stone. These gates discharged into a measuring box divided into six compartments with trap doors in the bottom. This box was so arranged that a truck could drive underneath and when the doors were tripped, the batch compartments each received their proper proportion of sand and stone. The truck then moved on to the cement platform where each batch compartment received 5½ bags of cement. The truck then proceeded to the road to charge the mixer.

The hopper bins were charged with stone by a stiff-leg derrick and boom with 1 cu.yd. clamshell bucket. This outfit also unloaded the boats. It was capable of handling a 500-cu.yd. cargo per day. A 20-hp. three-drum hoisting engine operated the hoist and swinging gear.

Sand was delivered to the hopper bins by means of a belt conveyor mounted on a trestle. This trestle, erected on an incline, ran from the hopper to the sand pit and had at its center a clearance of 14 ft., providing sufficient head room for the passing of trucks as they swung in a circle to drive under the hopper. Power for the belt conveyor was furnished by an 8-hp. gas engine with chain-and-sprocket drive. In the sand pit, the belt was fed from a hopper being charged with sand by a crane operating a 35-ft. boom with ¾-cu.yd. clamshell bucket.

Cement in sacks, was unloaded from the barges by a mast and gaff rig through an opening in the roof of the cement shed. A 5-hp. gas engine furnished power for hoist with hand swing.

The force operating the plant was as follows: 1 superintendent; 1 engineer and 1 fireman on the stiff-leg derrick; 1 engineer, 1 fireman and 2 laborers on the crane and sand pit; 1 laborer operating the control gates at the hopper and loading trucks; 6 laborers unloading cement bags from barges, charging truck compartments (5½ bags to each compartment) and baling empty cement bags.

Transportation of Material—Motor trucks with dump bodies (Fig. 2), each body being divided into three

compartments and each compartment carrying a 5½-bag batch of dry material, were utilized in conveying the batches from the proportioning plant to the mixer on the sub-grade. On arrival on the sub-grade the truck is turned around before reaching the forms set and is backed down to the mixer. The front end of the truck body is then elevated. Latches set in the floor of the truck and which secure the partition of the first compartment, are released and the first batch is

FIG. 3. SPREADERS AND FINISHERS AT WORK BEHIND CONCRETE MIXER

charged into the skip. The truck then moves ahead a few feet, the skip is elevated and the mixing drum charged. This operation is repeated until the three batches are discharged, the truck then returning to the mixing plant. An average of 10 trucks per day were used—five being of 3½-ton capacity.

The dead haul from the central proportioning plant to the highway under construction was 1.5 miles over roads which were in good condition. The average haul on the construction was 1.75 miles making a total average haul of 3.25 miles. Heavy up-hill hauls were encountered on the highway under contract, the percentage of some of these grades being as follows: 350 ft. of 8.77; 250 ft. of 8.35; 775 ft. of 5.00; 260 ft. of 7.7; 300 ft. of 5.7; 335 ft. of 7.0. A number of soft sandy spots in the subgrade also made hauling difficult on the contract.

Mixing and Placing Concrete—The equipment and labor for mixing and placing concrete is indicated below:

Equipment

One 5½-bag batch mixer, caterpillar tread, gasoline motor, chute discharge.
1,000 ft. of forms.
3,000 ft. 2-in. pipe.
One water pump, triplex, 6 to 8 hp., 50 gal. per minute.
Quantity of rubber hose.
One hand roller.
One screed, 22 ft. x 12 in. x 3 ft., cut to crown of road.
One 8x¾ in. x 22 ft. belt.

Force at Mixer

1 foreman.
1 engineer } Operating mixer.
1 oiler }
2 laborers, screed, roller and belt.
3 laborers, spreading concrete.
2 laborers, dumping trucks.
2 laborers, trimming sub-grade ahead of mixer.
2 laborers, covering pavement.
1 laborer, brooming pavement surface and wetting down.
3 laborers, form setting.
1 engineer, water pump.

A daily record of the lineal feet of pavement 20 ft. wide placed during the period from June 10 to Sept. 11, 1920, is shown in the accompanying table, which includes maximum and minimum hauls.

Summing up the advantages derived in this method of operation, it was noted that there was no wastage of materials as is the case when materials are distributed along the roadway; the cleanliness with which the materials were maintained and the uniform production resulting in a finished product that was of excellent quality. Compression tests of 6-in. tubes which were made from the matrix developed breaking strengths averaging over 4,000 lb. per square inch for 28-day tests.

The saving alone in the preservation of empty cement bags was marked, as the system enabled the contractor to concentrate the empty bags at one point under cover and to return them on the return trip of a barge to the mill. The mechanical handling of the cement also constituted a great saving.

Continuity of operation enabled the contractor to increase his production. The plant could have easily taken care of two or more concreting outfits had the contractor chosen to operate them on the road. Simplicity of checking the proportioning of materials in a batch enabled the contractor to keep a close record of quantities used. The plant was portable and could be moved quickly to any railroad spur or dock and set up.

PROGRESS OF WORK

Date	Lin.Ft.	Date	Lin.Ft.	Date	Lin.Ft
June 10	320	July 13	158	Aug. 14	360
June 11	323	July 14	222	Aug. 16	300
June 12	341	July 15	274	Aug 17	343
June 14	342	July 16	328	Aug. 18	189
June 15	328	July 17	310	Aug. 19	230
June 16	343	July 19	240	Aug. 20	289
June 17	358	July 20	338	Aug. 21	329
June 18	396	July 21	245	Aug. 23	309
June 19	352	July 22	285	Aug. 24	97
June 22	257	July 23	270	Aug. 25	366
June 23	284	July 24	277	Aug. 26	387
June 24	383	July 26	377	Aug. 27	340
June 25	425	July 27	368	Aug. 28	349
June 26	333	July 28	375	Aug. 30	362
June 28	147	July 29	381	Aug. 31	364
June 29	148	Aug. 2	375	Sept. 1	319
June 30	230	Aug. 3	404	Sept. 2	409
July 1	312	Aug. 4	428	Sept. 3	497
July 3	285	Aug. 5	494	Sept. 4	352
July 6	195	Aug. 7	331	Sept. 7	338
July 7	280	Aug. 9	187	Sept. 8	394
July 8	325	Aug. 10	370	Sept. 9	423
July 9	128	Aug. 12	257	Sept. 10	310
July 10	55	Aug. 13	294	Sept. 11	260
July 12	142				

Total days, 73. Total lin. ft., 22,536. Av. per day, 309 ft.

My general observations have been that each road contract presents a problem in itself which has to be studied; a plan of operation successful on one job may not be at all adaptable or practical on another. The system described above, I consider, is governed largely by hauling conditions, although with the use of lighter trucks the obstacles of hauling could be reduced to a minimum.

Hayti-Santo Domingo Mails Carried by Airplane

United States Marine Corps aviators are engaged in scheduled mail carrying between Hayti and Santo Domingo, the two halves of the Island of Santo Domingo in the West Indies. On the map these two countries do not look far apart, but actual communication between the cities is very difficult on account of the bad topography, lack of roads and hostile natives. It is currently reported, for instance, that it takes a week to ten days to get from Port Au Prince to Santo Domingo. The Navy and the United States Coast and Geodetic Survey both have representatives in the island, and communication between them is being carried on by Marine Corps Aviation service. In addition, officers and officials are using the plane for inter-city travel. Trips which formerly took days are now accomplished in a like number of hours.

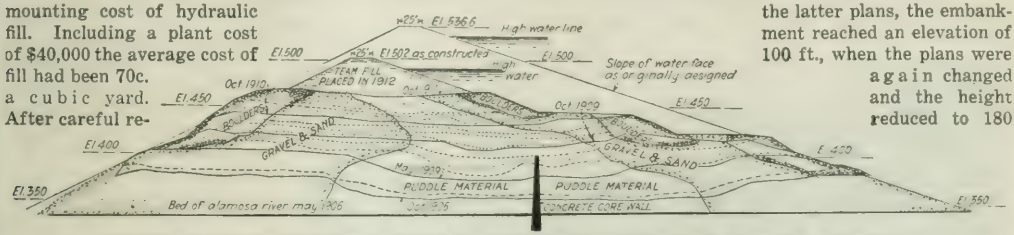
Hydraulic Fill Practice on Terrace Reservoir Dam

Details Given of Construction of Earth-Fill Dam—Studies of Flume Lining Place Cast-Iron Plates First and Green Spruce Blocks Second in Durability

By John E. Field
Consulting Engineer, Denver, Colo.

EXPERIENCE with several forms of sluice construction for hydraulic fill, in building the Terrace Reservoir dam in Southern Colorado, gave information of exceptional value on operating grades, lining wear and sluice efficiency. Incidentally important lessons in borrow-pit development were disclosed. This information has never been published. The main facts, it is, therefore, thought, are worth recording permanently even though they relate to an operation completed some years ago.

A description of the Terrace Reservoir dam and of the hydraulicking operations as of Nov. 1, 1906, was published in Transactions American Society of Civil Engineers, Vol. LVIII. June, 1907, pp. 237, 274. Construction was abandoned in October, 1907, because of the mounting cost of hydraulic fill. Including a plant cost of $40,000 the average cost of fill had been 70c. a cubic yard. After careful re-



PROGRESS CROSS-SECTION OF TERRACE DAM SHOWING LOCATION AND CLASS OF MATERIALS

planning, operations were resumed. Sluicing was carried on 1909, 1910 and 1911 when the flood of October, 1911, destroyed the headworks, and much of the channel of the power canal. The plans submitted in 1908 called for the finishing of the upper 20 ft. of the fill by teams, as tests of borrow pits showed that there would be no material available for sluicing for that portion of the dam. The dam was completed in 1912 by teams, the upper 30 ft. being so placed at a cost of 40c. per cubic yard, the volume being 54,000 cu.yd. The team fill was surfaced with two feet of gravel and heavy boulder riprap.

The reservoir has been in use since 1911 and has given considerable trouble, viz., the discs of the outlet valves broke twice and the stored water was lost; a leak near the contact between the hydraulic and team fill caused the lowering of the water, and required the construction of a cut-off trench and puddle core; the steel pipe leading from one of the valves was torn out by the high velocities of the water, and difficulties arose due to misunderstandings with owners of older direct flow water rights, and lack of funds. It is believed that the troubles are past as in 1920 good service was had. The writer has recommended the expenditure of some $25,000 to install a duplicate set of control valves in the tunnel, as the two 4-ft. circular valves are difficult to operate, and whenever out of order, cannot be repaired without emptying the reservoir. Resumption of the work was undertaken on the basis of an estimate by the engineer that, exclusive of plant engineering and interest on investment, the fill would cost 15½c. a cubic yard.

Terrace Reservoir, is located on the Alamosa River, a tributary of the Rio Grande in Colorado. The drainage area is 125 sq.mi. The annual average discharge is about 120,000 acre-feet; the minimum flow is 20 cu.ft. per second, and the normal maximum flow is 1,500 cu.ft.

The reservoir was built for a supplemental supply of water to some 30,000 acres in the San Luis Valley, five miles below.

Plant construction was completed in 1905 and sluicing was begun in April, 1906. Sluicing was first suggested by the late T. W. Jaycox, and the late J. D. Schuyler was consulting and designing engineer until 1906. The first plans called for a dam 180 ft. above the river bed, and the height was changed to 225 ft. Under the latter plans, the embankment reached an elevation of 100 ft., when the plans were again changed and the height reduced to 180 ft. The dimensions pertaining to the reservoir are as follows:

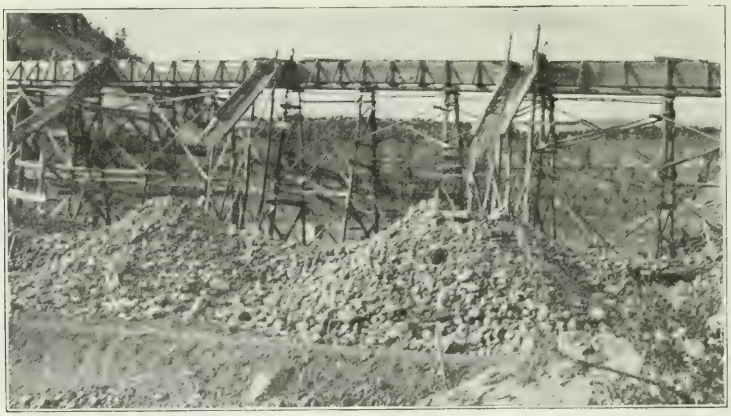
Area covered at high water, acres	300
Depth of water	152 ft.
Height above present river bed, upstream side	157 ft.
Present river bed to old river bed	15 ft.
Lowest foundation below old river bed	45 ft.
Total height of dam	21.70 ft.
Length of crest	500 ft.
Length of bottom	75 ft.
Upper slopes about, including benches	1 on 4
Lower slopes about	1 on 2
Thickness at base	1.075 ft.
Width of crest	20 ft.
Capacity at high water, acre feet	16,800

In March, 1909, the fill had an average elevation of approximately 70 ft. above stream bed; some 200,000 cu.yd. had been placed on slopes of 1 on 2 and 1 on 3. Little rock material had been sluiced, and the embankment consisted almost entirely of sand outside the core, which, should the settling pool overflow or break, would wash very badly. Seepage from the settling pool would also cause sloughing. The lack of coarse material subjected the surfaces to the action of wind and rain, and required extra expense for riprapping the upper face. Water in the reservoir, and in the river below the dam, was eroding the toes and the presence of cedar and pine boughs and small trees in the slope indicated a tendency of the lower toe to slough. To correct these conditions rock was blasted from the side walls of the canyon, and the lower face riprapped in this manner. Rock was blasted also and dropped into the river some 500 ft. below the dam and the pool so formed soon filled with gravel, sand and silt. At the end of the work the tunnel entrance was closed and the water, if the plan outlined has been followed, is now taken in at a point

25 ft. above the tunnel level, the intention being to allow the old river channel to fill with fine material and seal up the old river bed against seepage, or at least to increase the distance water must travel in passing underneath the dam. About 25 ft. of fine material deposited over the old river bed for a distance of probably 500 ft. upstream seemed so superior to any other method of guarding against underflow that it was unhesitatingly adopted, especially as it involved little extra expense.

In case of hydraulic fill dams the waste water should be discharged into the reservoir basin, where a second and larger settling pool might be provided, and the whole area of the basin adjacent to the dam be coated with the finest and most impervious material. This especially should be done where fines are deliberately wasted in order to secure coarser and better drained puddle. The precautions and work mentioned had the effect of lowering the height of the dam above the river bed, and the discharge of waste water into the reservoir basin had the effect of sealing to a considerable extent the moraine deposits forming the lower end and sides of the reservoir, and since the reservoir has been in operation this rim has been further tightened and the escaping water materially reduced. Their average distance was about 2,000 ft. from the center of gravity of the pits to the center of gravity of the fill.

FLUME LINE AND BORROW PIT



FLUME LINE WITH SIDE CHUTES, SHOWING TOE MATERIAL

The power canal was 7½ mi. long. Its capacity was nominally 30 cu.ft., but 20 cu.ft. was the practical safe capacity. This canal was built in 1904 at a cost of $36,000, and was not intended to be used for more than two years for construction purposes. During the last three years it was in use breaks and slides compelled the construction of more than half a mile of new flume, and the reconstruction of practically all the original flume at least once. At the end of the power ditch there was a penstock from which a steel pipe 15 in. in diameter led to the borrow pits, where three branches of 10 in. pipe led to the three monitors, two of which were used simultaneously.

Labor consisted of Americans for bosses, foremen, head carpenter, blacksmith, etc. The monitor men were generally pure blood Indians. Their intelligence was surprising, and their power of observation and imitation almost Oriental; they were methodical, reliable and apparently did not mind ice water spray in the least. The common labor was Mexican. Nearly all this labor remained steadily to the end of the sluicing in 1911.

Terminal moraine deposits containing 15 to 25 per cent of rock ½ cu.ft. to 3 cu.ft. in volume, with occasionally masses of rock in excess of 1 cu.yd., furnished the embankment material. The pits ran fairly uniform, but occasionally a belt containing much larger quantities of rock would occur. The material left in the pits contained the large rock and also much sand and small rock. About 15 ft. seemed to be the limit of the depth to which the excavation could be carried as the accumulated debris rendered impracticable the securing of much good material at greater depths. Efforts were made to sluice to bedrock, and while this could generally be done it was very expensive. Shooting of the larger rock was tried, but had so little beneficial effect that it was abandoned. The rock was granite and trap, and the sand was quartz, trap and other igneous materials. The fines consisted of glacial slimes, extremely fine sands and a clay material. When damp this mixture had the appearance and the characteristics of clay. It settled almost completely, leaving only a slight turbidity.

To ascertain the best character of lining for the flumes different kinds were placed in the first flume built, which was 600 ft. long, and on a grade of 4 per cent, which reached a borrow pit that had been worked over superficially and contained large amounts of the smaller gravel, 1.6 in. and under in diameter. This flume was 2-in. material, 2 ft. wide on the bottom and 2 ft. deep, with vertical sides. An extra 2 x 8-in. plank was nailed to the sides to hold firm the paving with which the bottom was lined, and to prevent wear on the sides of the flume itself. The linings employed were 200 lin. ft. of 18 x ⅜-in. x 12-ft. high-carbon steel plates; 100 lin. ft. of 18 x 18 x ⅞-in. cast-iron plates and 300 ft. of wooden blocks.

Of the 300 ft. of wood block paving about one-third was cut from dimension lumber sawed at a near-by mill; the other two-thirds was a mixture from newly cut red spruce, pine and quaking aspen trees, and from logs which had been cut more than a year and had become dry. The blocks were roughly hewed to octagon shape and to dimensions determined by the size of the log from which they were sawed. The different classes were at first segregated and placed in different sections. Later, in placing blocks in new flumes and in making repairs, they became mixed. However, it was observed almost at once that the sawed dry lumber wore very rapidly; that dry logs also wore rapidly, but being largely of spruce, and not so dry, gave better service than the dimension lumber. The blocks from newly-cut timber were best, and of the varieties of tree the red spruce wore best of all.

The steel plates were worn through near the ends after the passage of about 50,000 cu.yd. of material as measured in the dam. The cast plates had worn very little after more than 100,000 cu.yd. had passed over them, but a considerable portion had become broken by that time, and the rest were discarded. The maximum wear on these plates was $\frac{1}{16}$ in. in the center of these plates. The original cost and the impossibility of salvaging the broken plates, the work being some 25 miles by wagon haul and 150 miles by rail from the nearest foundry, militated against their adoption.

In the center of the flumes the wood block paving lasted until the construction of a flume at higher elevation became necessary, when it was discarded. The blocks along the sides and not so much worn were used in the new flumes, the worn surface being turned down. The first set of green spruce blocks, with some replacements, lasted throughout the operations of the 1909 season, when 80,000 cu.yd. were placed in the dam. These spruce blocks were, on the average, capable of sustaining the wear due to the passage of more than 60,000 cu.yd. of material. About 12,000 ft. bm. costing about $400 in place in 1,000 ft. of flume indicated a cost of paving of about ⅔c. per cubic yard per 1,000 ft. of flume.

While the wood block lining was new the efficiency was good and there was little difficulty from clogging. After the blocks became rough the largest rock moved less readily, but the other material gave no greater trouble; in fact the sand, which ordinarily gave the greatest trouble, seemed to be held in suspension fully as well, if not better. The upward currents produced by the concavity of the blocks seemed to keep the sand stirred up and it was swept along with the current. The paving was laid in sections about 6 ft. long and 2 x 6-in. plank were used to separate the sections so that should a block become dislodged in any section the loss of paving was confined to that section. The blocks were simply wedged in tight and held down at the edges only by the 2- x 8-in. wearing planks on the sides of the flume. Three lines of flumes were built on the dam, aggregating 3,000 ft., and three from the borrow pits to the dam, aggregating 5,700 ft., and the total cost was $15,694, or $1.80 per ft. Of this $5,532 was for material purchased, and the balance was for labor, which included the sawing and hewing of most of the paving blocks.

In general sluicing started May 1 to May 15, and continued to Oct. 1 of each year. An average of ten hours' active sluicing was the rule in the two shifts, and often the third shift was used in "ground sluicing."

In "ground sluicing" furrows were plowed, or small canals were dug, on the steep hills outside of the areas available for the monitors, and the water washed the dirt from these slopes down to the borrow pits proper, where the coarser material and sand were dropped. The fine material was carried through the flumes to the

TABLE OF COSTS OF SLUICING AT TERRACE RESERVOIR DAM

1909	Power Canal	Pipe Line	Sluice Flumes	Dam	Storm Flume	Engineering and Camp	Total	Cubic Yards	Cost per Cubic Yard
April	$353	. .	$80	$36	$1959	$663	$3,091		
May	2,562	. .	2	19	408	725	3,716	.	
June	1,450	$347	1,804	527	99	840	5,067	5,000	$1 01
July	1,148	228	1,986	2,133	214	752*	4,957	15,000	0 33
August	470	82	1,475	950	. . .	416	3,393	23,000	0 147
September	562	22	960	6M	. . . .	410	2,645	37,000	0 072
Total	$6,545	$679	$6,307	$4,356	$2,680	$2,302 * Credit	$22,869	80,000	$0 287
1910									
March	$43	. . . .	$4	$2	$126	$554	$729	. .	. . . .
April	615	$96	776	288	190	303	2,269	.	. .
May	655	16	561	1,394	.	357	2,983	20,000	$0 149
June	294	27	570	1,627	.	295	2,845	17,000	0.167
July	399	32	292	1,641	. .	131	2,659	18,000	0.147
August	312	118	122	2,294	. . . .	332	2,977	20,000	0 149
September	215	16	400	1,561		332	2,524	40,000	0 063
October	60	24	289	1,562	. . . .	406	2,341	16,000	0 146
Credits	. . . . .	. . .	.	1,700	.	700	. .	.	. .
Total	$2,594	$329	$3,014	$8,669	$316	$2,005	$16,927	131,000	$0.130
1911									
April	$374	$82	$396	$614	$133	$191	$1,788	.	.
May	295	53	1,521	2,192	60	326	4,444	21,500	$0 206
June	254	271	490	2,175	50	386	3,626	16,700	0.217
July	321	. .	1,378	1,795	144	503	4,141	9,000	0 460
August	325	1 2	1,421	1,935	.	,60	4,304	28,500	0.151
September to December	231	241	1,167	2,256	.	1,100	4,996	31,800	0.157
Credits	. . . . .	.	. . .	1,800	. .	700		. . .	. . . .
Total	$1,801	$806	$6,373	$9,167	$385	$2,267	$20,799	107,500	$0 195
Total 1909-1911	$10,940	$1,814	$15,694	$22,192	$3,381	$6,574	$60,595	318,500	$0.190
Cost per cu.yd	0 034	0 006	0 050	0 070	0 010	0 020	0 190		
Per cent of cost	18 3	3 0	25 8	36 6	5 5	10 8	100		
Plant and equipment	$18,000	$1,200	. . . .		.				
Cost per cu.yd	0 056	0 004							0 060
Total per cent of cost	36 2	3 8	19 7	27 7	4 3	8 3	100		
Materials	$1,276	$105	$5,532	$2,824	$996	$1,456	$12,189		$0 038

Total average cost, including plant and equipment, $0 25 per cubic yard

dam and built up the puddle core. This operation was usually employed when the core was becoming too contracted and not enough fines were being secured by the monitor operations. The sand deposited in the borrow pits was later picked up by the monitors and sluiced to the dam in the regular way.

Determination of minimum grades was accomplished by first building a flume on a 4 per cent grade. This worked very satisfactorily, with almost no tendency to clog. The flume was new and carefully built to line and grade with easy curves and no angles. The second flume constructed was designed for a 3 per cent grade, but in building it 2.9 per cent was shown by the levels. This flume clogged badly whenever the amount of water decreased or any excess of material, especially sand, was driven into it, but where skilled operation of the monitors was secured—that is, a nearly uniform quantity of water, and of solids with proper proportions of silt, sand and boulders—the clogging was avoided. A grade of 3 per cent was adopted as the minimum allowable as a result of experience with this flume.

Boulders in the flume created cross-currents and upward currents that kept the sand in suspension and swept it along. It was found that where clogging impended throwing in round boulders 4 to 8 in. in diameter had the effect of cutting out the sand on the bottom of the flume and often would relieve the congestion. Generally, however, the flume men would shovel vigorously, stirring up the sand, and causing it to be swept away from the congested section. In the flumes rock weighing 100 lb. were readily carried; some rocks weighing 200 lb. were carried, but help was needed from the flume men.

During the first year's operation screens were used to separate the rock from the other materials. In 1910 and 1911 they were not used and two men on the toes did all the work necessary to dress up the slopes and prevent the water from flowing outward instead of into the settling basin. These men also attended to directing the water to the proper points.

In building the flumes across the dam material was discharged from the end of the uncompleted flume, a cone being built up on which the bent for the next section was placed and the flume extended until it was entirely across the dam. Material was then discharged, principally from the end of the flume, until the toe was raised to a little above flume bottom, when the end section was taken down and the process repeated. During this "breaking back" process material was discharged from the sides of the flume where and when advisable, there being a gate in each section of 15 ft.

Two waste wells and sometimes four were provided, the waste water being drawn through the one farthest from the point of discharge. The wells were connected with a horizontal box through the toes of the dam and consisted of four 4 x 4-in. posts to which planks were nailed whenever it was desired to raise the water in the settling basin. When the sand and gravel encroaching on the settling pool reached beyond the well, it and a part of the outlet box were removed, the portion of the box remaining through the toes was plugged and filled with boulders, sand and puddle material. A new box was then built over the toe of the dam and framework for the new well erected.

It is interesting to note that when 15 cu.ft. per second of water was being run in the flumes, the velocity was 20 ft. per second (surface velocity), but when solids were being carried, the velocity dropped to 15 ft. per second.

The percentage of material carried by the water was very small, about 1,500 cu.yd. per day was considered a very creditable accomplishment. The net amount of water used in sluicing was about 450 acre-feet per month, or 756,000 cu.yd., or the percentage of solids to water was 5½ per cent, as a maximum on a single month's run. Generally, the amount of solids was about 3 per cent, of which, from numerous tests, one-third was puddle material. Under similar conditions, and with similar materials, it would be unsafe to assume more than 5½ per cent solids, even where water was scarce, and would be carefully conserved and handled.

Had it been possible to put the sluice flumes on a 5 per cent minimum grade much better results would have been obtained; the flume men could have been dispensed with; the monitor men could have driven in a greater per cent of solids without clogging, and the necessary and added expense of securing every possible yard of material from the borrow pits would have been avoided, as the borrow pits could have been excavated to greater depths.

The proportion of boulders, gravel, sand and puddle in the dam was never determined, but the boulder section on both faces is in excess of 50 ft. at every point. A section of the dam, with the different classes of material indicated, is shown by the drawing. The boulder section is composed of material in excess of 3 in. in diameter, the interstices, however, being filled with gravel and sand. The gravel section is composed of material less than 3 in. in diameter. The sand is material which would pass a ¼ in. mesh screen, and was deposited at the edge of the settling pool. The boulders were deposited on a slope of about 1 on 3, the gravel on a slope of 1 on 10.

Cost Data

In the accompanying summary of costs the item Power Canal includes repairs and the wages of ditch walkers. It is probable that those items are too low, as in the numerous emergencies materials and labor charged to sluice flumes and dam were used on the power canal. Pipe Line includes the expense of moving and maintaining the monitors and pipe lines; Sluice Flumes includes construction and repairs; Dam is the expense of sluicing and includes wages of monitor men, sluice flume tenders and other work pertaining to the placing of materials on the dam; Storm Flumes is the expense of protective work against floods, the principal item being the building of the storm flumes; Engineering and Camp includes engineering and other camp expenses, loss on commissary, boarding house, etc.; Plant and equipment, consisting of the power canal and pipe line, was built by contract for $63,000, and it is said to have yielded a very large profit to the contractor. Certainly the expenditure of such a sum should have secured a much more permanent and reliable structure.

Timber for trestle work was obtainable on the adjacent hills. Local sawmills furnished lumber at $25 per thousand; the distance to supply points was twenty-five miles, with roads fair and generally level, except five miles which had from 2 per cent to 10 per cent grades. The cost of hauling supplies was 75c. per cwt. The wages were, for foreman, $150 per month, and board; for shift bosses, $125 per month, and board;

and for labor, $2 to $3.50 per day. Board cost 75c. per day. Rubber boots and slickers were furnished to men working in water.

The accompanying table shows the cost of sluicing for each year. The year's program was, March 25 to 31, organizing forces and securing supplies; April 1 to May 1, digging channel in power canal, and cutting ice out with water; May 1 to 15, testing out plant, generally repairing power canal, building flumes, etc.; May 15 to Oct. 1 to 10, sluicing. Ice often froze and weighted down flumes prior to May 15 and after Sept. 15. By Oct. 10 it was impossible to work, and work was generally suspended, as the men were hard to hold on account of the freezing water in which they worked.

Diagram for Computing Paint Values

IN *Engineering News-Record* of Jan. 6, p. 42, Prof. A. H. Sabin discussed the question of how much a paint user can afford to pay for paint which will last, say four years and costs $6 per gallon to apply, when he has available at $3.50 per gallon another paint, which also costs $6 to apply, but which lasts five years. The chart reproduced herewith enables such cost calculations to be made more rapidly. It includes the three factors of paint cost, labor cost to apply the paint (both in dollars per gallon), and years of life. Three explanatory diagrams below the main diagram show the method of using it in three different calculations.

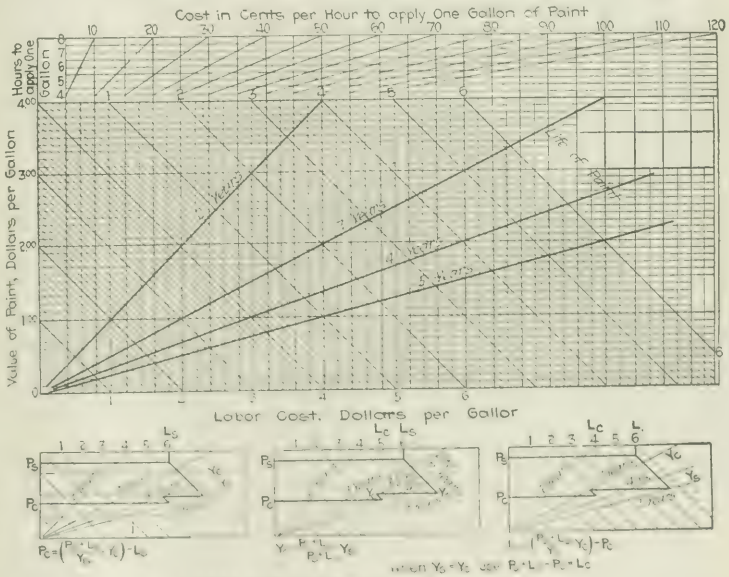


CHART FOR DETERMINING PAINT VALUES

In the first example, the case calculated by Prof. Sabin is shown. One paint is worth $3.50 per gallon, costs $6 per gallon to apply, and will last five years; then how much is a gallon of paint worth that lasts only four years, the cost of application being the same? At the intersection of the horizontal for $3.50 paint cost with the vertical through $6 labor cost (upper scale), the diagonal (which represents cost of a gallon of paint applied) is followed down to where it meets the sloping line representing five years of life. From here, following back the horizontal to intersect the line for four years of life, the total-cost diagonal is followed down to intersect the labor-cost vertical, giving the horizontal line $1.60, which is the value per gallon of the second paint.

In the second small diagram the problem is worked out of determining how long a given paint must last in order to be as economical as another paint, for which cost and length of life are known. Following through the lines shown on the diagram, it will be found that a life of 3.47 years should be expected of the cheaper paint.

Sometimes computations of justifiable labor cost to apply paint may have to be made. The third of the small diagrams shows such a calculation. A $3.50 paint is used whose spreading rate requires a man to spend $6 worth of labor time to apply it, and it is customary practice to repaint every five years. If instead a cheaper paint, bought for $1.60 per gallon is used, which, however, requires repainting every three years, it may not pay to spend as much labor in applying it. The calculation, carried out as indicated on the diagram, shows that not over $4.10 labor cost per gallon should be spent.

The formulas by which the calculations may be carried out are noted on the diagrams. Ordinarily, however, the diagrams themselves will be found much more rapid than numerical computation.

Study of Sulphur and Phosphorus

TEST of rivet bars and rivets madew ith various sulphur content including sulphur well above present allowable limits are in progress at the Watertown Arsenal and the Naval Experiment Station at Annapolis, according to information just issued by the joint committee on investigation of phosphorus and sulphur in steel (G. K. Burgess, chairman, C. L. Warwick, secretary). These tests will shortly be extended to plate and shape steel with carbon ranging from 0.06 to 0.22 per cent, manganese 0.35 to 0.40 per cent, phosphorus normal, and sulphur varying from 0.03 to 0.08 per cent. Still higher sulphur content will be subjected to test in material rolled from special ingots recently made with sulphur (iron sulphide) added after pouring, the maximum in this series being 0.15 per cent. This material will be tested transversely as well as longitudinally.

Studies are being initiated to devise service tests on material of high sulphur or high phosphorus content. The joint committee is also continuing its efforts to secure material that has either failed or proved itself in service with sulphur or phosphorus content above normal.

Tests Fix Vehicle Tunnel Ventilation Policies

Carbon Monoxide Limit of 4 Parts Per 10,000 Established—Forty Air Changes Per Hour in Tubes

BASED upon the results of experiments conducted jointly with the U. S. Bureau of Mines, the New York-New Jersey Tunnel Commissions have determined upon general policies of ventilating the two 29-ft. subaqueous tubes which involve fresh air requirements of 3,600,000 cu.ft. per minute, equivalent to about forty changes of air per hour in each tube. The tests also show that safe conditions will result if a dilution of the exhaust gases of motor vehicles using the tunnel is regulated so as to limit the amount of carbon monoxide to 4 parts per 10,000. The results of the tests are summarized in the 1920 annual report of C. M. Holland, chief engineer of the commissions, the source of the following notes:

The ventilation of the tunnels, about 8,300 ft. long between portals, has been investigated under the following three subdivisions: (1) Amount and composition of exhaust gases from motor vehicles; (2) the dilution necessary to render the exhaust gases harmless; (3) method and equipment necessary for adequate ventilation.

Impurities in the atmosphere of a tunnel used by motor vehicles are the products of combustion of gasoline. Ventilation requirements are largely dependent upon the amount of carbon monoxide produced. This gas is a result of incomplete combustion and is poisonous. It has an affinity for the blood and reduces its oxygen-carrying capacity. The symptoms of carbon monoxide poisoning are headache, nausea, weakness of the limbs, and, in severe cases, unconsciousness.

Amount and Composition of Exhaust Gases—Tests under the direction of A. C. Fieldner, supervising chemist, were made on 101 motor vehicles to determine the amount and composition of exhaust gases. The motor vehicles tested were classified in four groups—passenger cars, trucks under 2-ton capacity, 2 to 5 tons, and 5 tons and over. The average results of all road tests show that at a speed of 6 miles per hour the exhaust gases of trucks contained the following percentages of carbon monoxide: 7.44 on up-grade, 5.38 on down-grade, and 7.56 on level-grade, with corresponding quantities of carbon monoxide, in cubic feet per car per minute, of 1.95, 0.72 and 1.40. At a speed of ten miles per hour, the corresponding percentages for trucks were 6.20, 6.22 and 7.30, and for passenger cars, 7.03, 6.30 and 7.19, with corresponding quantities of carbon monoxide in cubic feet per car per minute for trucks of 2.43, 1.21 and 1.99, and for passenger cars, 1.33, 0.62 and 0.99. The average percentages of carbon monoxide in the exhaust gases for all cars tested were: With engines idling, 6.72; engines racing, 7.37; accelerating from rest up maximum grade, 6.40; with corresponding quantities of carbon monoxide in cubic feet per car per minute, 0.644, 1.53 and 2.11. The fact that the quantity of carbon monoxide produced per minute with engine idling is small shows that where traffic is blocked and the cars crowded closer together than during normal operation, the ventilation requirements would be no greater than during normal operation.

The experiments also included the determination of the heat produced by the combustion of gasoline and it was found that 1 lb. of gasoline produced 14,910 B.t.u. In general, the results of the test showed that the exhaust gases contained about 6.8 per cent carbon monoxide and 8.4 per cent carbon dioxide, developing only 67 per cent of the heat value of the gasoline, so that about one-third of the gasoline fuel used for motor vehicles is wasted through incomplete combustion.

Dilution of Gases—Experiments to determine the proper dilution to render the exhaust gases harmless were conducted at the Bureau of Mines Experiment Station at Yale University under the direction of Dr. Yandell Henderson, consulting physiologist. Members of the staff spent periods of 1 hr. in a chamber of 226 cu.ft. capacity in amounts of carbon monoxide varying from 2 to 10 parts per 10,000. In addition, tests were also performed on a large number of persons in a chamber of 12,000 cu.ft. capacity into which an automobile engine exhausted. The length of time required to travel through the Hudson vehicular tunnel from portal to portal at a speed of 3 miles per hour will be 31.4 min. and the 1-hr. test, therefore, was considered sufficient. The average speed of passenger cars through the tunnel will probably be not less 10 miles an hour, requiring a 9.4-min. trip. It is considered, the report states, that a standard adopted on a basis of 45 min. time in the tunnel will assure the safety of passengers.

The physiological effects of carbon monoxide are wholly due to the union of carbon monoxide with the hemoglobin of the blood. The combination of carbon monoxide and hemoglobin is a reversible action, so that when a person returns to fresh air the carbon monoxide is gradually eliminated. Headache proved the most definite and reliable sign of carbon monoxide poisoning. Concentrations of gas too weak or periods of exposure too short to induce this sign are considered harmless. No one had this symptom to an appreciable degree after a period of 1 hr. in the chamber with 4 parts per 10,000 of carbon monoxide. With 6 parts the degree of effect, if any, was usually very slight, while with 8 parts there was decided discomfort for some hours, although not enough to interfere with the continuance of efficient work in the laboratory or at the desk. The accompanying table summarizes the experimental results for 1-hr. exposure to various concentrations in the chamber:

Parts CO in 10,000 Parts of Air Breathed	Corresponding Equilibrium Value for Blood Percentage Saturation	Percentage Saturation in Blood After 1 Hr.	Headache
2	23	11–12	None
4	36	16–20	None
6	47	18–26	None or slight
8	53	32–34	Distinct
10	58	38	Marked for several hours

Passengers in cars going through the tunnel in about 10 or 15 min. will absorb very little gas. The standard recommended for the tunnels—a uniform concentration not exceeding 4 parts carbon monoxide in 10,000 parts of air or its equivalent is considered a safe and conservative figure. Risk of considerable discomfort would begin at from 8 to 9 parts. These conclusions agree closely with others arrived at independently by Dr. Haldane, the British authority.

Ventilation Method and Equipment—The estimated capacity of the 20-ft. tunnel roadway with two lines of

motor vehicles operating in the same direction is 1,900 vehicles per hour. In calculating the ventilation requirements, however, this number has been increased as a basis for determining the amount of fresh air required. Assumed speeds and spacing in the two lines of traffic have been used giving a total of 2,113 vehicles per hour, or about 11 per cent greater than the estimated capacity of the tunnel.

ESTIMATE OF TRAFFIC FOR VENTILATION REQUIREMENTS

	Vehicles per Hr.	Per Cent of Total Traffic	Vehicles in Tunnel
Fast Line (speed 10 mi. per hr., spacing 40 ft.)			
Pleasure cars	360	17	57
Trucks less than 2-ton capacity	180	8.5	28
Trucks, 2 to 5 tons	780	37	123
Slow Line (speed, 6 mi. per hr., spacing 40 ft.)			
Motor trucks 5 tons and over	793	37.5	208
Total	2,113	100.0	416

The road tests on motor vehicles showed that the volume of carbon monoxide produced varies with the gradients. For the conditions of traffic as given in the table, 293 cu.ft. of fresh air per minute per foot of up-grade are required, 124.6 cu.ft. for the down-grade and 224.5 cu.ft. for the level-grade. The sections from the tunnel portals to the street surface will be either entirely open or sufficiently open to allow of natural ventilation. The following tabulation shows the amount of fresh air in cubic feet per minute required on the various grades in each tube:

CUBIC FEET OF AIR PER MINUTE FOR VENTILATION

	Up-Grade	Level-Grade	Down-Grade	Total
North tube	810,145	757,687	266,074	1,833,906
South tube	701,735	757,687	323,277	1,782,699
				3,616,605

This represents 54, 42 and 23 air changes per hour on the up-grades, level-grades and down-grades, respectively, or an average of 41 changes per hour for the north tube and 40 changes per hour for the south tube.

In considering the method of ventilation two general methods have been studied, namely, longitudinal and distributive. High air velocities and lack of definite control have led the commissions' engineering staff to discard the longitudinal method of ventilation and to recommend a distributive method whereby air is introduced into and exhausted from the tunnel through a number of openings at frequent intervals leading from the roadway. The fresh-air duct is to be located below and the exhaust duct above the tunnel roadway. Fresh air, supplied by blower fans at the shafts, will be discharged from the main ducts through adjustable openings into continuous expansion chambers on each side of the roadway, from which the air will escape into the tunnel. The exhaust ducts, located above the roadway and connected with the exhaust fans at the shafts, will have openings of varying sizes provided with adjustable shutters. By making the openings for the intakes and outlets adjustable, it will be possible to regulate the volume of air supplied and withdrawn so as to meet the requirements of traffic.

Each tunnel will have four ventilating shafts, two located near the pierhead line and the others about midway between these points and the portals. The distance between river ventilating shafts is about 3,375 ft. In co-operation with the U. S. Bureau of Mines a series of tests is now being conducted at the University of Illinois to supply data for an adequate and economical design of the ventilating ducts for the tunnels.

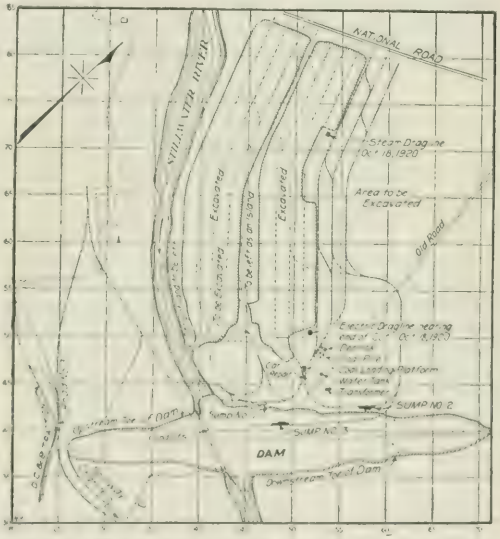
Dragline Excavator Operations at the Englewood Dam

By H. S. R. McCurdy

Division Engineer, Englewood Dam, Miami Conservancy District, Dayton, Ohio

CONTINUOUS high output, because of the plan of operation followed, has been recorded by the dragline excavators at work on the Englewood dam of the Miami valley flood protection works. These machines are loading a coarse glacial gravel into 12-yd. cars hauled in five-car trains to hog-box sumps, whence the dumped material is pumped into the dam embankment. Working two 10-hour shifts the monthly output for each excavator has averaged 75,000 cu.yd. To date the best performance of a single machine has been to load 274 cars or 2,740 cu.yd. in a 10-hour shift. At three bucketfuls to a car this performance involves 82.2 scoops and swings per hour.

As shown by the map, the borrow pit area at Englewood is about 2,000 ft. square. The depth of excavation



BORROW PIT AND SPOIL TRACK LAYOUT AT ENGLEWOOD DAM

is from 15 to 20 ft. When the dam is completed the pit connecting with the Stillwater River will form an artificial lake of about 200 acres.

Two 115-ton draglines, one steam and one electric, fitted with 85-ft. booms and equipped with 4½-cu.yd. buckets excavate and load the material. The loading tracks run north and south across the pit area, at intervals of 150 ft., with connections to each other and to the sumps as indicated by the map. All cuts run north and south and are made progressively across the pit from west to east. The draglines travel up one cut and down the next, being spaced about 1,500 ft. apart along the cut. By this arrangement one machine reaches the middle of the pit as the other reaches the end and both move to the new cut at about the same time. In each cut the machines excavate the area between the face of the previous cut and the loading track, backing along as they work as the map indicates.

There are six materials trains. The empty trains run from the sumps directly to the southerly dragline, waiting there for the trains to be loaded and moved ahead. A train stands at each dragline. As the northerly machine is loading the next to the last car the engine runner blows his whistle. At this signal the train, also partially loaded, at the southerly dragline proceeds to the northerly dragline and an empty train takes its place at the southerly dragline. Time for the shift is provided by the period required to load the last car of the northerly train. Should it happen that a train at the southerly dragline is fully loaded before a signal comes from the northerly dragline it moves directly to the pumps by means of a cross-over from the loading track. This schedule is sufficiently flexible to meet actual operating conditions and reduce the dragline delays due to train service to very limited periods. It is worth note perhaps that experience with over two million cubic yards of excavation shows that each 4½-cu.yd. bucketful excavated builds 3 cu.yd. of dam embankment.

The Englewood dam is a portion of the flood protection works of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Charles H. Paul, assistant chief engineer and C. H. Locher, construction manager.

Milwaukee Chemists Say Postpone Water Filtration

AN ADVERSE report on the proposed water filtration plant for Milwaukee has been made by a committee of the local section of the American Chemical Society and endorsed by the section, according to the March *Chemical Bulletin.* This report is the result of a request made by the Mayor to the local section for an opinion on the recommendations of J. W. Ellms in his report on the Milwaukee water purification experiments and plans for treating the supply (*Engineering News-Record,* Aug. 5, 1920, p. 297). The principal finding of the committee (George N. Prentiss, chairman) was that water filtration will not remove tastes and odors in the Milwaukee water which are due to products from the chlorine treatment of water contaminated by phenol derivatives in industrial wastes, whereas the activated-sludge process will keep the phenol derivatives out of the lake or else so change them that they will not combine with chlorine to cause tastes and odors in the water.

Other points made are (1) that chlorination will continue to insure a safe water until the sewage treatment plant is in operation when the contamination will decrease with a corresponding decrease in chlorine required; (2) that contamination from passing vessels can be eliminated by federal regulation; (3) that most of the street contamination will be carried into the sewers by the first rush of storm water; (4) that the activated-sludge process will remove 90 per cent of the bacteria and 95 per cent of the solid matter in the sewage; (5) that some form of filtration is desirable but it can be deferred until additional chemical and experimental work has been done upon the problem of precipitation, filtration and chlorination, or even until the sewage treatment plant has demonstrated what influence it will have on these problems; (6) that recent experiments on sewage sedimentation and filtration on Jones Island justify consideration of their applicability to water filtration; (7) that an additional water chlorination house and equipment be installed for emergency use; (8) that the city endow one of the larger universities with a suitable sum for research on sewage and water along the lines of sedimentation, filtration and chlorination, the work to be carried on by an expert in modern physical and colloidal chemistry; (9) that a committee of chemists and engineers be appointed to act as an advisory and consulting body on all matters pertaining to water purification; (10) that all research and experimental work and all projects dealing with water purification and sewage treatment be under the jurisdiction of one body.

The committee points to the typhoid statistics of Milwaukee as proof that the water supply is not a present menace to health. It states that in 1919 the Milwaukee typhoid death rate was 3.5 per 100,000, placing it second best among cities of over 200,000 population, and says that advance figures for 1920 show a still lower death rate from typhoid.

The New Indiana License Law

POINTS in the Indiana license law, recently enacted, are as follows: It covers professional engineers and surveyors whose duties are not defined. They must obtain a license within six months after the act goes into effect. A State board of registration consisting of six members, at least two of whom shall be professional engineers and two land surveyors, is to be appointed by the Governor. Board members receive $10 per day plus expenses during the period of attendance at sessions. Registration costs $25 and annual renewal $10. "Evidence satisfactory to the board" is required. A reciprocity clause is included for those holding licenses from other states and provinces of Canada, where requirements are of a "standard satisfactory to the board."

Persons eligible must be more than 25 years old; citizens of United States or Canada; must speak or write English; be of good reputation and have been engaged for six years in active practice. Ten years' practice or graduation and four years' practice shall be regarded as *prima facie* satisfactory evidence of the applicant's qualifications. When evidence is not conclusive an examination may be given. Those now practicing may be registered at any time within a year. Revocation of license may be made in the case of gross negligence, incompetence or misconduct. Practicing or offering to practice, except for non-residents, is a misdemeanor punishable by a fine of from $100 to $500, or three months' imprisonment or both. Outside engineers may offer to practice and practice after filing application. Exemptions include employees of registered engineers and surveyors, officers of the United States when practicing as such, duly elected and qualified county surveyors. Corporations or partnerships may practice if the members are registered.

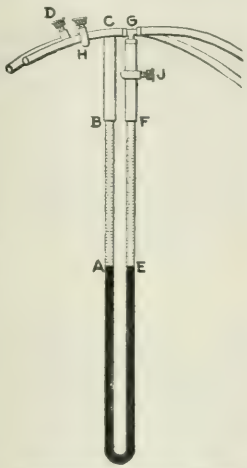
Traffic Chart Correction

Figures for the distribution of tonnage on the traffic chart on p. 339 of the Feb. 24 issue were erroneously given. The chart shows a total of 8,607 tons, which should have been distributed as follows: Pleasure motors, 6,556 tons or 76.1 per cent of the total tonnage; motor trucks, 1,807 tons or 21 per cent; motor-cycles, 17 tons or 0.2 per cent; horse-drawn vehicles, 227 tons or 2.7 per cent.

Excluding Air From Pitometer Piping

By F. W. Medough
Department of Engineering, Johns Hopkins University, Baltimore, Md.

THE usual method of expelling air from the pitometer piping preparatory to taking readings consists of the following steps: Close valve *J* (see figure) to prevent circulation and consequent loss of the carbon tetrachloride mixture. Open valves *D* and *H* and allow water to flow through freely until all of the air in the tubing between the water pipe and the valves has been expelled. Then close valves *D* and *H* and open valve *J*, thus allowing the liquid to circulate. Now very carefully open valves *D* and *H* a trifle at a time, so regulating the pressure that the liquid is forced up first in one side of the tube and then in the other. The result is that the water column *EF* is forced up to the position *FG* and any air bubbles between *F* and *H* are carried up and out with the outflowing stream. The same thing happens to air bubbles between *B* and *C* when the liquid is forced up in the other side.



PITOMETER PIPING AND VALVES

The only objection to this method is that is requires a very steady hand and the amateur usually allows the pressure to become too great on one side, with the result that the carbon tetrachloride mixture is shot past the bottom of the U-tube and lost. This may be easily avoided by running a fine wire through each valve so that one wire will extend from *D* to *B* and the other wire from *H* to *F*. Also between *B* and *C* add another valve, *K*, similar to the valve *J*. Now close valve *K* and open valves *H* and *J*, holding the discharge end of the tubing up a little higher than the tee. The air bubbles between *F* and *G* will travel up the wire and escape at the same time that the air is being pushed out of the tubing between the water pipe and the valve *H*. When all of the air has been expelled from one side close the valves *H* and *J* and open the valves *K* and *D* and allow the water to run until all of the air has been expelled from this side. Now close valve *D* and open valve *J* and the operator may begin to take readings. As the valves can be closed with the wire in the rubber tubing it is not necessary to remove the wire.

City Faces Damage Suits After Typhoid Epidemic

As a result of a typhoid outbreak in Pittsburg, Cal., ascribed to a polluted water supply, reference to which appears in *Engineering News-Record*, Dec. 30, 1920, p. 1288, and on p. 605 of this issue, 21 suits have been filed against the city by persons who were sick during the outbreak. The damage claims are reported to total about $140,000.

Letters to the Editor

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

The First Engineering School in America

Sir—In *Engineering News-Record*, Feb. 24, 1921, p. 349 there appeared a letter claiming that Norwich University and not Union College was the first college in America to give an engineering course. Neither of these was the first; the honor belongs to the Rensselaer Polytechnic Institute, Troy, N. Y. This school was founded by Stephen Van Rensselaer in 1824 as a school for "Instruction in Mathematics, Physics, Chemistry, Geology, and Natural History, with their application to Civil Engineering, the Arts, Manufacture, and Agriculture" and was at that time called the Rensselaer School. Professor Eaton, the senior professor, was a land surveyor in 1790 and in the catalogue of 1828 Eaton is put down as Professor of Civil Engineering. In a pamphlet of 1826 it says that surveying, hydraulics and mechanical powers were taught, as was likewise what was known of galvanic batteries and electrometers.

A full description of the college may be obtained from History of the Institute, John Wiley, 2nd ed., or may be found in "The New International Encyclopedia."

Danbury, Conn., March 28. Thomas M. Belden, R. P. I., Class of 1915.

Chlorination at Pittsburg, Cal.: A Correction

Sir—I wish to correct an erroneous impression given in *Engineering News-Record*, Dec. 30, 1920, p. 1288, under the title "Results of Stopping Chlorination One Day." I fear that a casual reader of this article, which is supposed to be an abstract of a paper recently prepared by me, would conclude that the typhoid outbreak at Pittsburg, Cal., resulted from a method of water-works operation consented to by the State Board of Health.

The article states that "as the population served is only about 5,000, a single small-capacity chlorination plant was considered sufficient." This department certainly did not so view the situation; nor did the city. As a matter of fact, an emergency hypochlorite installation and rapid sand filters were also provided at this plant.

The article further states that "for the short time during which chlorination was to be discontinued it was not considered necessary to start up the chlorine of lime plant." It should be added that the person who took it upon himself to decide this point was the plant operator. Neither the city officials nor the State Board of Health were notified of a cessation in treatment. When the typhoid outbreak brought on an investigation revealing the facts, this operator and the superintendent of water-works were both discharged.

The article then states that "In view of this experience Mr. Hilscher recommended the installation of duplicate chlorination plants." Such a recommendation was not made in the case of Pittsburg. The epidemic was due to carelessness operation and not a lack of equipment. Furthermore, the city at that time had nearly completed development of a well supply and within a month following the epidemic the river supply was permanently abandoned.

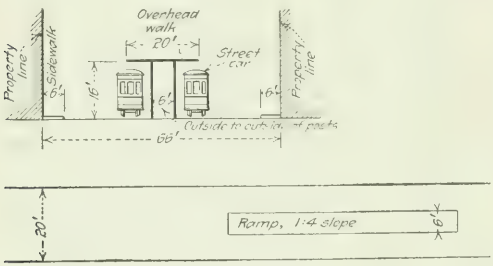
Very truly yours,

Berkeley, Cal., Jan. 4. Ralph Hilscher,
Director Bureau of Sanitary Engineering
California State Board of Health.

[We regret our misunderstanding or misinterpretation of the paper in question.—Editor.]

Elevated Sidewalk Proposed to Relieve Traffic Congestion

Sir—Nearly all cities face the congested traffic problem. It is also well known that the 66-ft. street is a factor to be reckoned with. The accompanying sketch shows construction of a proposed 20-ft. sidewalk directly over the street car lines. The supporting columns are 6 ft. from outside to outside. This gives a 6-ft. platform in the center of the street which will facilitate loading and unloading street



cars. The ramps are 6 ft. wide and have an easy 1:4 slope. Retail merchants would favor the construction of this central sidewalk as it would equalize both sides of the street. Practically all stores would make a connection with the sidewalk. The construction of the central overhead walk would mean cutting down side walk property line to 6 ft.

Olympia, Wash., March 20. FRANK W. HARRIS.

In Defense of the Marshall Plan

Sir—In your issue of Feb. 10, 1921, p. 273 there was published a letter under the caption "Marshall Plan For All-California Irrigation Held Chimerical" in which the Marshall plan was roundly scored as being "chimerical," "ill conceived," "fantastical," etc. In the same issue was a notice that the San Francisco section of the American Society of Civil Engineers has passed resolutions condemning the Marshall plan.

Now, what is the Marshall plan, and why the haste to condemn it, out of hand, as it were? Briefly, the Marshall plan proposes to impound in storage reservoirs along the upper sources of the rivers, the flood waters of the rainy season, and to distribute them during the dry season; to divert a portion from the northern part of the state where there is an excess, to the southern portion where there is a deficiency. In the completion of this plan at least five great objects are to be accomplished: (1), Complete control of the spring floods with elimination of the heavy annual cost of levee work; (2), a state control of all available water resources with equitable distribution; (3), irrigation of a vast domain of potentially rich valley lands; (4), generation of hydro-electric power; (5), adequate supplies of potable water to all communities.

These problems have been pressing for solution with ever increasing urge and the past year, which was the culmination of a series of very dry years in California, has served to forcibly bring them before the public mind as never before. By reason of the small fresh water flow in the Sacramento River last summer the salt water from the ocean crept many miles inland carrying with it the teredo, which destroyed many thousands of dollars worth of wooden piling hitherto immune, and polluted the drinking water of some of the cities along the way. In consequence, one of these cities started litigation against the irrigationists along the upper stretches of the river and while the present heavy rainfall will relieve the situation for the time being, it is evidently no guarantee against future recurrences of a similar nature.

Water rights in California have been the source of long and expensive litigation and the end is not in sight. Private owners, the state of California and the Federal Government have spent hundreds of thousands of dollars in dredging, straightening and levee work along the Sacramento and San Joaquin rivers and are still at it. Irrigation projects in the past have been developed or promoted with little or no regard for the interests of anyone outside the particular territory involved and similar schemes are constantly being agitated. San Francisco has turned to the Sierra Nevada mountains for a domestic water-supply and the cities on the east side of San Francisco Bay, already warned by their local water company that its limit of development will provide for only ten years more of normal city growth are trying to get together upon some method that will insure a supply adequate for their future needs.

Surely, no time is more opportune than the present for a broad gage and impartial solution of these troublesome matters if any such can be had. This, it is believed, the Marshall plan, if feasible, will accomplish, and the California State Irrigation Association is asking the state legislature to make, through the state engineering department, a thorough investigation of the project.

Col. R. B. Marshall who has proposed this comprehensive scheme was for many years in charge of the United States Geological Survey's topographic work in California and is therefore acquainted, as is probably no other man, with the state's topography as a whole. After a lifetime of labor in this particular field he is staking his reputation on the assertion that the plan he has developed is physically practical and the question is too important for the state of California to refuse it serious consideration.

Alameda, Cal., G. B. ASHCROFT.
Mar. 17. Civil and Structural Engineer.

Wind Pressures on Surfaces

Sir—In *Engineering News-Record*, Feb. 24, 1921, page 352, is a discussion of the effect of wind pressure on inclined surfaces. Both parties seem to put their faith in formulas which were developed before the advent of the airplane had given its great impetus to the study of aërodynamics. It would seem to an engineer in touch with aëronautical work that the proper way to learn the effect of wind on buildings is the method used to determine its effect on an airplane wing; i.e., by wind tunnel tests on a model. Instead of relying on the old formulas of Hutton and Duchemin for their wind loads, civil engineers should obtain the co-operation of aëronautical engineers to obtain wind tunnel tests that would determine the wind loads which should be assumed for different conditions.

In view of the number of wind tunnels in existence, as at the Bureau of Standards and the Massachusetts Institute of Technology, to name only two, there is little excuse for engineers using formulas for wind pressure handed down from the "dark ages" of aërodynamics instead of using our modern facilities for obtaining correct data.

ALFRED S. NILES,
Aëronautical Structural Engineer,
Engineering Division, Army Air Service.
Dayton, Ohio, Mar. 7.

British Road Classification Is Nearing Completion

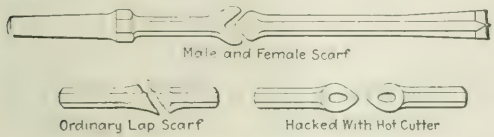
The classification of roads under the British Ministry of Transports' scheme is nearing completion and, when the schedules reach their final form it is the intention of the ministry to distinguish each first- and second-class road by an individual number. Another feature of the scheme is the standardization of warning signs and road direction posts; provision has been made for indicating the route numbers on the arms of posts in the belief that "the universal adoption of this practice would be of the greatest service to road users generally." These details are included in a letter from the ministry to the highway authorities in England. The letter concludes by saying that Sir Eric Geddes is not advocating "any wholesale replacement of serviceable signs at the present time.

HINTS FOR THE CONTRACTOR

Reclaiming Hollow Drill Steel

By J. C. Lamon
Calderwood, Tenn.

IN QUARRY and mine operations where jackhamers and water-line drilling machines are used largely, many pieces of hollow drill steel become broken owing to the hard use to which they are put. Considerable loss is involved unless some proper method of reclaiming this steel is devised. Hollow drill steels should first be collected and classified, so that in reclaiming the original lengths can be kept.



METHODS OF SCARFING STEEL FOR THE WELD

It is essential to pay proper attention to the arrangement of the forge fires and the use of high-grade smithing coal. Slaked coal having no lump larger than that which will pass through ½-in. mesh should be used.

In building the forge fire dampen the coal and thoroughly mix it until it is in a plastic condition. Then place a block of wood 4 in. x 4 in. x 15 in. on the draft opening, and fill up around the block thoroughly and pack the coal with a sledge. Remove the block and fill up the hole with live coals, oily waste, or any dry material which will ignite readily. When the fire is well started, put on some coke, allowing the fire to get hot before welding operations proceed. The idea in this is to confine the fire to a very small area so that the welding operations can proceed with ease.

The plane of the anvil should be that of the forge. On the side of the anvil opposite the forge place some sort of rigid frame upon which the drill steel can rest and against which they may be thrust when the welding operations begin. If the male-and-female-scarf method is used, the pieces of scarf steel are driven together in the fire, then withdrawn on the anvil. Careful attention to the scarfing details should be made regardless of the methods used.

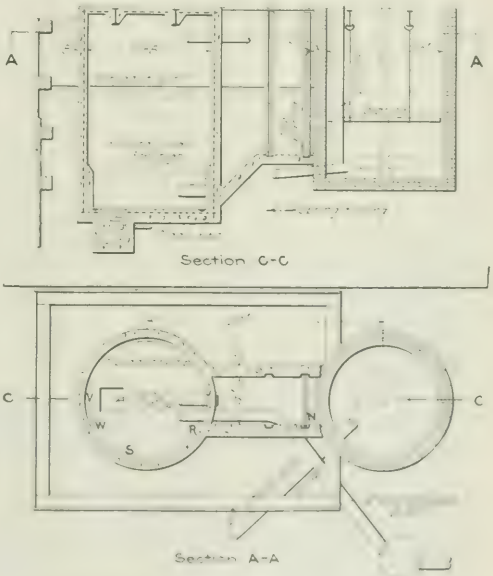
In diagonal scarf welding the broken ends should be heated to a forging heat a distance of approximately 3 in. from the break and where the weld is to be. After heating, drift holes with a long tapered drift pin. Then with a sharp hot cutter cut the steel diagonally to form the scarf. Drift out the hole again and pack the scarf with the hot cutter. Place the steel in the fire, scarf side up. Take a slow heat, applying a little welding compound. When at the proper welding temperature, bring out the steel and make the weld on the anvil. After the weld has been made, the holes can be cleared out of all scales with a small wire. Place the steel in a dry place and allow it to cool. Care must be exercised in both heating and cooling as only in that manner can forging strains be removed and the drill steel be insured against breaking at or near the weld.

Waterproofing a Vertical Lift Well

By George L. Knott
Civil Engineer, Brooklyn, N. Y.

WHILE the writer was superintendent of public works at the Naval Operating Base, Hampton Roads, Va., he had charge of a new concrete lift sewer well 10 ft. 8 in. in diameter, 17 ft. deep, with 8-in. walls, and with ⅜-in. rods for reinforcing the sides and ½-in. rods for bottom slabs. The passageway between the wells was 12 in. thick, with reinforcement only at the bottom. The concrete mixture was 1 : 1½ : 3, with 5 lb. of hydrated lime for integral waterproofing. The earth pressure assumed was 90 lb. per cu.ft.

The material excavated was a heavy muck, and 6 ft. below the surface water was found. A running spring with a 10-ft. head of water was also encountered. The muck weighed 130 lb. per cu.ft.



SECTIONS OF SEWER LIFT WELL SHOWING LEAKAGE POINTS

When the excavation was completed and the water was pumped out the inner and outer forms were placed, the pumps working all the time. The labor foreman was instructed to complete the job in one day without the top slab in place and to puddle well the sides of the shell in placing each batch of concrete. After pouring the concrete the spring broke through the sump and we had to allow the water to remain for seven days before stripping the forms. We then pumped the water out, finding additional leaks at *N* and *W*. We then decided to build an inner curtain wall 3 ft. 6 in. high, 6 in. wide, of a 1 : 1½ : 3 mixture with 5 lb. of hydrated lime per batch of concrete. After this had set three days we

stripped off the forms and again pumped the water out. Only the leak at *W* had stopped.

As the leak in the sump was a bad one, we inserted a 3-in. galvanized pipe under the slab and forced the water to come to one place. We then capped the pipe and soon had other leaks as the water arose outside. We uncapped the pipe, brought pumps to both inside and outside, and then had the outside back-filled with well-tamped heavy muck in the hope of forcing the stream off from the bottom slab. When the backfilling was completed we capped the pipe again, filled the sump up with concrete, incasing the pipe in it, but still the water leaked through.

We then chipped up the 1-in. concrete inner surfacing, drove down at the edge of the inner curtain wall leaded hemp 1 in. deep, then applied 1 in. of new finish over all. We then took common brick, heated it and placed it in the sump, flush with the inner bottom. We troweled the cement hard, and found after cooling we had no more leaks from the sump.

Concrete Truss Spans Erected Without Falsework

IN ERECTING the six 66-ft. truss spans of a reinforced-concrete highway bridge at Wichita Falls, Tex., the contractor used a scheme of construction that eliminated the necessity for falsework. This resulted in a cost very much lower than bids submitted for concrete arches and made it possible to carry on the work without regard to the stage of the river or fear of settlement in the falsework supports. In place of the usual falsework a pair of steel trusses, supported by the piers for the permanent structure, carried the weight of the concrete during erection. These steel trusses were moved along from one span to another as the work progressed. The concrete trusses were cast in a horizontal position on a temporary floor carried by the steel trusses, and after hardening were raised to their final vertical position by tackle slung from the top of the steel trusses.

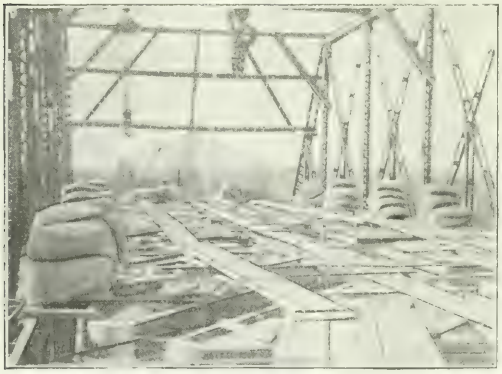
This method simplified the pouring of concrete, as the forms used consisted chiefly of simple triangular frames or bottomless boxes placed on the temporary floor. The depth of these forms was the width of the truss. The forms were so placed that when the truss was raised to a vertical plane it was very nearly in its final position, so that a minimum of handling was necessary.

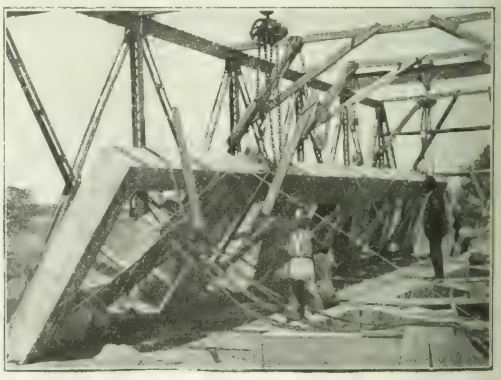
In order to avoid getting lateral curvature in the concrete trusses due to deflection of the steel trusses under the weight of the concrete, the temporary bridge was so cambered that the weight of the concrete would bring the floor to a horizontal line. The sand and gravel to be used in the concrete was sacked and, together with the cement, also in sacks, was distributed uniformly along the span before any of the concrete was mixed and poured. Thus the full deflection in the steel trusses occurred before the pouring commenced, and did not change afterward.

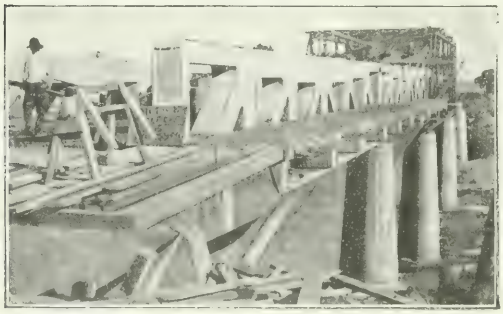
Provision for supporting the floor beams was made at the time of casting the trusses, rectangular openings being left in them for this purpose. The floor beams are 42 in. deep and 15 in. wide; their reinforcement continues on through the openings and serves to reinforce the cantilever brackets supporting the 4-ft. sidewalks built on the outside of each concrete truss.

When the work on one span was finished, the steel trusses were moved forward to the next span, first on rollers resting on the top chords of the concrete trusses and later, after the trusses were half way across the new span, on another set of rollers underneath the bottom chord of the concrete trusses, the steel span acting as a cantilever during the process.

The contractor, the Jenkins Bridge and Construction Co., of Denver, Colorado, reports that the same method was used to good advantage on the erection of several other bridges.







BUILDING CONCRETE TRUSS BRIDGE AT WICHITA FALLS WITHOUT USING FALSEWORK

Forms in Place on Floor of Temporary Bridge—Raising Finished Truss—Floor Concreting

NEWS OF THE WEEK

New York, April 7, 1921

Sewage-Works Studies To Be Made at Akron, Ohio

A complete study of the sewage-works of Akron, Ohio, is to be made by Harrison P. Eddy, of Metcalf & Eddy, consulting engineers, Boston, to determine the proper loading of the plant, what minor additions and changes should be made and what repairs and reconstruction are required to place the plant on a more efficient basis. The Akron sewage-works were completed in 1916 at a cost of about $425,000 and up to recently were second largest sewage treatment plant in Ohio using Imhoff tanks with sprinkling filters. The plant was designed to take care of the sewage of Akron until 1930, but due to its rapid growth, the plant has been working under an overload almost since it was put in operation.

The site of the present sewage-works has been selected by the city authorities for park, playground and recreational purposes, so that eventually the plant will have to be located elsewhere, according to information received from J. E. Root, engineer, bureau of sewerage, Akron, Ohio. It is probable, Mr. Root states, that a new site will be selected at 5 or 6 miles north of Akron on the Big Cuyahoga River. It is also expected that complete investigation and plans for the new sewage-works will be prepared during the coming year. The present idea is to build at the new site sufficient units to treat the excess sewage for the next eight or ten years over the sewage that can be treated at the old works. Mr. Eddy will direct special attention to immediate changes to get the old plant on the best possible operating basis so as to give more efficient service for the balance of its period of use. The engineering departmnt of the City of Akron will work jointly with Mr. Eddy and his engineers on the sewage treatment question. A preliminary estimate for new treatment will exceed $2,000,000.

In 1920 about $900,000 worth of sewerage work was completed in Akron and it is expected that about $1,500,000 worth will be done this year. It is expected that an election will soon be held to vote on the authorization of an additional $5,000,000 to continue the Akron sewer construction program.

Pennsylvania May Tax Cement

It is announced from Harrisburg, Pa., that the legislative committee in search of new sources of revenue may tax cement production at its source. It is reported that a tax so placed would bring into the state about $2,000,000 a year. Already in the draft of the bill are taxes on minerals, lumber, oil, gas

New York State Assembly of A. A. E. Organized

At a meeting held on March 12 at Albany, N. Y., the New York State Assembly of the American Association of Engineers was organized. Officers are S. J. Stone, general superintendent of the John Cowper Co., Buffalo, president; A. M. Knowles, assistant bridge engineer, Erie Railroad, New York, first vice-president; G. F. Scharbach, Lackawanna Railroad, Binghamton, second vice-president; J. G. Brennan, State Highway Department, Albany, secretary-treasurer.

Resolutions were passed protesting against the classification of professional engineers with mechanics and laborers on the part of railroads and other employing bodies. On the subject of the pending amendment to the New York State licensing law, the meeting expressed itself emphatically against the principle of licensing corporations to practice as professional engineers or land surveyors and requested the state legislature to support Bill 147, which would prohibit such practice.

The assembly was formed to co-ordinate the activities of all the chapters and clubs of the American Association of Engineers in the state on state issues, leaving full autonomy in local matters to the local organizations. It expects to co-operate with the state section of the Federated American Engineering Societies and other organizations. Two regular meetings are to be held in March and November respectively.

Modified Belle Isle Bridge Plans Approved and Advertised

(Special Correspondence)

Revised plans for the Belle Isle bridge over the Detroit River, prepared by Esselstyn, Murphy & Hanford, were presented to the Detroit city council on March 30 and were unanimously approved by that body. The commissioner of public works was authorized to advertise the work immediately (see advertising page 88 of this issue—EDITOR) and bids will probably be opened on April 23. This will be the third time bids have been called for, no contracts having been let on the two previous sets of bids because the lowest bid exceeded the amount of money appropriated.

In presenting his revised plans to the council, H. H. Esselstyn, whose firm is in charge of supervision of design and construction of the bridge for the city, stated that they can be carried out for less than $2,400,000 according to his latest estimate. This amount with the cost of the approach subway under Jefferson Ave. already constructed will bring the total cost within the $3,000,000 voted by referendum four years ago. In revising the plans only minor changes were instituted, the commission's primary design for a concrete and steel cantilever bridge being adhered to mainly.

The approval of the council's latest action by Mayor Couzens is in line with the mayor's efforts at the second opening of bids to have bids accepted so as to get construction work on the foundation under way. It is the hope of the city officials that the bids will be within the desired limits and that construction work can be started in May.

Don Pedro Dam To Be Built by Day Labor

After twice receiving and rejecting bids for the construction of the Don Pedro dam on the Tuolumne River, California, to store water for the use of the Turlock and Modesto irrigation districts in the San Joaquin Valley, a joint board has decided to have the work done by day labor instead of by contract. On March 10 the joint board officially representing the two districts opened bids and voted to award the contract for the construction of the dam to W. A. Kraner of San Francisco. This action was rescinded March 17 before the contract had been actually signed. New bids were called for, to be opened March 22. At this opening six bids were presented—a less number than were received at the previous opening. On March 23, after a San Francisco banker had appeared before the board and offered to take the bonds of the district, all bids were rejected and the board announced the decision to do the work by day labor.

The dam is to be built on a simple curve with a radius of 675 ft. It will be 280 ft. high, 975 ft. long on the crest, and will contain 266,000 cu.yd. of concrete. Only about 10,000 cu.yd. of excavation are said to be necessary to expose solid rock underlying the site, but about 120,000 cu.yd. of excavation will be made in cutting a spillway channel in the canyon wall at the north end of the dam.

The construction program includes building a narrow gage railroad from the Southern Pacific line at Hickman to the dam site, a distance of 29 miles. About 12 miles from the dam site this railroad passes through gravel pits from which gravel for the concrete will have to be taken. It is estimated that the work can be completed in two years time at a total cost of approximately $4,000,000.

Council Committee Reports on Pittsburgh Slide

(Special Correspondence)

Following an extended investigation of the Jones Hollow landslide in Pittsburgh last November, the councilmanic committee that made the investigation has reported, laying the blame for the occurrence on the engineers in charge of the work. It states that insufficient precautions were taken in investigating the conditions at the site before starting work, and that authorization of departure from the contract provision that the hillside fill be deposited in layers and rolled was partly responsible for the accident. On the former point the report says:

> Regarding the matter of the sufficiency of the precaution taken in the investigation of conditions preliminary to starting work, however, we have no hesitation in expressing the opinion that such precautions as were taken were woefully inadequate, in view of the presence of the retaining wall at the bottom of the hill and the wooden cribbing erected some distance back of the wall.
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> These two structures should have served as glaring danger signals, but apparently did not. There seems to be no possible excuse for the almost total lack of effort to secure available facts and data which the presence of the wall and the cribbing would seem to have demanded as essential, and without a knowledge of which it was extremely hazardous, to say the least, to proceed with the fill as planned. The problem which confronted the public works department in perfecting plans for the boulevard widening was essentially one of engineering, and the responsibility for the success or failure of the plan must rest upon the engineer who approved its adoption.
>
> Upon N. S. Sprague, therefore, as head of the city engineering department, must rest the responsibility, provided he approved of the plan as carried to execution. On this point, however, the evidence given in the hearing was flatly contradictory. Sprague himself testified that he had approved the plan; D. P. Williams, assistant counsel for the Pennsylvania R.R., testified that Sprague stated distinctly in his presence that "The engineering department of the city had not approved of the method adopted for improving the boulevard at that point . . . and that the engineering department will have to decline to assume any responsibility for the thing that happened.
>
> If Sprague's statement is true, then the responsibility for a huge engineering blunder is his own. If, on the other hand, Williams' statement reflects the truth, Sprague, impelled by a sense of loyalty to his superior officers, must have accepted deliberately a responsibility which did not properly belong to him. In this event it is obvious that someone higher in authority than Sprague must have over-ridden the objections of the engineering department and have insisted that the work be prosecuted regardless of the protests of the engineers.

Interviewed by the representative of *Engineering News-Record* on this report, Mr. Sprague said:

> The finding of the committee ignores all of the engineering testimony taken at the hearing and apparently is content and satisfied to fix the responsibility for the slide upon the basis of political expediency, rather than upon the engineering testimony submitted. The inconsistency of the report and the attitude taken by the committee is clearly shown by their willingness to place the responsibility for the slide upon the mayor and at the same time attempt to exonerate the director of public works on the grounds that he is not an engineer.
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> The problem confronting the committee was essentially an engineering problem and if a finding was desired, based upon the merits of the case and the testimony submitted, the council should in all fairness have employed a board of disinterested engineers to review the testimony and make a report.

District Court Upholds Concrete Surface Roller Patent

In a decision rendered March 2, 1921, Judge S. H. Sibley, sitting in U. S. District Court for the Northern District of Georgia, declared valid claims 5 and 6 of U. S. Patent 1,273,022, "Process and Device for Finishing Concrete Pavements," which is a patent by W. A. Ashmore and W. T. Morgan, Jr., on the so-called "Macon roller" used in finishing concrete roads and pavements. The suit was brought by the Macon Concrete Roller Co. against the Brookes-Callaway Co., and alleged the infringement of the two claims in the use of the roller. This allegation was sustained in the decision. The judge held that the use of a light roller was new in the art and constituted invention. One of the claims sustained reads as follows:

"The herein described method of finishing concrete pavements and the like, which consists in rolling the surface of a freshly laid soft plastic concrete with a roller of small diameter and comparatively great length and light weight adapted to float on the soft plastic concrete and to act on the surface thereof as a straight edge, and subsequently rolling the same with a shorter and proportionately lighter floating roller to further smooth and finish such surface."

New Administrative Engineering Course at Union College

Union College, Schenectady, N. Y., has added a new course in administrative engineering designed for training managers and superintendents of industrial plants. The course covers a period of four years in which science comprises 26 per cent of the total time; engineering, 39 per cent; business administration, 10 per cent, and cultural studies, 25 per cent. The course includes studies in accounting, finance, banking, business law, contracts, and industrial management. It is designed for students more likely to be interested in manufacturing industries dependent upon engineering as a basis.

Chicago Receives Large Gifts for Bridge Tenders' Houses

Two gifts of $50,000 each have just been received by the city of Chicago for architectural development of the four bridge-tender houses on the new Michigan Ave. bascule bridge across the Chicago River. The gifts will be administered by the Chicago Plan Commission. C. H. Wacker, of the Commission, says that through the gifts "it will be possible to make the structure historically significant, a fitting capstone to Michigan Boulevard." The site of Fort Dearborn and the spot where stood the first white man's house constructed in Chicago are both included in the bridge plaza, he says, and both will be commemorated. The two gifts are from William Wrigley, Jr., owner of a building near the bridge, and the trustees of the Ferguson fund.

Road Opposes Commission's Order To Rebuild Bridges

Application for an injunction has been made by the Louisville & Nashville R.R. in the U. S. District Court at New Orleans to prevent the railroad commission of Louisiana from enforcing an order requiring the railroad to rebuild its gulf coast bridges over the Rigolets Pass and Chef Menteur. The petition alleges that there is no public necessity for the new bridges, that the expenditure of money required is grossly out of proportion to the benefits to be derived, that the receipts of the railroad during the last nine months of 1920 were more than $3,000,000 under operating expenses and that the cost of the two bridges would be $2,300,000 and $1,300,000 respectively, that the money could not be borrowed now except at prohibitive rates of interest, and that the Federal Reserve Bank and the Interstate Commerce Commission had both counseled against extension of credit at this time. No date has yet been fixed for a hearing on the commission's injunction.

Engineers Unemployed

Records of the employment service bureau of the American Association of Engineers show that approximately 10 per cent of the engineers in the country are out of employment. In many cases companies which ordinarily have 100 or more engineers on their staff now have only 8 or 10. The greatest demand for engineers is in municipal and highway work; there is little demand for railroad engineers and indications are that no improvement can be expected before August.

In February the following conditions existed:

	Feb. 1921	Feb. 1920
Applicants for employment	2,293	610
Positions received	552	504
Men referred	3,525	2,383
Men placed	286	172

The average monthly salary of positions filled during February was $195 and the total salary of all positions filled was $55,000.

First Engineers Decorated

The Secretary of War has accepted fourrageres from the French Government for several American regiments including the First Engineers. The citation referring to the First Engineers reads as follows: "A regiment which under all circumstances displayed ardor in combat, and the finest technical and moral qualities. During the counter-offensive to the south of Soissons it contributed to the success of the operations of the 1st American Division in attacking with the infantry on July 20, 21 and 22, and capturing all its objectives. In the course of the operations between the Argonne and the Meuse from September to November, 1918, it again showed itself worthy of its magnificent reputation."

Arkansas Road Financing May Lead to Inquiry

Local District Assessments Heavy—Federal-Aid Roads a Small Percentage of the Total

While conditions incident to the financing of road projects in Arkansas may lead to a Senatorial investigation of the Government's activities in the general field of highway construction under the Federal-aid act, as definitely promised by Senator King, of Utah, in an interview with *Engineering News-Record's* representative in Washington, April 4, it is pointed out by those familiar with the situation that the Arkansas muddle is a local one and is due essentially to the creation by the state legislature of local improvement districts with broad powers to issue bonds and levy taxes, over which the U. S. Bureau of Public Roads has no direct control. In fact, the Bureau, for some time past, has seen the trend of affairs in Arkansas and has endeavored, through suggestion by its own representatives, to have defects in the existing laws remedied. This effort, to date, has been fruitless.

Approval of many of the Arkansas Federal-aid projects has been refused by the Bureau and of a total allotment of $4,619,929 of Federal funds to that state about $800,000 had been paid up to April 1, 1921. Largely through the lavish and uncontrolled authorization of road bonds by the local districts there have been accumulated in the state, which has a population of 1,752,000 and an area of 52,525 sq.mi., outstanding obligations for road improvements of about $108,000,000. Heavy burdens on the taxpayers within comparatively small areas are thereby imposed. Federal-aid roads are a small percentage of the total—about 9,900 mi.—which the local districts have undertaken to construct.

Under the Arkansas law exclusive jurisdiction over roads and bridges is vested in local district authorities and much of the engineering work is done on a percentage basis—generally 5 per cent. In many cases, under the Alexander law, assessments for roads amounting to 30 per cent of the assessed property valuation of a district are permissible, in others the percentage under special acts of the Legislature rises to 50 and in one case to 90. Some of the districts overlap, thus imposing upon land-owners double taxes. Provision is made for a very low assessment ($' per acre) on timber land, thereby giving the lumber interests road facilities for the transport of their products at a tax ridiculously small as compared with the general individual levy. Other irregularities are disclosed in the appointment, as land district commissioners, of members of the state Legislature which creates the districts.

The history of now more than 100 Arkansas road projects have fared in the secure of Federal participation in their cost is as follows: Six projects proposed were informally inspected and cancelled as unsuitable; 18 projects were submitted, assigned Federal-aid numbers and then withdrawn on the ground of unsuitability; 10 projects were withdrawn and cancelled before plans had been made; 35 projects are now active in that location has been approved and plans prepared; 5 projects on which plans had been submitted were found to be incomplete and decision on them is pending; on 3 projects plans have been recommended for approval; in the case of 6 projects an actual agreement has been made between the Secretary of Agriculture and the State Highway Department; 1 project submitted and agreed to has been withdrawn by the State.

At the present time 44 projects are under contract. Of this number work is progressing on 33 and has been shut down on 6, due to lack of funds. On 3 projects conditions have been found unsatisfactory and Federal-aid funds have been withheld. One project is delayed by a suit against the district commissioners and another, under contract, in which the Federal-aid portion was only a small section of a longer road, has been cancelled. To date, 10 projects in Arkansas have been completed.

Among those who believe that little, if anything, will come of the proposed senatorial investigation of Federal road activities, it is pointed out that the Arkansas situation has no counterpart in the other states and is a matter of improper local legislation which only the state itself can correct.

Governor Miller Signs Bill for Port Treaty

Governor Miller of New York, April 4, signed the bill authorizing any two of the three New York members of the New York-New Jersey Port and Harbor Development Commission to sign a compact with commissioners from the State of New Jersey in the form of a Port Treaty, the terms of which are included in the bill and which provide for the creation of the New York Port Authority. The second port treaty bill, providing the means of appointment of members of the Port Authority, has passed neither branch of the New York legislature, at this writing, although it is ready for vote in each.

Governor Edwards of New Jersey vetoed both bills, April 5, the day after they reached him.

Last week both the first and second bills were passed by both branches of the New Jersey legislature. However, they did not formally go to Governor Edwards for approval or veto until April 4, allowing less until April 9 to act. It is expected that the legislature will promptly pass both bills over his veto, before the normal time of adjourning the session April 8. If such action has to be deferred, it is now planned by the Republican legislature to adjourn this week *sine die*, only to meet again next week to pass Republican measures over the veto of the Democratic Governor.

In the meantime the City of New York has taken legal steps to block the signing of the Port Treaty, obtaining an order to show cause why an injunction should not be ordered restraining the members of the New York-New Jersey Port and Harbor Development Commission and the Attorney General of the State of New York from entering into the treaty. Alleged constitutional grounds are cited.

Massachusetts Defers Action on Licensing Bill

By referring a petition urging the passage of a bill for the registration of professional engineers and land surveyors to its next annual session, the State Assembly of Massachusetts has disposed of the question of licensing in that state for the time being. A public hearing was given at the State House in Boston on Feb. 18 upon the bill submitted to the Massachusetts Legislature by the American Association of Engineers. Practically its only proponents at the hearing were the members of the American Association of Engineers and its counsel, the proposed bill being opposed by representative members of the Boston Society of Civil Engineers, the Boston sections of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Heating and Ventilating Engineers, the American Institute of Mining and Metallurgical Engineers, and the Northeastern Section of the American Chemical Society, the American Institute of Chemical Engineers, the Boston Society of Landscape Architects, and the Engineering Society of Western Massachusetts. Both the principle of licensing and the form in which the bill was drawn were objected to. The bill as drafted conformed substantially to the model law prepared by Engineering Council.

The hearing upon the proposed bill was held before the legislative committee on mercantile affairs. A count of those present at the hearing by the legislative committee showed nineteen in favor and eighty-nine against the proposed bill. The legislative committee, therefore, recommended that the bill be referred to the next annual session of the legislature, this recommendation being adopted in the senate, Feb. 24, and in the house, March 3.

In reporting to its board of government at the recent annual meeting, the committee on licensing of the Boston Society of Civil Engineers recommended the continuation of it or a similar committee to study further the matter of licensing engineers, and also recommended that other engineering or architectural societies be invited to join in such a study.

Personnel Research Federation Is Organized

Under the auspices of the National Research Council and Engineering Foundation, in the building of the National Research Council, Washington, was effected March 15 the organization of the personnel research federation. This federation includes in its membership scientific, engineering, labor, management and educational bodies. The federation has been organized to bring about interchange of research information among the numerous organizations who are engaged in personnel research.

It is reported to the new federation by the bureau of labor statistics, of the Department of Labor, that there are 250 such organizations in the United States. The federation will collect research information, will encourage research through individuals and organizations and will co-ordinate research activities.

Temporary officers were elected as follows: Chairman, Robert M. Yerkes, National Research Council; vice-chairman, Samuel Gompers, American Federation of Labor; treasurer, Robert W. Bruere, Bureau of Industrial Research; secretary, Alfred D. Flinn, Engineering Foundation; acting director, Beardsley Ruml, assistant to the president of the Carnegie Corporation of New York.

The aims of the new organization are increased efficiency of all the personnel elements of industry—employer, manager, worker—and improved safety, health, comfort and relationships.

Highway Educational Bureau To Produce Road Film

James W. Brooks has resigned from the Federal Highway Council to become director of the American Highway Educational Bureau. Mr. Brooks announces that the change was made for the purpose of conducting highway educational work along more intensive and effective lines, supporting the federal-aid principle, and looking to the construction of state and county systems as the logical first step in highway development.

Production of "The Changing Road," the first standard road film ever undertaken, is now under way. The film is to be comprehensive in scope and official in character and will be released during the early summer. It will portray the evolution of road construction and administration from primitive to modern methods, with the aim of educating the public away from cheap construction and showing taxpayers the real work which their state highway officials are striving to do in their behalf.

Viewpoint of Public Service in Engineering Courses

With the reorganization through which the College of Engineering of the University of Maryland is passing, it is announced that the general purpose will be to broaden the courses of instruction for the better preparation of engineering students for public service. The new university catalog states that it is not the intention that the subject matter of the courses shall be essentially different, but that the viewpoint of the student and the application of the principles will be that of public service. The view is held that the large public works program contemplated in practically every state makes urgent the demand for engineers trained for such work and that modern engineering education affords suitable preparation for many callings in both public and private life outside of the engineering profession. A. N. Johnson is dean of the College of Engineering.

Illinois Central Engineers Begin Educational Work

Education of engineers on the Illinois Central, to establish closer contact with the management and to prepare men for high executive positions, was begun March 24. The Illinois Central Section of the American Association of Engineers, under whose auspice the work is to be carried on, consists of 125 railroad professional engineers.

Professional Society Organized in Spain

Engineers of Catalonia, a province of Spain, have organized a professional society somewhat similar to the American Association of Engineers, under the title (translated) General Technical Society of Catalonia. Its present membership appears to consist largely of Barcelona men. According to a statement in its introductory bulletin, just issued, the society is organized for cultivation of the common interests of engineers, for participation in bringing about a solution of the "social struggle of our times," for contributing to the settlement of the conflict between employing and laboring classes, and for upholding the profession of engineering in public life. Manuel Vidal is president, Alejandro Homdedeu is secretary, and Manuel Escude is corresponding secretary. The addresses of the two latter are Calle San Salvador 61, and Calle Laforja 12, Barcelona.

Tell Public About Engineering Problems at St. Paul

As a result of the activity of the St. Paul (Minn.) Engineers Society, the *Daily News* of that city is publishing in its Sunday edition a series of articles designed to inform the public regarding the most important local engineering problems. On March 21 the *Daily News* carried a story on the alternative projects of widening of the existing Robert St. bridge or building a new bridge at Sibley St. A feature of the service just inaugurated is the offer of the society to answer, through the medium of the daily press, engineering questions of general interest.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27-30.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

The New York Post, Society of American Military Engineers, at its meeting April 13 at New York, will discuss "Military and Engineering Defense of New York—Its Methods and Principles as Modified by World War Lessons." The meeting will be addressed by Col. John McA. Palmer, U. S. A. on "The Scheme of Coast Defense as Now Formulated" and by Col. Samuel G. Shartle, U. S. A., G-3, 2nd Corps Area on "Special Tests of Coast Defense Scheme and Relation of Committee on Public Safety." The New York Sections of the Am. Soc. C. E., Am. I. M. M. E., A. S. M. E., A. I. E. E. and the S. A. E. have been invited to attend this meeting.

The Mohawk Valley Engineers Club, at its meeting in Utica, N. Y., March 17, was addressed by W. S. Murray, chief chemical engineer, Oneida Community, Ltd., on "Research."

The Engineers' Club of Philadelphia on April 16 will tender to Herbert Hoover, Secretary of Commerce, a dinner at the Bellevue-Stratford Hotel, Philadelphia.

Personal Notes

HENRY G. SHIRLEY will resign May 1 as secretary of the Federal Highway Council, Washington, D. C., to accept the position of road and sanitary engineer of Baltimore County, with headquarters at Towson, Md.

C. L. DEWEY, formerly president of the Traylor-Dewey Contracting Co., is now second vice-president of the MacDonald Engineering Co. in charge of operations in the east, with headquarters in New York. The firm specializes in reinforced concrete grain elevators, flour and feed mills, cold storage warehouses, cement mills and coal handling plants.

H. C. NUTTING, manager of the Pittsburgh Testing Laboratory, Cincinnati, for the past six years, has recently organized a new company under the name of the H. C. Nutting Co., Cincinnati, Ohio. Mr. Nutting is highway engineer for the Cincinnati Automobile Club and will specialize in highway construction.

GEORGE C. DIEHL has been reappointed county engineer of Erie County, N. Y., with headquarters at Buffalo, N. Y.

ALBERT L. UPHAM, formerly with Stone & Webster, has been reinstated as inspector of construction in the U. S. Navy Department, Bureau of Yards & Docks, and assigned to duty at U. S. Naval Base, San Diego, Cal.

ARCHER P. CROSLEY, assistant supervisor of the Philadelphia & Reading R.R. at Trenton Junction, N. J., has been promoted to supervisor with headquarters at Coatesville, Pa. He has been in the employ of the above company since 1917.

F. W. BILITZ, assistant supervisor of the Wilmington and Columbia division, Philadelphia & Reading R.R., has been transferred to Trenton Junction, N. J., succeeding A. P. Crosley as assistant supervisor.

EARLE B. MOSS, formerly junior civil engineer at the U. S. Engineer Office, Buffalo, N. Y., has been appointed to the newly created office of appraiser in the Bureau of Assessment and Taxation, Niagara Falls, N. Y.

THE MID-WEST ENGINEERING CO., Coffeyville, Kan., has been organized by G. A. Barcroft, formerly assistant construction engineer Sinclair Refining Co., Coffeyville; associated with him are engineers of experience in the design and construction of large engineering projects in the United States and Central and South America. The firm will engage in general engineering practice, including buildings, power development, water supply, dams and reservoirs, surveys maps, estimates, designs and investigations Mr. Barcroft was with the Isthmian Canal Commission at Panama for four years in the capacity of rodman, levelman, transitman and general foreman. In 1919 he was superintendent of construction at the government's water-power project on the Tennessee River at Muscle Shoals, Ala.

J. C. MCLEAN has been appointed county engineer of Woodbury County, Iowa.

R. T. WYKOFF, recently in private engineering practice and for a number of years with the Truscon Steel Co., St. Louis, Mo., is again connected with this company as engineer in the St. Louis office.

GEORGE F. MCGONAGLE has resigned as state engineer and in company with C. J. Ullrich, deputy state engineer, will open consulting engineering offices in Salt Lake City, Utah.

LIEUTENANT-COLONEL GUSTAVE LUKESH, Corps of Engineers, U. S. A., has been confirmed as a member of the Mississippi River Commission.

GLENN S. WHITE has been appointed city engineer of Fort Morgan, Col.

H. J. HEMSTREET, since 1919 engaged in the inspection of Montana and Idaho Federal Aid projects, U. S. Bureau of Public Roads, with the exception of three months when he was assigned to the bureau's special study of the California State system of paved roads, has been transferred to District 9, U. S. Bureau of Public Roads, with headquarters in Troy, N. Y. He will be engaged in the inspection of post road projects.

H. B. CASSIN, formerly assistant engineer of Jefferson County, Ky., is now engineer for the Louisville Real Estate and Development Co., Louisville, Ky., at present engaged in subdividing and selling Camp Zachary Taylor.

A. T. BAGGS, formerly with the Globe Grain and Milling Co., Ogden, Utah, has accepted a position with the Pioneer Sugar Co., Whitney, Idaho, as engineer and assistant superintendent of construction.

WILLIAM H. SMITH, recently connected with the sewer and paving improvement work in Tarboro, N. C., is now with the firm of P. G. Ligon & Co., on a large sewer and paving contract in Washington, N. C.

GUNNI JEPPHSEN, formerly chief engineer of the Strauss Bascule Bridge Co., has joined the Chicago Bascule Bridge Co., Chicago, Ill., as associate engineer. He was connected with the Strauss company for 12 years, from its inception until 1917, and since then has been engaged in industrial plant work as structural engineer of the Leonard Engineering Co.

BUSINESS NOTES

ROBERT C. WELLER has been appointed general sales manager of the Lakewood Engineering Co.

E. F. PEGG, who has been connected with manufacturers of constractors' equipment in Cleveland and vicinity for the past twelve years, has opened an office in Cleveland for the purpose of handling contractors' equipment.

THE MORRISON & RISMAN CO., jobbers in new and relaying rails and accessories of Buffalo, N. Y., has opened an office in Philadelphia, Pa., with R. B. Morrison as district manager.

THE RUBEROID CO. is the new name of the company formerly known as The Standard Paint Co., New York, manufacturer of Ruberoid roofing and weatherproofing products.

THE GENERAL CHEMICAL COMPANY has announced that J. H. Libberton, formerly manager of the Service Bureau, Universal Portland Cement Co., has joined its staff. He will handle service and sales of Hard-N-Type, a chemical crystalline hardener for concrete

M. L. NORTHROP, recently connected with the Pittsburgh Meter Co., has been appointed New England representative, Warren Foundry & Machine Co., with offices at Boston, Mass.

THE CHICAGO PNEUMATIC TOOL CO. has appointed R. F. Eissler, formerly district manager, Pittsburgh branch, assistant to the vice-president with headquarters in New York.

E. C. MORSE, former director of sales, War Department, Washington, D. C., is the head of the newly organized Foreign Trade Supply Corporation, with its main offices in New York. With Mr. Morse, the president, are A. LaMar, until Dec. 31, last, assistant director of sales, War Department, who is vice-president; Paul Klopstock, of New York, chairman of the board of directors, and Arthur Mayer of New York, counsel. The corporation will engage in a general merchandise brokerage exporting and importing business, and in the buying and selling of foreign securities.

THE STEARNS CONVEYOR CO., Cleveland, Ohio, has been organized by Earl D. Stearns, formerly vice-president and sales manager of the H. K. Ferguson Co., Cleveland. The new company will handle elevating, conveying, screening, transmission machinery and accessories. The officers are: President, Earl D. Stearns; vice-president and superintendent of shops, W. E. Phillips; secretary and treasurer, G. H. Whitman.

THE NATIONAL STEEL FABRIC CO. has opened a sales office in the Mutual Building, Kansas City, Mo., in charge of H. W. Pobinson.

WENDELL M. BUTTS has accepted the position of sales representative and resident engineer at Manila, P. I., with William H. Anderson & Co., agents for the Truscon Steel Co., Youngstown, Ohio.

HYLAND-JENCKS, landscape engineers and contractors, New York, has been incorporated for the extension of its landscape construction and planting work along the East coast from Boston to Miami, Fla., and to develop its metropolitan branches in an intensive manner. H. A. Jencks is president of the new corporation.

WILLIS LERICHE, formerly district sales manager with the Cement Gun Co., Kansas City, has been elected vice-president of the Traylor-Dewey Contracting Co., Allentown, Pa. This company specializes in contract work with cement guns and is connected through its board of directors with the Cement Gun Co.

London Guild of Builders Is Factor in Housing

Contracts Held More Than $3,000,000—Insurance and Materials Supplied By Co-operative Societies

By C. H. S. Tupholme
London, England

After seven months of operation the London Guild of Builders has secured contracts aggregating $750,000 in value, extending over a period of two years. It has also proven a contending factor in the contracting field, for, according to Malcolm Sparks, its general manager and secretary, from the first inclination to ridicule it the building employers are now fighting it, endeavoring to squeeze it out of business.

As matters stand in the British building trades the contemplated action of the master builders may benefit the guild considerably. The building employers have threatened a national lock-out in the event of the operatives declining to accept the Government's scheme for the dilution of the building trades. If a national lock-out actually takes place, it may lead to the placing of more building contracts with the Guild and materially increase the supply of labor from which it can draw. As it is the general manager informs me that for the guild purposes there is a wealth of labor already available for the contracts in hand, which includes architects, surveyors and members of the building trades unions. It may be added that the guild has the wholehearted support of the Royal Institute of British Architects.

Guild Organization

The London Guild of Builders was set up by a vote of the National Federation of Building Trades Operatives (London District Council) last year. The purpose of this guild is to develop its organization by means of three distinct types of committee, each with its own sphere of operations and each with clearly defined functions. They are:

1. *The Area Guild Committee*, of which there are 11 covering London and the outlying districts, representing the trade-union branches and the approved groups in each area and concerned mainly with the organization of the labor for each local contract, and with the social development of the guild movement.

2. *The Regional Guild Committees* (*e.g.*, London) representing the trade unions, the groups and the area committees in each region; registered as legal entities on a standard code of rules and acting as contractors with all the necessary technical and administrative services for estimating contracts and carrying them through.

3. *The National Guild Committee* representing the national trade unions, the approved functional organizations and the regional guild committees, and concerned mainly with the purchase, manufacture and supply of materials, the co-ordinated use of plant and equipment, the arrangement of credit, and the central reserve funds for continuous guild pay, technical research and insurance.

The guild committee consists of representatives elected by the trade unions affiliated with the district section of the National Federation of Building Trade Operatives, and any other trade unions or groups of building-trade workers within the district, whether administrative, technical, clerical or operative. Each trade union or group elects one member. Approved groups have already been formed by the architects and surveyors, and groups of civil engineers and of sculptors and decorative artists are under consideration.

Each member of the guild committee holds one shilling share and deposits with his electors a signed open transfer, thus giving them power to replace him at any time.

The guild committee is responsible for the appointment and removal of managers and general foremen and for the fixing of their salaries. General foremen are nominated by the area committee and ratified by the guild committee. Departmental foremen are elected by the guildsmen of the trade concerned.

Contract Methods

The guild form of contract as approved by the Ministry of Health for Municipal Housing Schemes creates a triple alliance under which the guild carries out the whole of the work. The Co-operative Wholesale Society undertakes to supply the materials, and the Co-operative Insurance Society guarantees the due performance of the contract, the liability under this head being, however, limited to 20 per cent of the estimated cost. The price paid by the local authority is the prime cost of material and labor at standard rates, with the addition of £40 per house to enable the guild to guarantee continuous pay to its workers in all contingencies, and 6 per cent calculated upon the estimated cost, to provide for plant, head-office administration and, if necessary, for interest upon hired capital. The estimate of cost is given by the guild and approved by the Ministry of Health for each contract. The initial cost of plant and equipment is covered by an advance from the Co-operative Wholesale Society's bank, secured against payments due under the contract. All other problems of finance are reduced to manageable proportions by the provision of payments weekly by the local authority, both for labor and materials delivered, and for the authorized guild charges.

London's first guild contract was made with the Walthamstow Urban District Council, by the terms of which contract the guild undertakes the whole of the work involved in the building of 400 houses to plans approved by the Ministry of Health. The houses are of brick with slate roofs, two stories and four-family structures, each with five rooms, kitchen bath and hall.

The London Guild has also secured contracts to build 132 houses at Enfield and 190 at Greenwich on the same conditions. Designs for these houses can, if necessary, be altered in detail as long as the basis of the Ministry scheme is adhered to.

Possible Extensions

Though no building costs are yet available, the Minister of Health has promised that if the cost of the first guild-built houses is satisfactory, and a suitable form of contract can be drawn up, the present order which limits guild contracts in the London area to four will be rescinded, and no obstacle will be placed in the way of guild contracts wherever a local authority desires to employ the guild. The publication of the guild costs will now only be a matter of a few weeks.

The guild is also prepared to submit tenders for other forms of building-trade work such as painting, decorating and the erection of schools and other public buildings. In fact, the guild will shortly commence operations on a joinery factory in London.

The guild is now working on designs of its own for the most up-to-date labor-saving dwelling of 1,400 sq.ft., 700 sq.ft. to each of its two floors. A house to the completed designs will be built and will then be thrown open to the inspection of local authorities.

It is interesting to note that the conception of this guild originated with the rank and file and did not begin with the formation of a guild committee. Thus the growth has been upward instead of downward. So far there are but two building guilds, the London body and the Manchester Guild, both working on exactly the same principles.

Cheaper Building in Britain

(*London Correspondence*)

The fall in the builders' wages and the decreased cost of building materials is shown in the tenders accepted for the erection of houses by Leicester Rural Council. The price for parlor houses as shown in this tender is £772; a few months ago the prices of these dwellings were from £1,000 to £1,200 each. The dwellings are to be built to the standard specifications and accommodation as laid down by the Ministry of Health.

Joint Legislative Body to Make Building Inquiry in Chicago

Preliminary plans have been made for an investigation of building conditions in Chicago by a joint legislative committee of fourteen. Senator John Dailey of Peoria, chairman of the committee, is reported to have said that he believes extortionate methods have been followed in Chicago which, upon investigation, may reveal a situation existing in that city worse than that brought to light by the recent investigations in New York City by the Lockwood joint legislative committee on housing.

President Confers With Heads of Railroad Unions

This week President Harding has held a series of conferences with the heads of the railway brotherhoods, at which, it is presumed, the status of the so-called national agreements was discussed. On April 4 B. M. Jewell, president of the railway employees department, American Federation of Labor, and A. B. Garettson, former president of the Brotherhood of Railway Trainmen, called on the President, followed by W. S. Carter, president of the Brotherhood of Locomotive Firemen and Enginemen the next day. It is understood that the case of the brotherhoods will be heard previous to the President's calling railroad executives. It is not known whether the President will take any action in the matter of reducing railway wage scales or whether it will be left to the Railway Labor Board and the Interstate Commerce Commission.

Crisis Expected in the British Building Trades

(London Correspondence)

A crisis is expected soon in the building trade in England. It is generally expected that the employers will declare in favor of the government's scheme for the introduction of 50,000 unemployed ex-service men into the trades, while the unions are generally against the proposition altogether, a few considering the scheme with reservations. The government scheme has been discussed in private at a conference of the executives of the various unions affiliated with the National Building Trades Operatives' Federation. It is reported that fresh proposals, which have not yet been disclosed, have been made by the government, and these have been submitted to a ballot of the master builders with an executive recommendation for their acceptance. Meanwhile the outlook is not very hopeful. It is certain that the system of payment by results will be resisted tooth and nail by the operatives' federation.

In the meantime a conference of the National Building Operatives' Federation has endorsed the proposed wages sliding scale, which provides that reduction will take place at the rate of 1d. per hour for each 13 points fall in the cost of living, and ½d. per hour for each 6.5 points, with advances in wages of similar amounts for rises of 10 and 5 points respectively.

It was proposed at this conference that 170 per cent above the pre-war cost of living be taken as the basic figure, and as the last official return shows the cost of living index to stand at 153, a reduction in wages is imminent.

School Construction Leads

Owing to the large number of educational buildings put under contract miscellaneous building contracts aggregated during the past week $11,331,126 for sixty-two projects. Apartments in that figure approximate $1,100,000. An increase in the number of small public works projects is noted and in bids advertised it is apparent that road construction is opening up generally. Illinois opened test bids on several road projects April 5, and Pennsylvania opened bids on 150 miles of roads, details of which are found in the construction news of this week.

Arbitration of Boston Building Strike Blocked

After the Boston Building Trades Council had agreed April 1 in an all-night meeting to accept the proposal of the State Board of Conciliation and Arbitration to act in the settling of the building trades dispute which has tied up Boston building since early in the year, announcement was made by the chairman of the arbitration board that the Building Trades Employers Association of Boston had decided not to submit its case. The reason given was that not all the constituent members of the Building Trades Council had agreed to the arbitration plan and that the employers would not consent to arbitration proceedings unless a guarantee were given that all the constituent members of the council would be bound by the general action.

Brindell Begins Prison Term

Robert P. Brindell, president of the New York Building Trades Council, was taken to Sing Sing April 4 to begin a sentence of from five to ten years for extortion. His conviction was an outgrowth of testimony adduced at the recent investigation of building conditions in New York City, carried on by the Lockwood committee.

New York School Program to Cost $52,387,000

The Board of Estimate of New York City recently adopted the building program of the Board of Education calling for the construction of 53 new buildings and additions to several existing schools, the total cost to be $52,387,000.

Labor Rates and Conditions Throughout the Country

DESPITE the talk of "liquidation" of labor, we have to report decreases only in Seattle and Denver. In Seattle the majority of building projects under way are controlled by the Master Builders' Association, which maintains open shop. Union bricklayers are paid $9 per day; non union, $8. Non union hodcarriers receive $5.60 against the union rate of $7. Common labor has declined from $5@$6 to $4 @$4.80. Cement finishers receive $6.40.

The Colorado Industrial Commission has granted permission to Denver contractors to make reductions in wages in the building crafts as follows: Bricklayers from $12 to $11 per day; carpenters, from $9 to $8; hoisting engineers, from $9 to $8; pile drivers and structural iron workers, from $9.25 to $8; and common labor on buildings, from $5 to $4 a day. Reductions from $9 to $8 were also authorized for sheet metal workers, and cement finishers; from $9.50 to $8.50 for steam fitters, plumbers and gas fitters; glaziers from $6.60 to $6 and electrical workers from $8.20 to $7.20. The changes are effective April 1. Hod-carriers' wages remain at $6, $6.25 and $6.50 a day. Similar adjustments are being negotiated throughout the state, using the Denver rates as the basis. The crafts accepting the reductions are the hoisting engineers, pile drivers, structural iron workers, common labor, sheet-metal workers, cement finishers, steam fitters, plumbers and gas fitters, glaziers and electrical workers. The bricklayers and carpenters have not yet accepted and a strike by these crafts appears probable. No strikes are on in Denver. Employment in the building trades has increased approximately 10 per cent in the last two weeks. A large amount of construction work has been held up waiting these adjustments and heads of the labor organizations express the opinion that there will be a shortage of labor in all crafts shortly after May 1.

That the union schedule in Cleveland is not the maximum is shown by a letter just received from a well known contractor in that city. Here is a comparison of hourly union rates (effective until May 1) with the rates our correspondent has been paying for the last year:

	Union	Correspondent
Bricklayers	$1 00	$1 25
Carpenters	90	1 25
Hoisting engineers	1 00	1 25
Hod-carriers and common labor	57½	87½

New Orleans reports that there will be no change in the wage scale until June 1, when the labor agreements expire. The situation was explained at length in *Engineering News-Record* of March 31, p. 576.

The Minneapolis Builders' Exchange reports considerable of cutting under the official scale, despite agreements with the union. Common labor is at 50c. with exceptions both above and below that figure. Following is the official scale, with the scale proposed by contractors for general observance May 1, and already operative on many jobs:

	Official	New Scale
Bricklayers	$1 25	$1 00
Carpenters	1 00	80
Hoisting engineers	1 00	80
Hod-carriers	75	65
Structural iron workers	1 00	80
Common labor	60	50

Many wage cuts are announced. Master builders of Passaic and Bergen counties will cut 10 to 20 per cent on May 1. The Building Trades Employers' Association of Essex County, N. J., will reduce wages by 10 to 20 per cent in ten of thirteen trades. The wages of carpenters and painters will remain unchanged, but bricklayers, masons and plasterers will be cut from $10 to $9; plumbers, from $10 to $8; ironworkers, from $9 to $8; hod-carriers and mason laborers, from $7 to $5.60. The Carpenters' District Council of St. Louis, representing more than 5,000 men, on March 25 rejected a proposition to reduce the rate from $1.25 per hour to $1, the secretary claiming that labor is 30 per cent more efficient than when work was plentiful. The union of hoisting engineers of St. Louis, with 135 members, voted unanimously to reject a proposed 20 per cent decrease, the Painters' District Council, of 2,000 members, rejecting a similar proposal.

Building contractors in Rochester, N. Y., are awaiting official notification by the Building Trades Council of its rejection of their offer of a "renewal of existing agreements with a 15 per cent decrease." A leading general contractor is reported to have said: "The contractors have pledged themselves to do their share, also, in a reduction of building costs by a proportionate lessening of their profits. In requesting their employees to accept lower wage scales they have no mercenary motive." Current wage rates are as follows:

S means scarce; E, enough; P, plentiful

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta...	$0.90P	$0.70P	$1.00P	$0.30P		$1.00P	$0.25P
Baltimore	1.25	80P	87½P	40@.54P	$0.74P	1.00P	30@35Pz
Boston	90S	90P	90P	60P	90	90P	55P
Cincinnati	1.25P	90E	1.00P	.0E	1.00S	1.00E	.60E
Chicago	1.25	1.25				1.25	1.00
Cleveland	1.00S	90S	1.00E	57½E	80E	1.00E	57½E
Dallas.	1.00P	1.00P	1.00E	60E	1.00E	1.00E	50@.75P
Denver...	1.37½	1.00	1.00	75@.81¼	1.00	1.00	.50
Detroit..	1.25P	85@1.00P	1.10P	70P	1.10P	1.25P	.50@.60P
Los Angeles	1.25P	1.00P	1.00P	1.12½P	1.00P	1.00P	.75P
Minneapolis	1.00P	80P	80P	65P		80P	.50P
Montreal..	90P	65P	60P	.40P	50P	65P	.35@.45P
New Orleans	1.00P	1.00P	1.00P	65P	1.00P	1.00P	50P
New York.	1.25	1.12½	1.25	87½	1.12½	1.12½	75@.80
Pittsburgh	1.50P	1.25P	1.12½P	1.00P	1.00P	1.25P	80P
St. Louis.	1.25P	1.25P	1.25P	85P	1.00P	1.25P	67½P
San Francisco	1.25P	1.12½P	1.12½P	1.00P	1.12½P	1.12½P	81¼P
Seattle.....	1.12½	80@.87½	87½@.90	70	1.00	90	50@.60

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Prices $1.50@$3 lower than last month, with market stagnant.

Steel Rails — Moderate demand for light rails by coal companies. We quote a lower price than last month, at Pittsburgh.

Railway Ties—Latest prices of plain and creosoted ("empty cell") cross-ties in Chicago and San Francisco, and of untreated ties in St. Louis. On the Pacific Coast ties are usually purchased and used untreated, except by the Santa Fé and the Southern Pacific railway companies. The Southern Pacific uses the Burnett or zinc chloride process over its entire system, the railway doing its own treating. The Santa Fé applies the Boulton or boiling-in-vacuum process in Arizona and Southern California. We quote on ties treated by the Rueping or empty-cell process.

Pipe—While there has been no mill change, New York dealers have announced a piece cut. The only change in sewer pipe is a cut in Baltimore. Denver quotations on sewer pipe are again available.

Road Oils and Asphalt — Road oils down ½c.@1c. in New York. Asphalt down in New York, Minneapolis and Atlanta. Maurer, N. J., quotations are again offered.

Wood Blocks — Down in New York and Minneapolis.

Sand, Gravel and Stone — Gravel is down 50c., to $2.50, in New York. Other decreases in New Orleans and Atlanta. Crushed stone down in Dallas, Atlanta and Montreal.

Cement—Price in New York remains $3.10 net, with the change for bags now 40c. per bbl. instead of $1 as heretofore. We quote the cement companies' price alongside dock to dealers, $2.40 net. Decrease in New Orleans.

Reinforcing Material—Triangle mesh quotations have been thoroughly checked and are correct as they stand. Steel bars sell for as low as $2 per 100 lb. in large lots, Pittsburgh; $2.38 for mill shipments, New York. We quote the minimum and the Steel Corporation prices.

Common Brick—Last week the wholesale price of brick alongside dock, New York, was reduced from $18 to $15@$17; but the delivered price to contractor remains at $21.70, which includes the dealers' profit of 10 per cent and the cartage. Decrease reported by Dallas, New Orleans, Minneapolis and Montreal.

Hollow Tile—Down in New York and St. Louis; up in New Orleans and Atlanta. Our New Orleans correspondent has not been able to determine the reason for the 3c. per block advance in that city.

Structural Shapes—We show a range of $2@$2.45, at Pittsburgh mill. Sharp decreases on deliveries from New York, Chicago and St. Louis warehouses. Rivet down at mill, Pittsburgh, and in St. Louis warehouses. Market dull.

Steel Sheets—General decrease in St. Louis. Blue annealed down in San Francisco. Market dull.

Lumber—The decline continues, with conditions unsteady. Demand flat. Wholesale prices down $7 in New York since last month. Chicago reports "no change," but urges caution as to price. Decreases in Seattle, New Ordleans and Baltimore. Douglas fir down $1 in San Francisco.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$30.50	$44 60
Northern Basic	27.52	42 80
Southern Ohio No. 2	30.50	43 80
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 to 2.75)	36.51	47 70
BIRMINGHAM		
No 2 Foundry	26.50	41 00
PHILADELPHIA		
Eastern Pa., No. 2X, 2.25@2.75 sil	27 00*	45 65*
Virginia No. 2	28 00*	43 25*
Basic	26 25†	43 00†
Grey Forge	27 00*	42 50*
CHICAGO		
No. 2 Foundry Local	25 00@27 00	43 00
No. 2 Foundry Southern	32.92	46 00
PITTSBURGH, including freight charge from the Valley		
No 2 Foundry Valley	26.96	43 65
Basic	26.86	42 90
Bessemer	27.00	43 40

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago Current	Chicago One Year Ago
Standard bessemer rails	$45 00	$45.00	$45.00	$45 00
Standard openhearth rails	47.00	47 00	47 00	47 00
Light rails, 8 to 10 lb	*2 30@2 55**	2 585*	2 45@3 00*	2 585*
Light rails, 12 to 14 lb	*2 15@2 50**	2 54*	2 41@2 95*	2 54*
Light rails, 25 to 45 lb	*2 10@2 45**	2 45*	2.32@2.85*	2 45*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft	7 In. x 9 In. by 8 Ft. 6 In
Chicago, White Oak	$1 60	$1 75
Chicago, Hardwood and Red Oak	1 40	1 55
Chicago, Empty Cell Creosoted	2 00	2 25
San Francisco, Green Douglas Fir	.80	[illegible]
San Francisco, Empty Cell Creosoted, Douglas Fir	1.76	[illegible]

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Sap Cypress
Grade 3	$1 35	$1 20	$1 10
Grade 2	1 25	1 10	1 00
Grade 1	1 15	1 00	90

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, 9-in. and longer	$3 00	$3 35	$3 40	$4 87	[illegible]
Track bolts	4.00@5.50	4 90	4 60	5 75	[illegible]
Standard section angle bar	2.50@3.00	2 75	3 75	4 05	[illegible]

PIPE

WROUGHT PIPE—The following discounts are to apply [illegible] on the Pittsburgh base card of Mar. 21, 1919:

BUTT WELD

Inches	Steel Black	Steel Galv	Inches	Iron Black	Iron Galv
⅜ to 3	54 to 57½	41½ to 44	⅜	15 to 21	[illegible]
			½	19 to 27	[illegible]
			¾ and 1	24 to 34	[illegible]

LAP WELD

2	47 to 50½	34½ to 38	2	20 to 28	6 to 14
2½ to 6	50 to 53½	37½ to 41	2½ to 6	23 to 30	9 to 17
7 to 12	47 to 50½	33½ to 37	7 to 12	19 to 27	6 to 14½
13 and 14	37½ to 41				
15	35 to 38½				

BUTT WELD, EXTRA STRONG, PLAIN ENDS

¼ to 1½	52 to 55½	39½ to 43	¼ to 1½	24½ to 34½	9½ to 19½
2 to 3	53 to 56½	40½ to 44			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	45 to 48½	33½ to 37	2	21½ to 29½	8½ to 16½
2½ to 4	48 to 51½	36½ to 40	2½ to 4	23½ to 31½	11½ to 19½
4½ to 6	47 to 50½	35½ to 39	4½ to 6	22½ to 30½	10½ to 18½
7 to 8	43 to 46½	29½ to 33	7 to 8	14½ to 22½	2½ to 10½
9 to 12	38 to 41½	24½ to 28	9 to 12	9½ to 17½	5½ to +2½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
⅜ to 3 in. butt welded	50%	54@40%	45½%
2½ to 6 in. lap welded	43%	50@40%	41½%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
⅜ to 3 in. butt welded	35%	40½@30%	30½%
2½ to 6 in. lap welded	26%	37½%@27½	27½%

Malleable fittings, Class B and C, from New York stock sell at *net* list prices. Cast iron, standard sizes, 20—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Month Ago	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$73 30	$73 30	$75 30	$69 10	$66.70	$92 65
6 in. and over	63 30	63 30	72 30	64 10	61.70	87 65

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$50 00	$35 00	$60 00	$50 00		$55 00
4	60 00	51.00	70 00	70 00	$90 00	65 00
5	90.00	65 00	90 00	90.00	115.00	84 00
6	115 00	90 00	120 00	110.00	150 00	110 00
8	185 00	130 00	185 00	160 00	250 00	181 00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Current Delivered	Pittsburgh	St. Louis	Chicago	San Francisco	Dallas
3	$0 24	$0 132		$0 15	$0 14	
4	.24	.132		15	175	$0 18
5	.36	.198		225	21	
6	.36	198	$0 17½	225	245	25
8	.56	308	25	35	35	35
10	.84	462	35	525	49	
12	1 08	594	45	625	63	80
15	1 61	792	68	90	1 05	
18	2 30	1 10	88	1 25	1 47	
20	2 76	1 32	1 20	1 50	1 96	
22	3 68	1 98		2 00		
24	4 14		1 56	2 25	2 52	2 40
27			2 75	4 50	3 50	
30			3 40	5 50	4 20	
33			4 35	6 75		
36			4 50	7 00		
	4	5	8	12	24	3
Boston	$0 21	$0 315	$0 49	$0 945	$3 15	$8 712
Minneapolis			42	77	2 45	5 66
Denver		15	30	50	1 95	
Seattle			40	80	2 88	
Los Angeles	[illegible]	165*	27½	495	1 65	
New Orleans	[illegible]	.165	33½	564	2 15	
Cincinnati	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Atlanta	11*	165*	27	47	1 80	
Montreal	30*	35*	70	1 35	4 50	6 50
Detroit	138	211½	329	621	2 56	6 [illegible]
Baltimore	[illegible]	.26	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	11	56	[illegible]	

[illegible] 30 [illegible] on trucks

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per [illegible] gal. in carloads f.o.b. place named:

		Current	One Year Ago
New York, 4 [illegible]	[illegible]	$[illegible]	$0 11
New York, [illegible]	[illegible]	[illegible]	11
New York, binder	[illegible] terminals	[illegible]	11
[illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	11	[illegible]
[illegible]	[illegible]	[illegible]	08
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	07
[illegible]	[illegible]	11	08
[illegible]	[illegible]	15	[illegible]
[illegible] per 42 gal.	[illegible]	[illegible]	2 [illegible]

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums), and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$28.00	$18.00
Boston	No quotations	
Chicago	28.50	21.00
San Francisco	21.50	15.00
Dallas	35.00	27.00
Seattle	27.50	
Denver		50@70
Minneapolis		25.50
St. Louis	27.50@42	
Baltimore	40.00	
Los Angeles	23.75	15.00
Montreal	37.00	....
Atlanta	42.00	
Detroit (petroleum asphalt)	28.40	21.15
Cincinnati	32.50	24.00
Maurer, N. J. (asphalt)	27@38	....
Maurer, N. J. (asphalt cement)	29@36	25@31

PAVING STONE—

New York	5-in. granite	No quotations
Chicago	About 4x8x4 dressed	$3.40 sq.yd.
	About 4x8x4 common	3.05 sq.yd.
San Francisco	Basalt block 4x7x8	65.00 per M
Boston	5-in. granite	4.20 sq.yd.
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107.00 per M
Baltimore	Granite	2.25 sq.yd.
Montreal	Granite	6.50 sq.yd.
New Orleans	Granite	3.00 sq.yd.
Cincinnati	Granite	3.25 sq.yd.
St. Louis	Granite	3.40 sq.yd.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	.95	lin.ft.
Chicago	18 in. wide	.70	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 70c. for 5x16 in., 80c. for 5x18 in.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3½	16	$2.99
New York	4	16	3.33
Boston	3	16	3.45
Chicago	4	16	3.75@4.00
Chicago	3½	16	3.25@3.50
St. Louis	3½	16	3.05
St. Louis	4	16	3.50
Seattle	4	16	Off market
Minneapolis	3½	16	2.35
Atlanta	3½	16	2.30
New Orleans	3	16	2.99
New Orleans	3½	16	3.42
New Orleans	4	16	3.85
Dallas	4	18	3.90
Baltimore	3½	16	3.75
Montreal	4	16	4.90
Detroit	3½	16	3.40

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.50	$2.25	$2.50	$2.25	$1.25	$1.25
Denver	2.00	1.80	1.80	1.80	1.60	1.40
Chicago	2.75	2.00	2.75	2.00	2.75	2.00
St. Louis	1.65	1.78	1.70	1.82	1.70	1.68
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas	1.75	2.50	1.75	2.50	1.75	2.00
Minneapolis	2.00	1.50		1.35	1.00	.75
Cincinnati	2.00		2.00		1.30	1.30
San Francisco	2.50	1.90	2.50	1.50	1.65	1.50
Boston, per ton	2.65	2.85	2.65	2.85	2.00	2.00
New Orleans	.85	3.00			1.65	1.40
Los Angeles	1.55	1.50	1.45		1.00	1.00
Atlanta, per ton	[illegible]	2.25		2.25	1.50	1.15
Detroit	1.85	2.50	1.85*	2.00	2.50	1.85
Baltimore, per ton	1.40	1.40	1.60	1.60	.70	.70
Montreal, per ton	1.50	1.15	1.75	1.50	1.50	1.40

CRUSHED STONE—Price for cargo or carload lots is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.90@2.00	$1.85	$2.15	$2.00
Chicago	2.75	2.00	2.75	2.15
St. Louis	1.85	1.65	1.85	1.65
Dallas	2.10	3.50	2.10	3.50
San Francisco	2.50	1.50	2.50	1.50
Boston	3.00*(del)	3.25	3.00*(del)	3.25
Minneapolis	2.00†	1.50†	2.25†	1.60
Denver	....	3.75	....	3.75
Seattle (del.)	3.50	3.50	3.50	3.50
Atlanta	2.50*	3.10*	....	....
Cincinnati	2.30	....	2.15	....
Los Angeles	1.75*	1.50	1.80*	1.50
Detroit	2.00	1.75	2.00*	1.75
Baltimore	1.75*	1.50	1.75*	1.50
Montreal	2.00*	1.75	2.10*	2.00

* Per ton. † Limestone; traprock, $1.60 and $1.80 per ton for 1½ and ¾-in.

CRUSHED SLAG—Price of crushed slag per net ton in carload lots:

	1½-In.	¾-In.	Roofing	Sand
Lebanon or Bethlehem, Pa.	$1.00	$1.00	$2.50	$0.90
East n, Pa.	1.20	1.20	3.00	1.10
Buffalo, N. Y.	1.25	1.00	2.00	1.00
East Canaan, Conn.	1.25	1.35	4.00	1.10
Birmingham, Ala.	1.25	1.25	2.05	1.00
Toledo, Ohio	1.50	1.50	2.35	....
Atlanta, Ga.	2.58	2.25	....	....

LIME—Warehouse prices.

	Hydrated, per Ton Finished	Hydrated, per Ton Common	Lump, per 200-Lb. Barrel Finished	Lump, per 200-Lb. Barrel Common
New York	$21.00	$20.00	$3.50* – at plant –	$3.30*
Chicago	20.00	.....	....	1.75
St. Louis	26.00	20.00	....	4.12½*
Boston	29.00	26.00	3.80	3.55
Dallas	.....	25.00	....	2.50†
Cincinnati	17.60	16.60	....	13.10‡
San Francisco	25.40	22.00	....	2.25
Minneapolis	29.00	22.00 (white)	2.00	1.70
Denver	.....	3.20 (bbl.)	1.00 (bu.)	....
Detroit	22.00	19.00	2.00†	1.80†
Seattle	27.00	.....	3.25	....
Los Angeles	30.00	30.00	3.00*	3.00*
Baltimore	22.25	17.50	...	12.75‡
Montreal	32.00	....	16.00‡	...
Atlanta	.....	18.00	...	2.00
New Orleans	.....	22.50	....	2.40

* 300-lb. barrels. † Per 180-lb. barrel. ‡ Per ton.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosedale)	$2.80	$1.50
Kansas City (Ft. Scott)	1.60	1.75
New Orleans	3.36	3.36
Atlanta (Magnolia)	11.00 ton	1.90
Cincinnati (Louisville)	2.75	2.25
Boston (Rosedale)	2.35	....

PORTLAND CEMENT—Current prices are for barrels in carload lots, *without* bags, to contractors:

	Current Without Bags	One Month Ago Without Bags	One Year Ago Without Bags
New York (delivered)	$3.10	$3.10	$2.80
New York, alongside dock to dealers	2.40	2.40	2.35
Jersey City (delivered)	2.64	2.89	2.47
Boston	2.87	2.87	2.42
Chicago	2.17	2.17	2.00
Pittsburgh	2.17	2.17	2.05
Cleveland	2.43	2.43	2.32
Detroit	2.51	2.51	2.08
Indianapolis	2.31	2.31	2.27
Toledo	2.51	2.51	2.12
Milwaukee	2.39	2.39	2.11
Duluth	2.10	2.10	2.10
Peoria	2.43	2.43	2.12
Cedar Rapids	2.51	2.51	2.18
Davenport	2.47	2.47	2.14
St. Louis	3.40	3.40	2.20
San Francisco	3.09	3.09	2.63
New Orleans	3.60	3.60	2.36
Minneapolis (delivered)	2.70	2.70	2.22
Denver	3.10	3.10	2.82
Seattle	3.10	3.10	2.78
Dallas	2.85	2.85	2.15
Atlanta	3.00	3.00	2.70
Cincinnati	2.87	3.32	3.00
Los Angeles	3.21	3.21	2.78
Baltimore (del.) drayload lots	3.58	2.93	2.90
Detroit	2.43	2.33	....
Montreal	3.44	3.50	3.48

NOTE—Bag charge is generally 25c. each, 10c. each in New York and Jersey City.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH by 4-INCH MESH

Style Number	Sectional Area Square Inches per Ft. Width	Pittsburgh, Mill	New York, (Del'd)	Chicago	Dallas	San Francisco
032	0.032	$1.03	$1.55	$1.11	$1.11	$1.54
049	0.049	1.32	1.95	1.43	1.43	1.96
068	0.068	1.61	2.35	1.74	1.74	2.41
093	0.093	2.07	2.98	2.24	2.24	3.11
126	0.126	2.57	3.67	2.79	2.79	3.88
153	0.153	3.06	4.34	3.32	3.32	4.03
180	0.180	3.51	4.97	3.81	3.81	....
245	0.245	4.64	6.52	5.03	5.03	....
283	0.287	5.36	7.50	5.81	5.81	8.10
376	0.336	6.21	8.67	6.73	6.73	....
395	0.395	7.20	10.03	7.81	7.81	....
			PAVING			
036P	0.036	$0.79	$1.23	$0.85	$0.85	....
053P	0.053	1.12	1.68	1.21	1.21	....
072P	0.072	1.41	2.08	1.53	1.53	....
097P	0.097	1.82	1.76	1.97	1.97	....
049R	0.049	1.12	2.08	1.21	1.21	....
067R	0.067	1.49	2.64	1.53	1.53	....
089R	0.089	1.82	....	1.97	1.97	....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 10% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	New York Delivered	Chicago	St. Louis	San Francisco	Dallas
27	233	$29.20	$29.50	$32.00	$34.20	$32.75
26	250	31.00	31.00	33.00	....	34.50
25	300	32.75	32.40	35.00	.....	36.75
24	340	33.65	34.10	37.00	42.70	39.25
22	450	35.50	.....	40.00	.....	43.30

BARS, CONCRETE REINFORCING—Current quotations per 100 lb:

ROLLED FROM BILLETS

In.	Pittsburgh, Mill	Warehouse, Uncut: New York	Chicago	Dallas	San Francisco
¼ and larger..	$2.00@2.35	$3.13	$3.48	$3.87	.....
⅜..	2.05@2.40	3.18	3.53	3.92	.....
½..	2.10@2.45	3.23	3.58	3.97	.....
⅝..	2.25@2.60	3.38	3.63	4.12	.....
¾.....	2.50@2.85	3.63	4.18	4.57	.....

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¼ in. and larger.	$2.50	$2.40	$4.25	⅝.....	$2.90	$2.65	.....
½.....	2.55	2.45	4.30	¾.....	2.90	....	.....
⅝.....	2.65	2.50	....	.....	....	....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	$21.70	$22.70	$25.00	$47.25	$54.50
New Orleans.....	25.50	25.50	22.50	.....	.....
Chicago	15.00	15.00	14.00	37.00	.....
St. Louis, salmon....	15.00†	15.00	16.00	.....	.....
Denver, salmon....	14.00	14.00	17.00	.....	.....
Dallas.....	18.50	25.00	24.00	44.00	.....
San Francisco.....	18.00	18.00	15.00	....	44.38
Los Angeles.....	15.50	15.50	12.50	(not used)	
Boston (del.).....	25.00	25.00	30.00	49.25	57.25
Minneapolis (del.)...	18@20	20@22	20.00	37.00	43.00
Kansas City.....	....	20.00	20.00	....	.....
Seattle.....	19.00	19.00	15.00	48.00	53.50
Cincinnati	21.00	22.00	22.00	43.00	.....
Montreal (del.).....	18.00	20.00	17.50	100.00	120.00
Detroit	18.00	18.00	21.00	46.00	52.00
Baltimore (del.).....	20@25	22.50	20.00	40.00‡	44.00‡
Atlanta	18.00	13.00			
New Orleans	21.50	24.00			

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †Hard brick $20.50 in St. Louis. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots for hollow building tile

	New York: Current on Trucks	One Year Ago	Chicago	St. Louis	San Francisco	Perth Amboy, N. J., Factory
4x12x12		$0.1895	$0.12	$0.112	$0.145	
6x12x12		2526	18	147	21	
8x12x12			216	207	29	
10x12x12			27	237		
12x12x12			324	282		

Note—Definite prices not decided upon in New York

	4x12x12	8x12x12	12x12x12
Boston	$0.173	$0.28	$0.43
Minneapolis	....	[illegible]	[illegible]
Minneapolis (delivered)	10½	[illegible]	[illegible]
Cincinnati	10	[illegible]	[illegible]
Kansas City		No prices obtainable	
Denver	11	18	25
Seattle	13	175	30
Los Angeles	11	192	23
New Orleans	21	35	50
Detroit	15	27	39
Montreal	25	31	38
Baltimore	16	27	45
Atlanta	12	20	

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	New York (Del.)	1 Yr. Ago	St. Louis	Chicago (del.)	San Francisco
Beams, 3 to 15 in.....	$2.00@$2.45	$3.33	$5.00	$3.32½	$3.13	$4.85
Channels, 3 to 15 in....	2.00@2.45	3.33	5.00	3.32½	3.13	4.85
Angles, 3 to 6 in., ¼ in thick..	2.00@2.45	3.33	5.00	3.32½	3.13	4.85
Tees, 3 in. and larger...	2.00@2.45	3.33	5.00	3.32½	3.13	4.85
Plates....	2.00@2.65	3.33	5.00	3.32½	3.13	5.50

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York: Current	One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger..	$3.70@$3.75	$5.08	$6.00	$5.08	$4.97½	$7.05	$6.85

CONE HEAD BOILER

¾ in. and larger..	3.80@3.85	5.18	6.10	5.18	5.07½	7.15	6.85
⅝ and 11/16.....	3.95@4.00	5.33	6.25	5.33	5.22½	7.40	6.85
½ and 9/16.....	4.20@4.25	5.58	6.60	5.68	5.47½	7.65	7.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in take an extra of 25c. Tank rivets, 49 per cent off

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$3.00@$3.25	$4.15	$5.50	$5.20	$4.10	$4.95
Cut.....	.... ..	7.65	7.75	7.75	4.75	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade..	$2.15	$2.55	$3.00	$1.95	$2.30	$2.70
No. 2 grade..	2.05	2.45	2.95	1.85	2.20	2.60

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $8.00 per square in carloads; $8.25 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices per ton f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.....	$2.80
Tar pitch (in 400-lb. bbl.) per 100 lb.....	2.10
Asphalt pitch (in barrels) per ton.....	49.50
Asphalt felt (light) per ton.....	98.00
Asphalt felt (heavy) per ton.....	102.00

SHEETS—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$3.20@$3.55	$4.22½	$4.68	$6.50	$4.50
No. 12	3.25@3.60	4.27½	4.73	6.66	4.55
No. 14	3.40@3.65	4.42½	5.03	6.60	4.60
No. 16.....	3.50@3.75	4.42½	5.13	6.95	4.70
Black					
*Nos. 18 and 20.....	4.05@4.20	5.30	5.80	7.05	4.80
*Nos. 22 and 24.....	4.10@4.25	5.35	5.85	7.10	4.85
*No. 26	4.15@4.30	5.40	5.90	7.15	4.90
*No. 28	4.20@4.35	5.50	6.00	7.25	5.00
Galvanized					
No. 10	4.50@4.70	5.50	6.35		5.05
No. 12	4.60@4.80	5.60	6.45	7.85	5.1[illegible]
No. 14	4.60@4.80	5.60	6.45	7.85	5.1[illegible]
No. 18 and 20	4.90@5.10	5.90	6.75	8.15	5.3[illegible]
No. 22 and 24	5.05@5.25	6.05	6.90	8.30	5.4[illegible]
*No. 26	5.20@5.40	6.20	7.05	8.45	[illegible]
*No. 28	5.50@5.70	6.50	7.30	8.75	[illegible]

* For painted corrugated sheets add 30c. per 1000 lb. for 5 to 28 gage, 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw, in barrels (bbls.)	$0.73	$1.87	$0.82	$1.66

WHITE AND RED LEAD—Base price per pound.

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Yr Ago Dry and In Oil
100-lb. keg	13 00	14 50	15 50	17 00	13 00	15 50
25 and 50-lb. kegs	13 25	14 75	15.75	17.25	13.25	15 75
12½-lb keg	13 50	15 00	16 00	17 50	13 50	16 00
5-lb. cans	16 00	17 50	18 50	20 00	16.00	18 50
1-lb cans	18 00	19 50	20 50	22 00	18 00	20 50

500 lb. lots less 10% discount; 2000 lb. lots less 10–2½% discount

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

	Lumber Prices in Yards at San Francisco 6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24 50	$25 00	$26 00	$28.00
3x6 and 8	26 50	26.00	27 00	29 00
4x4-6 and 8	26 00	27 00	28 00	29 50
3x10 and 12	26 00	27 00	28 00	30 00
3x14	26 50	27 50	28 50	30 50
4x10 and 12	26 00	27 00	28 00	30 00
4x14	27.00	28.00	29.00	31.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$25.50	$27 50	$28 50
6x14	27 00	29 00	29 50
8x10	25.50	27.50	28.50
8x14	27.00	29.00	29.50

New York, Chicago and St Louis

	Southern Pine New York* 20 Ft. and Under	New York* 22 24 Ft.	Chicago 20 Ft and Under	Chicago 22-24 Ft.
3x 4 to 8x8	$37 00	$38 00	$51 00	$52 00
3x10 to 10x10	42.00	43 00	53 00	54 00
3x12 to 12x12	48.00	49.00	55 00	56 00
3x14 to 14x14	51 00	53 00	60 00	61 00
3x16 to 16x16	60.00	61.00	65.00	66 00
3x18 to 18x18	72.00	73.00	69.00	70 00
4x20 to 20x20	.....	.....	72.00	73 00

* For long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis—Yellow pine, 22@ 24 ft long, 3 x 12@ 4 x 12, $42; 2 x 16, $53; 3 x 16 @ 4 x 16, $53; 6 x 10 @ 10 x 10, $37, 6 x 12@ 12 x 12, $41; 6 x 14@ 14 x 14, $45; 6 x 16@ 16 x 16, $51

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20-Ft and Under P	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft and Under P.	Fir
Boston	$49 00	$55 00	$56 00	$50 00	$56 00	$58 00
Seattle	.....	25 00	....	....	....	27 00
New Orleans	35.00	....	....	....	38.00	....
Baltimore	60 00	....	....	....	70.00	....
Cincinnati	....	....	....	....	30.00	....
Montreal	78.00	78 00	68 00	78.00	79 00	100 00
Los Angeles	.....	47.00	46 00	.....	....	49 00
Detroit	Quotations f.o.b mills only					
Denver	....	37 25	....	....	....	38 25
Minneapolis	47 00	41.00	34 00	.....	56 00	41 00
Atlanta	27 50	....	....	....	40 00	....
Dallas	45.00	....	....	.....	55 00	....

	1-In. Rough, 10 In. x 16 Ft. and Under P	Fir	Hemlock	2-In. T. and Gr 10 In x 16 Ft P	Fir
Boston	$45 00	$60 00	$45 00	$45 00	$60 00
Seattle	....	18 50	..		
New Orleans	55 00	.....	.....	55 00	
Baltimore	42.50@ 45	.....	....	40@ 45	
Cincinnati	26 00	.....	....		
Montreal	120 00	60 00	60 00	80 00	80 00
Los Angeles	....	41.00	45 00	....	84 00
Denver	....	31 25	....	....	29 25
Minneapolis	40 50	29.25	35 00	35 00	31.25
Atlanta	15 00	....	....	18 00	....
Dallas	....	33 00	....	42 00	....

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.33½	Detroit	$0 33
Birmingham	76½	Kansas City	.81½
Boston	41½	New Orleans	.51½
Buffalo	29½	New York	.38
Chicago	38	Pacific Coast (all rail)	1.66½†
Cincinnati	.33	Philadelphia	.35
Cleveland	.24	St. Louis	.47½
Denver	1 35*	St. Paul	.69½

Note—Add 3% transportation tax. * Minimum carload, 40,000 lb.
†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEET PILING—The following price is base per 100 lb. f o.b Pittsburgh, with a comparison of a month and a year ago

Current	One Month Ago	One Year Ago
$2 55	$3.00	$2.55@$3.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows

	New York
Hercules red strand, all constructions	15%
Patent flattened strand, special and cast steel	15%
Patent flattened strand, iron rope	List
Plow steel round strand rope	30%
Special steel round strand rope	25%
Cast steel round strand rope	17%
Iron strand and iron tiller	List
Galvanized iron rigging and guy rope	+17½%

San Francisco Galvanized iron rigging and guy ropes + 22½%; bright plow, 25% off.

Chicago: Plow steel, round strand, 30% off; flattened strand, 15%; cast steel, round strand, 17½%.

Western and California territory, 25% plow steel; 22½% galvanized iron rigging and guy rope.

Montana, Idaho and Arizona, 20% plow steel; 27½% galvanized iron rigging and guy rope.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ⅞-in., 6, ⅞-in., 4½, 1-in., 3½, 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 22	Dallas	$0 29
New York	.21	New Orleans	21½
Chicago	21	Los Angeles	.18*
Minneapolis	23	Seattle	.20
San Francisco	19	St. Louis	.21
Atlanta	25	Montreal	.31
Denver	.20	Detroit	21
Cincinnati	.22	Baltimore	.25

*780-ft. coils

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb keg of black powder

	Low Freezing 20%	Gelatin 40%	Gelatin 60%	Gelatin 80%	Black Powder
New York	....	$0 323	$0 361	.....	
Boston	.225	2425	2825	$0.365	
Kansas City	2475	27	.30	34	$2 40
Seattle	1825	2025	.2275	2950	2 60
Chicago	2225	2425	2675	.335	2 50
Minneapolis	2222	2426	.2682	.....	2 80
St. Louis	.245	28	315	3575	2 50
Denver	.2250	2550	29	.3325	2 70
Dallas	.265*	275	3025	.....	2 60
Los Angeles	22	27	.32	.....	3 10
Atlanta	2525	2875†	.3225	.3650	2 50
Baltimore	2525	2875	3175	.36	2 10
Cincinnati	.2425			.....	2 65
Montreal	30	32	.37	.38	4 10
New Orleans	.255	275†	300†	.....	2 80

* 30 Per Cent. † Low freezing

PILES—For spruce and plain pine piles, delivered New York, the price is as follows:

Spruce 10-in. butts, 5-in tops, length 20-30 ft	$11 50
Spruce 12-in butts, 6-in. tops, length 30-40 ft	10 50
Pine 12-in butts, 6-in tops, length 41-50 ft	13 75
Pine 14-in butts, 6-in tops, length 51-60 ft	22 50
Pine 14-in butts, 6-in. tops, length 61-71 ft	25 25

	Dallas		St. Louis
6-in x 20-ft	$4.60	6-in. x 30-ft	$7 90
		7-in x 30-ft	10.10
6-in x 30-ft	7 10	7-in x 35-ft	15 55
		8-in. x 35-ft	16 55
8-in. x 30-ft	8.45	7-in. x 40-ft	16 05
		8-in. x 45-ft	27 05
8-in x 35-ft	10.38	8-in. x 50-ft	28.05

OLD MATERIAL—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$11.75	$12.50	$11 00
Stove plate	12.00	16.00	11 50
No 1 machinery cast	18 50	16 50	14 00
Machine shop turnings	7 00	6 75	5 00
Cast borings	7 50	8 50	7 00
Railroad malleable cast	14 50	14 50	12 50
Relaying rails	40 00	47.00	15 00
Relaying rails	41 00	34 00	35@ 40

SHIP SPIKES—Current prices per 100 lb.

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$9.20	$8 50	$8 55
⅝	8.75	6.75	8 25
¾	8 60	6 60	8 30

Pittsburgh base, $4.25@$4 50 per 100 lb.

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN Editor

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Load Limit for Soft Roads

ACTING upon authority given to him by the legislature on March 17, the state highway commissioner of New Hampshire has prohibited vehicles of more than 3 tons gross weight from using the trunk line, cross state or state-aid highways from March 21 until further notice. The order was issued to protect the highways during the period of spring road softening and will be rescinded as soon as conditions permit. Rulings of similar purport have been made before, though less drastic. The Connecticut limit, for the early spring season last year, was fixed at 10 tons as compared with a normal maximum gross load of 12½ tons. The 3-ton gross weight limit for New Hampshire, therefore, represents a decidedly radical reduction in allowable weight. It will, in large measure, rule the motor truck temporarily off the highway. Regulations of this sort obviously must be based on the type and condition of roads. Connecticut, with a considerable mileage of hard-surfaced roads can allow a higher load limit than can New Hampshire, where dirt and gravel roads are the prevailing types. The restrictions, even though they are temporary, are evidence of a commendable determination to conserve the money which the state has put into its road system.

Menace of German Exportations

RELATIVELY little attention has been given to the menace which heavy German exportations will have on the United States. The matter, however, is not a whit less important to us than to England and France. Both of them desire Germany to have a huge export trade—*but not to their countries*. They do not want to be undersold at home. However, Germany's goods, going into world trade, will compete with the goods of all other nations, and with ours as well. Germany's differential will be very considerable. Further than that, we are now rich, compared with other nations, and are looked upon to take a big volume of German products. If we do, there may be serious industrial disturbance here. Since Germany cannot pay fully in gold or by transfer of investments in other countries, she must export goods and labor, the labor either crystallized in goods or the labor itself. It is just the last that Germany has repeatedly said she wants to export. She has proposed to rebuild the devastated regions with German labor and German materials. Heretofore France has not been willing to accept the offer, but it is now reported that French labor has withdrawn its objections. Let us hope that that is true, and that the French Government, likewise, will fall in with the plan. From the standpoint of the three nations most concerned—England, France, and ourselves—the best solution would be such an exportation of German materials and German labor. Difficulties are involved, of course; the French, for example, pretend to fear the Germanization of northern France, but such difficulties are minor compared with the world-wide trade disturbance that would result from the forcing of huge quantities of German goods, at low prices, into world trade.

State Harbor Control

WHILE New York harbor is apparently in process of being transferred from city to state control just the reverse operation is taking place at San Francisco. There, the case for local control is being made, as noted in the news pages, solely on the rights of the city and the necessity of home rule, while the opposition largely depends on charges of possible municipal inefficiency and corruption. The issue is much broader than this; it centers around the future development of San Francisco bay as a great shipping harbor and not around the rights and privileges of the city of San Francisco. Sooner or later that wide bay, with its modern port developments on the west and with its transcontinental terminals on the east, must be developed as a unit and the rival demands and facilities of its dozen cities compromised. So long as the state controls San Francisco it will be an easy matter to extend control to the other cities and to round out a balanced development, but once let the city take over its own front years of controversy and delay will be ahead. The situation in the port of New York today should be a beacon by which the legislators of California may steer.

Dust Explosions

DUST explosions are commonly recognized as one of the hazards in certain industries and establishments, such, for example, as grain elevators, plants manufacturing grain products, sugar refineries, etc. The introductory paragraph of an article in this issue, however, indicates that dust explosions may be expected in many industries beyond those with which such explosions are commonly associated. That the possibility of their occurrence should be taken into consideration by the mechanical engineers of such industries goes without further emphasis, but is there not an obligation here, also, for the structural engineer? Manifestly the removal of the dust is a primary engineering problem. Its removal, however, may be intimately associated with the details of a structure—such, for example, as the design of the housings around grain elevator legs—and therefore a matter that the structural engineer must take into consideration. Furthermore, since dust explosions should be recognized as a hazard, it is proper to take into consideration in the design of structures for those industries such construction as will minimize the damage when an explosion actually occurs. This Mr.

Price urges in his article. He advocates curtain instead of bearing walls for the exteriors of structures, and commends large window areas, particularly when filled with self-supporting steel sash. The thought may be a new one to most structural designers, but with the records of damage that are available it is apparent that it is a matter for the structural engineer's consideration.

The "Sand-Hog" to Reappear

FRIGHTENED into retirement by the shadow of the recent world conflict, like the prophetic ground-hog, the New York "sand-hog," according to present indications, will soon reappear after a long period of hibernation. The announcement of the contract schedule for the Hudson River vehicular tunnels in the 1920 annual report of the New York-New Jersey commissions, made public recently, fixes May 15 as the date on which the plans, specifications and contracts for the 29-ft. twin tubes will be ready. Unless unforeseen delays occur, actual work under the river should be in progress shortly after that date. The announcement heralds the resumption of a type of engineering work in which no new projects have been undertaken since the United States entered the war. During the period of construction of the Pennsylvania's East River and North River tunnels, the Hudson tubes, and the subways connecting Manhattan and Brooklyn, New York City became the world's most important compressed-air tunnel center. In those days the sand-hog, always a dramatic figure, by reason of the risks of his calling, frequently found his way into the public prints. The engineering profession is his debtor, for it was largely through him that the public became acquainted with the magnitude and importance of great public and private engineering projects which, without his human interest touch, would have proceeded unheralded and unappreciated. The sand-hog was the best press-agent that the engineering profession ever had, and we welcome his return.

All-Year-Round Track Work

THE USUAL arrangement of track work involves building up practically new labor forces each spring. Spreading the work evenly over the entire year is by no means easy (see *Engineering News-Record* of March 17, p. 449) but some railways have found that enough maintenance work, even in the North, can be economically done in winter to hold continuously not only a skilled force but a reduced force of so-called "common" labor as well. A severe winter with heavy snows will prevent continuous maintenance, but then forces are required to keep line and yards clear. The work is often emergency work, better done by the loyal "company" man than by the casual laborer. In a mild winter, there is opportunity for much continuous work, with resulting absence of bad spring track and a condition that is virtually "deferred maintenance," more expensive to repair. As pointed out by Mr. Morse of the Rock Island, at the convention of the American Railway Engineering Association, much track work requires skilled labor, in spite of the general impression that any man who works on the track is a common laborer. These skilled men, at least, should be retained, the gangs being increased by common labor if necessary during the busiest seasons. Economy and efficiency of track work depend largely upon interest and loyalty hardly to be expected of temporary employees.

Politics Attacks Highway Departments

POLITICAL attacks on state highway departments have been particularly vicious during the past few months. A survey of the several lines of battle indicates each to have been laid down with the view of establishing the ascendency of political control of road location and construction. Ostensibly, of course, the purpose is quite different. It presumably is a patriotic attempt to reduce costs and eliminate extravagant standards.

Such efforts are being made in Illinois, Indiana and Missouri. The Illinois situation revolves about high prices for roads of high standard. In Missouri the struggle is to get the designation of state roads into the hands of the legislature. In Indiana the county organizations recently deprived of a large part of their road funds and the perquisites therefrom are trying to get back what they have lost. The Indiana situation is a plain struggle for local initiative and control of highway development. Such an arrangement is more to the liking of politicians than is centralized control by a well organized state highway department.

It is interesting to note how high prices and recent congressional action have temporarily strengthened the politicians. High prices have given them an opportunity to proclaim extravagance—a charge to which the public always gives attention. Congress, by its failure to make a new federal-aid appropriation has deprived state highway departments, in many states, of the strongest argument they possessed against the advocates of local independence in highway improvement.

It has taken much work to bring state highway departments to their present relatively satisfactory level of operation. All forces interested in public welfare must unite to prevent retrogression.

A Step Toward a Port of New York

UNLESS something unexpected intervenes the treaty or compact between the States of New Jersey and New York for the joint control of New York harbor is now assured. There thus comes into being a political entity rare if not entirely new in American government, an interstate appointed body with all the powers legally vested in, but only occasionaly exercised by, the state itself. The Port Authority may "purchase, construct, lease or operate any terminal or transportation facility, . . . make charges for the use thereof . . . own, hold, lease or operate real or personal property, borrow money and secure the same by bonds and mortgages . . ." Thus far it is in supreme charge of that great national, state and city asset, the port of New York, and in that respect it has been attacked as a usurpation of local authority. The fact is, however, that the compact as written constitutes such a supreme authority only insofar as the states and cities concerned are agreeable. The co-ordination of the port must depend on the co-operation of its separate parts.

In the first place the Port Authority cannot begin to function until the two states have adopted a "comprehensive plan" for port development. Such a plan, presumably, is what the recent interstate port commission has just submitted, but it is inconceivable that the legislatures will vote to adopt any plan unless the prospective chronology of the scheme is definitely stated so that each party to the agreement may have some idea of

its proportionate benefit. Any plan adopted, too, must take years to complete, years in which errors in the scheme will be revealed. But the plan will have been fixed, and to change it recourse must again be had to the legislatures; co-operation must be continuous.

The case of the cities within the port district is even more definite. None of their property can be taken without their consent nor can they be financially obligated unless they so agree. Furthermore, they may proceed as they please on their individual schemes of port development. In other words, the proposed Manhattan belt-line tunnel cannot be built unless New York City permits the use of the ground beneath its streets and Jersey City or even one of the smaller boroughs of New Jersey can block the outer belt railway. Every step in any comprehensive plan will involve the consent of one or more of the many municipalities, and the proper working of the plan will be disturbed, to say the least, by any individual development out of harmony with the combined development.

The new compact, then, merely provides the machinery for a unified port and a directing head which should be able to compromise the various interests. This, indeed, is a great step forward toward the kind of thinking and building that the port of New York has been sadly needing these many years, but the desired end cannot be reached unless every party sinks its short sighted provincialism in a common effort to better the whole port, and thereby bring proportionate benefit to itself.

British Miners' Strike and Its Moral for American Labor

Before this issue reaches its readers the British coal miners' strike will probably be compromised. The very seriousness of the stoppage would forecast an early termination, while as this is written (Monday) negotiations that are regarded as hopeful are under way.

England has had serious strikes since the armistice—the railroad workers and the coal miners have both tied up the country. The present contest is due to an attempt on the part of the miners to hold what, after long effort, they succeeded in getting during the war, nation-wide agreements on wages. Before the war, wages varied in accordance with the profitableness of the coal fields. The rich districts paid higher wages than the poor districts for the same kind of work. For years the miners have had as their great goal the wiping out of these inequalities and they achieved it during the war. Last fall's strike settlement was still on the basis of a national agreement in which it was proposed to substitute before April 1 of this year a permanent wage basis for the temporary one agreed on in the settlement. Though not planned last fall, the end of government control of the industry came simultaneously with the date set for a new basis and negotiations were therefore thrown into the hands of the mine owners and the workers, the government acting as an interested spectator but not as a party to the prospective bargain. The owners immediately took a stand against national agreements, holding that efficiency of operation was impossible unless the districts stood each on its own footing. That meant reversal to the policy of wages proportionate to the mine earning power—a proposal the workers refused to consider. Hence the strike.

It is freely conceded by the miners that on the basis of operating costs the various districts, standing alone, cannot all pay the top wage of the district of cheapest production. They contend, though, that it is unjust to pay different wages for the same work. Obviously no plan could meet the miners' demand except a consolidation of ownership, or, what amounts to the same, a pooling of profits. This the miners recognize.

At this distance, and lacking thorough acquaintance with all the factors, a judgment as to the sound way out is not possible. Evidently there are good reasons against ownership consolidation—aside from the unwillingness of owners of the more profitable to pool their interests with the poorer paying properties.

If it be conceded that such consolidation is out of question then there would seem to be no possibility of settlement, short of government ownership, except on the basis of district agreement.

If the temper of the British public is correctly reported, it will be on that basis that settlement will come, with, however, payment for the miners in proportion to the results attained.

The miners' strike brings to an end the nation-wide profit-sharing scheme for both owners and workers established as a temporary measure by the strike settlement of last year. The agreement ran onto hard days—the ending of government control, the temporary loss of the export market, falling coal prices and, as a necessary accompaniment of the two previous conditions, accumulated coal stocks. Consequently the value of the scheme cannot be appraised. Probably some profit-sharing features will be embodied in the future agreements, but the nation-wide profit-sharing plan for owner and worker, made with government participation and sanction, has come to an end.

Exhibitions such as the British strike make even the most sincere disinterested friend of the labor movement hesitate in his advocacy of the strengthening of the unions. The British miners have gone so far as to permit mines to be flooded—doing heavy, if not irreparable, damage—while the railway and transport workers have voted to strike in sympathy, thus endeavoring to paralyze the country. That approaches close to tyranny.

It is just such exhibitions of ruthless power that strengthens the stand of the dyed-in-the-wool labor-union opponent in this country. Do we want to put ourselves into the power of the unions, as the British public has done? is his question. And he gets a response that shows itself, to cite one instance, in the strength now displayed by the "open-shop" drive.

The English experience and its effect on the American public should be object lessons to the American Federation of Labor. Already that body is visibly troubled by the strong reaction of the public to the high-handedness of labor during the war. It has lost much of the sympathy it was building for itself previous to 1916. Many "open-shop" advocates sincerely believe in the shop where union and non-union men work side by side, but most of them are using the "open-shop" and "American-plan" drives as a cloak for anti-union efforts.

Labor strongly organized and intelligently led can be a benefit. Acting as British labor is acting, it will be a menace and will get short shrift. Because of our agricultural population, labor's numbers here are proportionately less than in Britain. Therein lies a condition with which American labor must reckon.

The moral is to have intelligent leadership determined to win sympathy by rectitude and fairness.

Construction Details of General Motors Office Building

Fifteen-Story Structure with Thirty-two Acres of Floor Space to House Six Thousand Persons—Heavy Girders and Columns in Steel Frame—Reinforced-Concrete Laboratory Building

By Joseph Matte, Jr.
Engineer with Albert Kahn, Architect, Detroit.

An office building of more than 32 acres floor space which was completed in Detroit during the past year represents a notable structural achievement. Ranking well among the largest office buildings in existence (the Equitable Building in New York City has about 40 acres of floor space), it is furthermore distinguished by unusually complete appointments and by being occupied by a single business, the General Motors Corporation having planned the building for its own use.

The year 1915 marked the beginning of a period of great industrial expansion, and of a corresponding slackening of general building activities, which culminated in 1917 when, all energies and resources being marshalled for the one purpose of winning the war, all building work not intimately connected with the national purpose was brought to a complete standstill. The inception of the General Motors Building marked the resumption of general building construction. It is the most noteworthy structure erected since the close of the war.

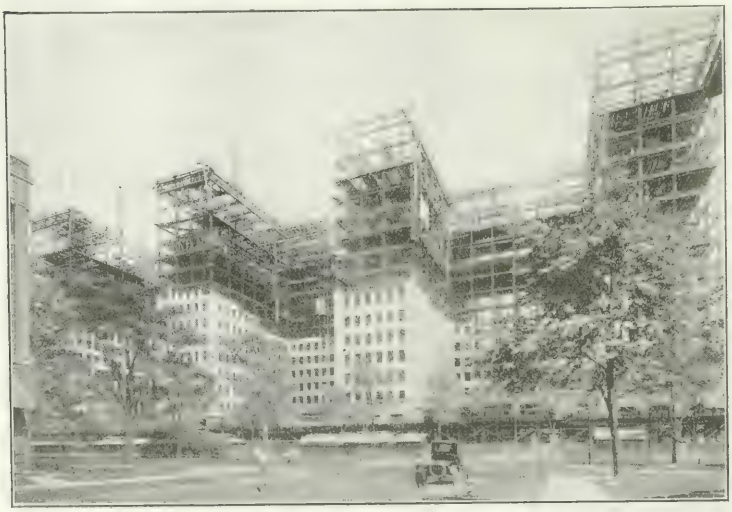
Size and Arrangement of Building

The building, 322 x 504 ft., occupies the block bounded by East Grand Boulevard, Milwaukee, Cass and Second Aves. It consists of two main connected units, the laboratory, 60 x 502 ft., fronting on Milwaukee Ave., and the office building, fronting on the Boulevard, consisting of four wings 52 x 262 ft. connected at the middle by a transept 52 x 504 ft. The basement and first floor of the office building extend over its entire area; the courts between the wings and the transept are roofed over at the second floor level. All exterior and court walls are faced with buff Bedford limestone.

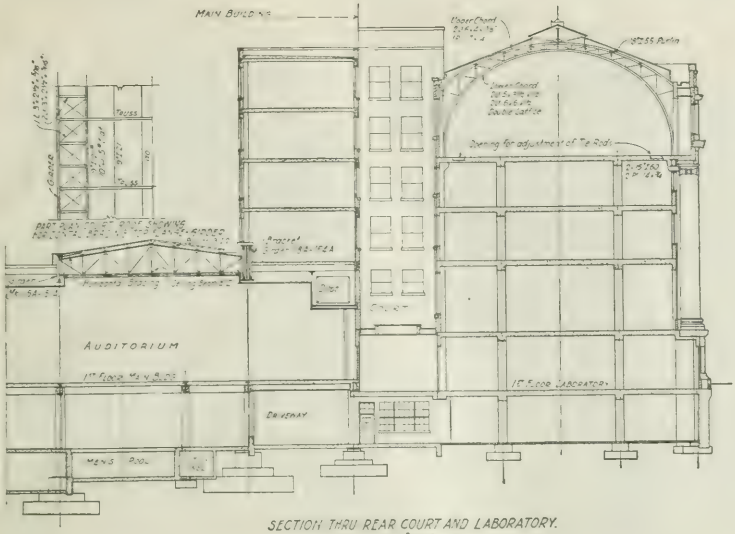
The laboratory is five stories high, with full basement. It is of reinforced-concrete construction with steel-arch roof frame. It will house the chemical, metallurgical and electrical laboratories, and provide space for a large machine shop on the first floor and an exhibition room on the fifth floor.

FIVE-STORY LABORATORY BUILDING, 60 x 502 FT., EXTENDS ALONG REAR OF MAIN STRUCTURE

The office building has a sub-basement extending under the central part, full basement, fifteen main floors, a mezzanine floor between first and second, and a pipe gallery floor below the roof. It is a steel skeleton building with reinforced-concrete floors. It contains in the basement two swimming pools each 25 x 75 ft., a gymnasium, twelve bowling alleys, billiard room, barber shop, mail room connected to the upper part of the building by 28 pneumatic tubes, and supply, stock and utility rooms. On the first floor are eight automobile show rooms, an auditorium seating 1,500 persons, offices, shops, and quarters for a bank and trust company. The second to thirteenth floors will house the offices of the General Motors Corporation, its subsidiary and affiliated companies. Every office is an outside room. The second floor is designed for a live load of 250 lb. to permit the installation of printing machinery or other heavy equipment. The fourteenth floor contains the exec-



FRONT VIEW OF GENERAL MOTORS BUILDING DURING CONSTRUCTION



GIRDER AND TRUSS CONSTRUCTION SEEN IN FRONT-TO-REAR SECTION OF BUILDING

utive offices, living suites, private dining and lunch rooms, and barber shop. The fifteenth floor contains two dining rooms with cafeteria service, capable of serving 6,000 persons in less than an hour and a half, a kitchen of 5,000 sq.ft. area, ladies' rest rooms, men's lounge, and dance hall. Over part of one of the wings, a sixteenth story contains valet's and maid's quarters.

Access to the basement for trucks carrying supplies is obtained by means of a driveway running the full length of the building between the laboratory and the office building, and passing underneath the five-story projections of the wings connecting them to the laboratory. The driveway has a ramp at each end to reach street level. The main entrance and elevator lobby are treated with Tavernelle marble pilasters, and the floors laid over with paneled Tennessee marble. The corridors are floored over with gray Tennessee marble, and wainscoted with white Alabama marble. The corridor doors are hollow metal. The interior doors of offices and the window trim are of American walnut.

The building has a floor area of about 1,400,000 sq.ft. and a population capacity of 6,000 people. It is served by four freight elevators and 27 passenger elevators. The principal quantities of material required in its construction were as follows: structural steel, 15,000 tons; reinforcing steel, 1,500 tons; brick, 8,790,000; cement, 100,000 bbl.; sand and gravel, 70,000 cu.yd.; fireproofing tile, 290,000 sq. ft.; limestone, 450,000 cu.ft.

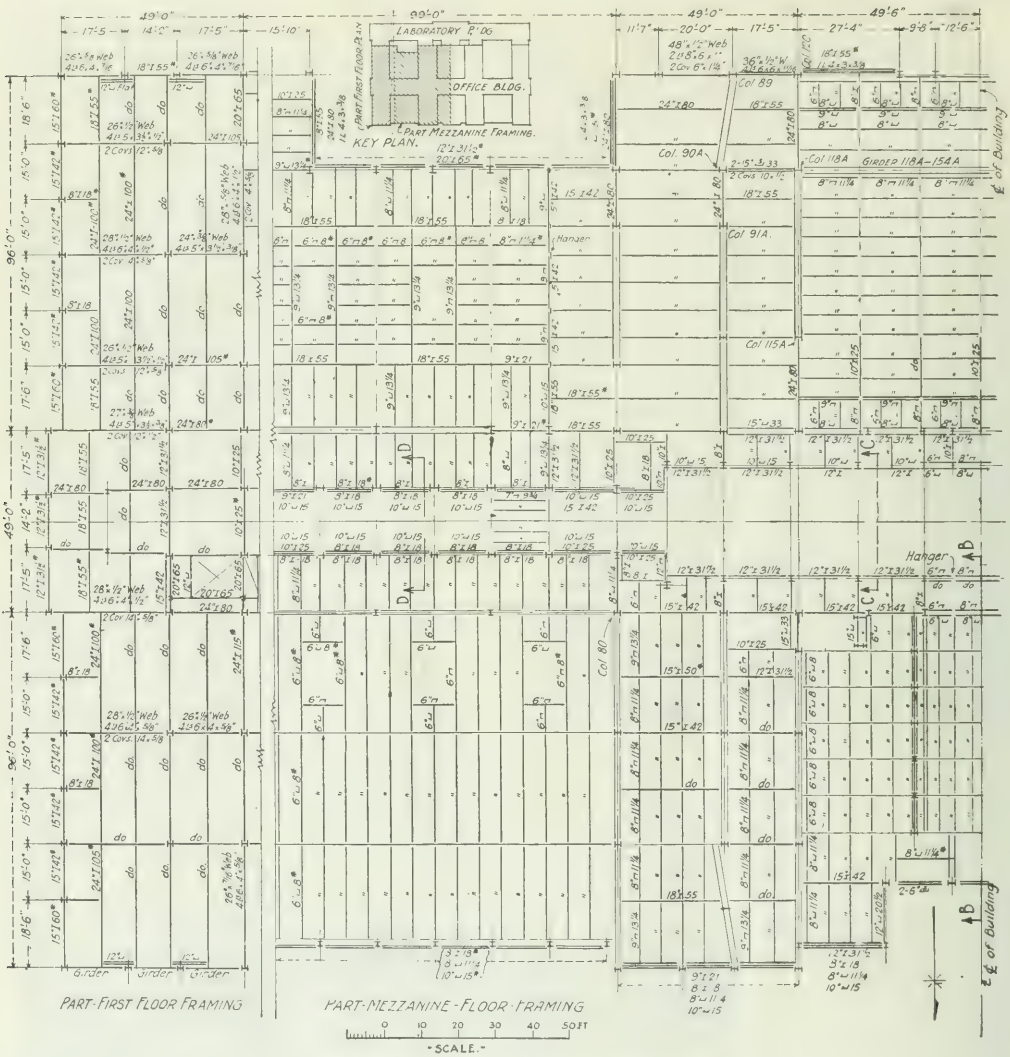
The site of the building was occupied by 26 minor buildings, mostly residences, and the office of the Hyatt Roller Bearing Co. The residences were all dismantled and the material removed. The office building, 60 x 95 ft., was a three-story-and-basement reinforced concrete building erected in 1916, weighing 3,600 tons. It was considered economical to move this building to a new site several hundred feet south of its location, and it was decided to attempt this. The work was entrusted to the F. P. Friestedt Co. of Chicago, who started June 20, 1919. It was entirely successful. While in transit the building was in full use; light, water, and telephone service were uninterrupted.

Foundations and a basement were prepared at the new site. Twelve lines of 12 x 12-in. moving timbers, supported by 225 jacks, received the load of the building. The jacks rested on hardwood skids carried by 6-in. maple rollers on running tracks placed on cribbing. The 12 x 12-in. moving timbers were connected in pairs by a loop of $1\frac{1}{4}$-in. steel cable. These loops were attached to three 90-hp. double-drum electric hoisting engines by means of 12,000 ft. of $\frac{5}{8}$-in. cable reeved through five sets of 3-in. sheave blocks and one set of 6-in. blocks.

The average progress of moving was 60 ft. per day, the maximum, 101 ft. in one day, when the building crossed Milwaukee Ave. The total cost for repairs to plastering and other work was only $50.

Basement excavation required the removal of 130,000

THREE-HINGED STEEL ARCH ROOF OF LABORATORY BUILDING



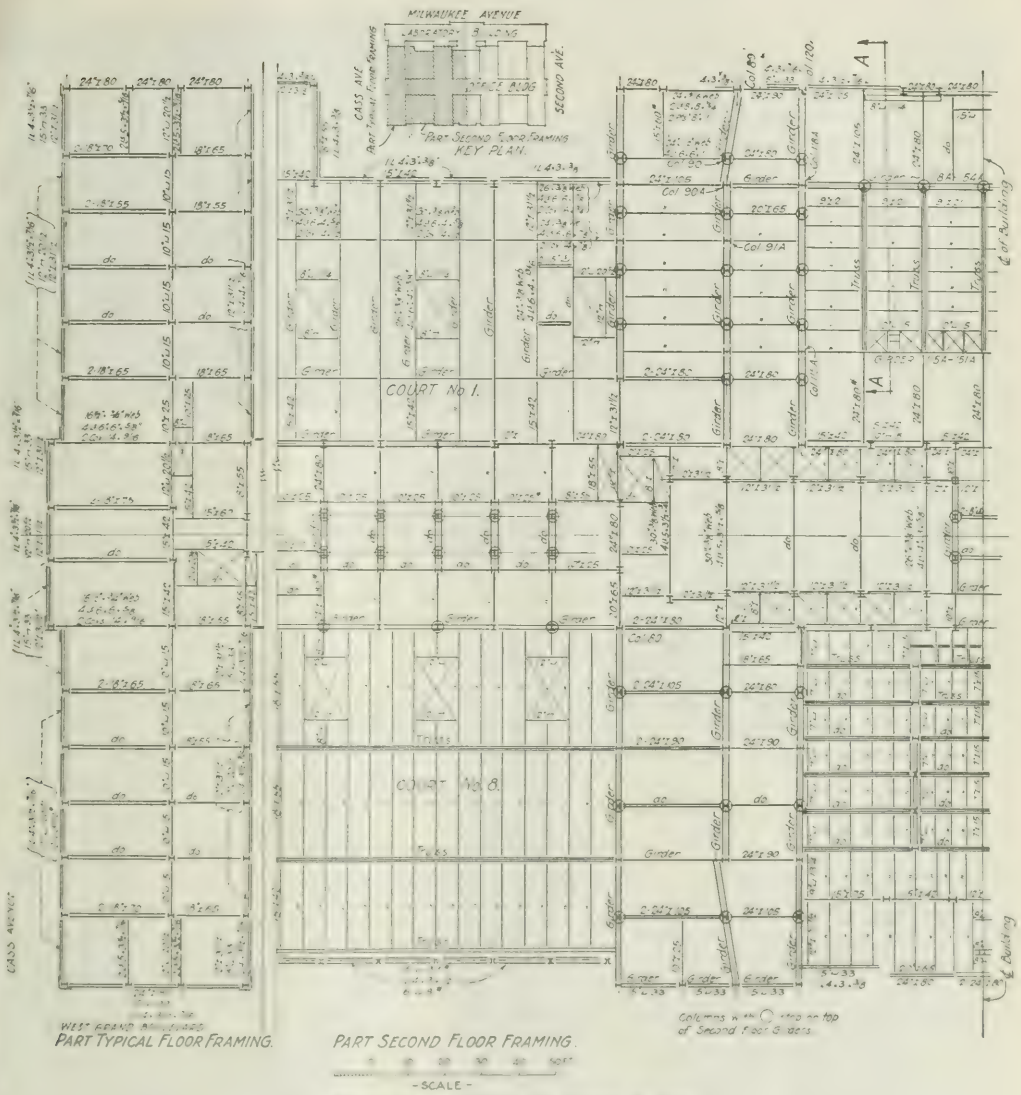
FRAMING OF FIRST AND MEZZANINE FLOORS

cu.yd. of material, mostly yellow and blue clay. This was handled by three steam shovels and from 30 to 40 four-ton motor trucks. Borings 60 ft. below curb had shown an excellent stiff, blue clay, suited to a safe load of 4 tons per sq.ft.

The column foundations were designed as individual concrete footings. In the center of the office building, the columns were spaced so closely that mat footings were used for groups of from 2 to 8 columns per mat. The soil pressure was taken as 8,000 lb. per sq.ft. for interior columns and columns carrying a large percentage of live load, 7,500 sq.ft. for intermediate wall columns, and 7,000 lb. for exterior corner columns.

The retaining walls of the office building are of reinforced concrete, 12 in. thick, with steel spanning vertically from the ground to the first floor. These walls are set about 6 ft. outside the wall columns. Similar walls were used around the sub-basement. The laboratory retaining walls are 18 in. thick, flaring out in the shape of a projecting cornice at the top to receive the stone base course. All such walls were shored temporarily with batter struts until the floors to which they abut were built.

Both swimming pools are supported directly on the ground, and are constructed with 10-in. reinforced-concrete walls containing waterproofing paste. The walls span horizontally to concrete buttresses which also support some of the secondary columns running up to the court roof. The floor slab around the rim of the pool, poured with the walls, forms a thin horizontal beam to stiffen the walls and transfer the pressure to the buttresses and corners; it spans the width of the pipe



FRAMING OF SECOND AND UPPER FLOORS

tunnel surrounding the pool. The floor of the pool, its walls, and the floor along the rim of the pool are covered with membrane waterproofing. A finish coat of concrete 3½ in. thick, recessed at the top to receive the scum trough, was laid over the membrane waterproofing, ready to receive the tile finish.

To obtain as much freedom from vibration as possible the laboratory was built of reinforced concrete. The wall columns are spaced about 13½ ft. on centers, and are connected by concrete spandrel beams supporting the walls and their share of the floor. The two rows of interior columns are spaced 16 ft. from the walls, 28 ft. apart transversely and from 25 to 30 ft. apart longitudinally. They carry two lines of shallow longitudinal concrete beams, which in turn support a floor of concrete joists 14 in. deep and 16 in. apart, with 12-in. hollow-tile fillers between them. This construction, while stiff, permits obtaining openings easily when required through the tile fillers, an advantage in a building of this type.

The roof frame consists of three-hinged steel arches, spaced from 27 to 30 ft. apart, with no other lateral bracing than that afforded by the purlins. The roof covering consists of a 2½-in. concrete slab on metal lath, overlaid with 1½-in. "nalecode," to which Spanish tile finish is secured. Below the slab is hung the plastered ceiling. Additional light is secured through the roof by means of a 12-ft. skylight. The segments of the arch are tied

through the floor by rods embedded therein during the pouring, to which connection is made by shackle plates and turnbuckles in a recess left in the concrete construction.

Floor Framing of Office Building

Because of wide column spacing and a design live-load of 125 lb. per sq.ft., the first floor requires the use of many single-web plate girders 26 and 28 in. deep, as well as heavy 24-in. I-sections. The main entrance consists of a loggia, a vestibule and the lobby. The wall dividing the loggia from the vestibule, and the colonnade in the vestibule are situated over the ladies' swimming pool, and are carried by the floor framework.

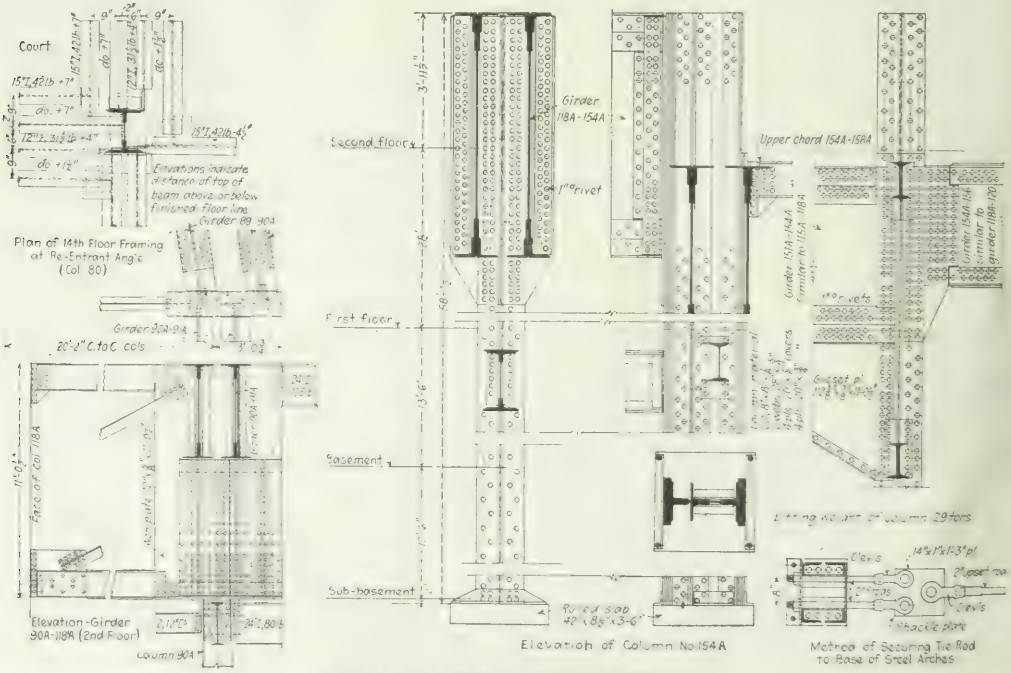
Tho so-called mezzanine floor framing comprises the supports for the moving-picture room and fan-room floors, ventilation ducts around the auditorium, supports for marble beams and backing between marble column capitals, supports for the barrel-vault corridor ceiling of the first story, auxiliary supports for the groined-arch ceilings of the entrance, backing for ornamental iron, framing for the ceiling of the auditorium, for the front court parapets, for the glass and plaster vaulted roof of the entrance lobby and for window cleaners' walkway under the skylight, framing for storage distribution walkways over the show rooms, and finally framing for the first-story ceilings. The latter was designed for a total load of 50 lb. per sq.ft. to permit this space to be used for storage of awnings and other appurtenances. The mezzanine frame consists almost entirely of light structural members, and probably required more attention than the frame of any other tier, on account of the diversity of requirements to be met and the various levels of the framing.

In the second floor there is a considerable amount of

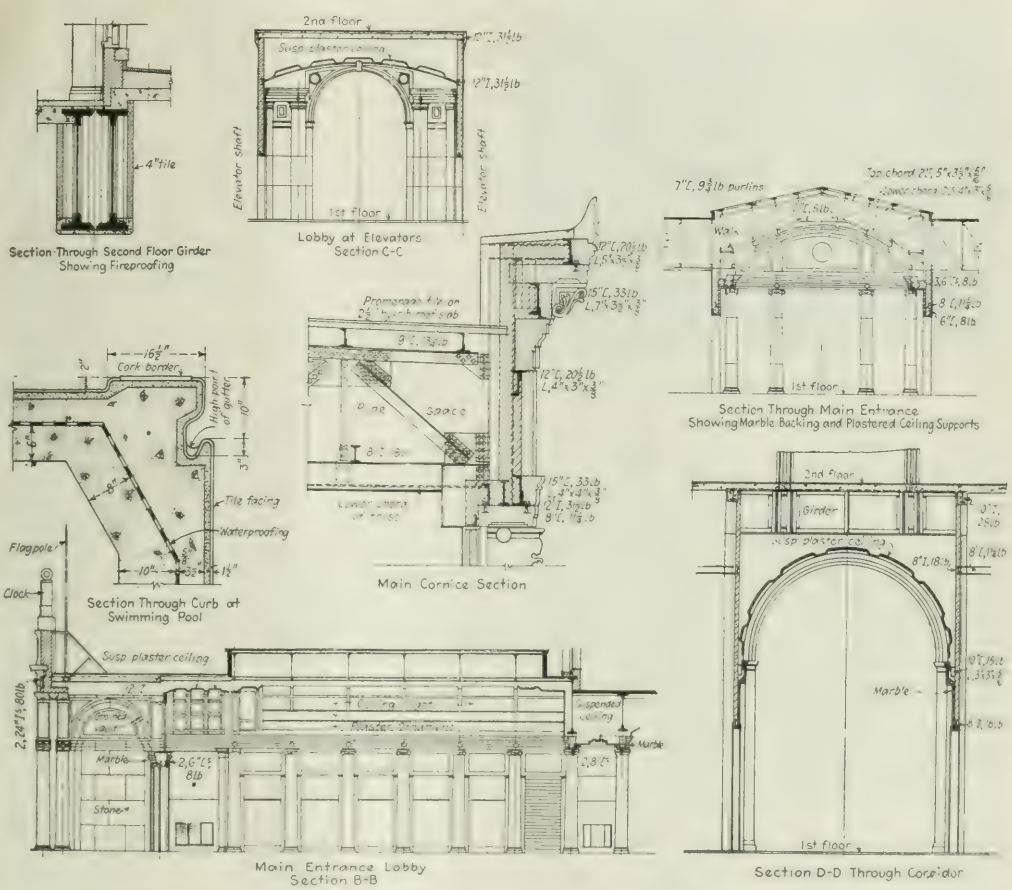
HEAVY SECOND FLOOR GIRDER CARRYING COLUMNS

heavy framing and some long-span girders and trusses. In order to have large unobstructed areas for the first floor show rooms and the auditorium, many columns are stopped at the second floor, and supported on girders attached to adjacent columns. The roofs of courts 6 and 8 are supported each by three trusses of about 100 ft. span. These trusses are of ordinary construction. Girders 80-90A and others similarly placed in other wings have a special connection, illustrated herewith for column 90A. This connection is necessary on account of the skew of the girder, which is required by the alignment of columns 89-90A and the position of upper column 90 carried by the girder.

The large plate girders run from 6 ft. to 11 ft. in



HEAVY AND UNUSUAL FRAMING DETAILS



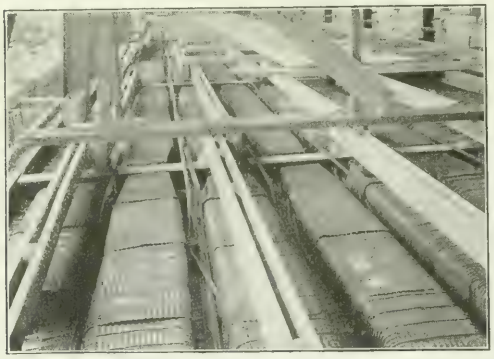
FIREPROOFING AND MASONRY DETAILS

depth. Some support the second floor on their top flange and the mezzanine frame near the bottom, but in most cases headroom is required for the mezzanine, so that the shallower girders are in preponderance.

The auditorium roof is supported by trusses of 45 ft. span, carrying on their top chord the skylight purlins and near the bottom chord the ceiling purlins. The truss verticals support the tracks for the window-cleaning movable bridges in each bay. These trusses are supported on their north end by girder 115A-151A, about 100 ft. span, provided with a horizontal bracing system to stay the top chord. The south end of the trusses is supported by girder 118A-154A. This girder has a span of nearly 100 ft., and is the heaviest member in the structure, weighing 100 tons. In addition to the auditorium roof trusses it carries the north wall and a part of the floors and roof of an extension of the main building between the two intermediate rear wings; this extension, four stories high, is situated entirely above the auditorium roof. The girder consists of two connected units of 50 tons each, erected separately, and each made up of a web plate 102 x ⅜ in., four flange angles 8 x 8 x 1⅛ in., four flange plates 16 x ⅞ in., and eight cover plates 18 x ⅞ in. It carries a total load, including girder and fireproofing, is 1,648,000 lb. As the top of the girder is above the beams which steady its top flange, gusset-plate braces were connected to the beams, butted tightly, and riveted to the girder.

From the third floor to the fourteenth inclusive, the live load used was 50 lb. The frame consists of single or double I-beams or built-up plate girders in general 18 in. deep, connected directly to the columns, placed transversely of the wings or transept, and supporting the concrete floor construction. The interior columns are tied together longitudinally by 10-in. channels framed to the columns with seat and top angle connections, or, where required not to show in the ceiling below, by pairs of 5 x 3½-in. angles, Z-shape, connected like the channels.

The differences which occur in the framing from the third to the fourteenth floors occur chiefly in the spandrel sections. At the fourteenth floor the upper colonnade is supported by three I-beams framing to the wall columns. These beams are placed so that the load which each one carries will cause an equal deflection in each beam. The multiplicity of fourteenth floor spandrel beams gave rise to an interesting detail at the re-entrant corners, such as the one illustrated for column 80;



SHALLOW METAL TILE USED TO CORE OUT 7-INCH LONG-SPAN CONCRETE FLOOR

eleven beams, practically at one level, are all framed to the one column.

The fifteenth floor is laid out on the same lines as the floors below, but the standard 18-in. depth of framing is changed to 20-in. to support the assumed live load of 80 lb., chosen because of the large dining and club rooms to which this floor is devoted. The spandrel consists of an 8½-in. brick wall backing an ornamental cast-iron fascia. It is supported by a single beam surrounded by a horizontal channel to stiffen the wall. This channel is strutted up from the spandrel beam. On account of the deep reveal of the colonnade, the spandrel beams are 33 in. inside of the building line and frame to the transverse floor beams, not to the columns.

The pipe-space floor and roof are carried in general by 50-ft. Warren trusses across the wings or transept. The bottom chord of these trusses is made of channels, as the pipe-space frame which it supports does not usually strike panel points. The roof purlins are carried on the top chord. A section showing one of these trusses and the main cornice framing is given herewith.

No great amount of wind bracing was considered necessary for the building. As the northwest and southwest winds attain great velocity at times in this locality, the outer ends of the wings, which are 52 ft. wide, were assumed to resist wind pressure for one-half of the length of the wing. From the stresses found were deducted the calculated capacity of wind resistance of the interior transverse bents in the half wing considered, these interior bents being framed to the columns with seats and top angle connections. The balance of the stresses was readily taken care of by beams only one or two sizes greater than that required for spandrel loads only, and properly connected to the columns by wing plates of ordinary construction.

In general, the columns are I-shaped, made up of a single web with angles and cover plates. The first tier of columns rests on steel billets and I-beam grillages directly on the concrete footings. The length of most of the columns in this tier varies from 47 to 58 ft. Because of the many upper columns supported by plate girders at the second floor, a considerable number of first-tier columns receive calculated loads ranging from 1,500,000 to 2,500,000 lb.

The only special column sections are columns 118A and 154A, extending from the footings to the top of girder 118A-154A, previously mentioned. Column 118A receives heavy beams and a 26-in. plate girder at the first floor. At the second floor it carries single-web girder 90A-118A, illustrated on p. 628; girder 118A-120, a double-web member some 55 in. deep, girder 115A-118A, a double web plate girder about 11 ft. deep, and the 100-ft. girder 118A-154A, already mentioned. The combined second-floor reaction is 2,854,000 lb., and the load below the first floor is 3,000,000 lb. The section, chosen largely because of the requirements for second-floor connections, consists of one web 29 x ½ in., six angles 8 x 8 x ⅞ in., two cover plates 20 x 2⅝ in.

Column 154A is similar to column 118A just mentioned, and has a length of 58 ft. This is the heaviest column in the building, weighing 29 tons.

Concrete Floors and Fireproofing

The reinforced-concrete floors span directly from one column bent to the next, parallel with the long axis of the wings and transept. They consist of concrete slabs from 6½ to 7½ in. thick, hollowed out by metal tile 5 in. deep and about 20 in. wide, made especially for this building. At the spandrel supports the slabs are fixed in place by anchors running through the web of the spandrel beams. The top of all slabs is placed 1½ in. above the top of the supporting beams. The slab is topped by 3 in. of slag concrete, in which are embedded the majority of the conduits. Where too many conduits would have intersected, some of them were placed on the reinforcing steel before placing the metal tiles, which were clipped to fit. The steel beams are fireproofed not with concrete, but with ordinary shoe tile surmounted by a block of partition tile, which forms the bearing for the concrete slab. Except for the second floor, this tile was not filled with mortar, as actual tests show that tile will carry a live load of some 250 to 300 lb. per sq.ft. without difficulty on 18-ft. spans.

The centering for the concrete slabs consisted of units, supporting each joint, carried by pairs of 2 x 6's spaced about 6 ft. apart. The 2 x 6's were hung by bolts from pairs of 2 x 8's, blocked up at each end from the steel beams of girders supporting the concrete floor after it had set. In some cases one row of shores was used instead of intermediate hangers. The forms were readily removed after the slab had hardened, and were re-used for the floors above.

The large second-floor girders are fireproofed with partition-tile walls projecting beyond the stiffener angles, and blocked against the girder webs. These walls are supported on a concrete casing poured around the bottom flange of the girders. All steel columns are fireproofed with hollow tile, except below the first floor, where they are cased in concrete.

Two blocks south is the power house, 100 x 100 ft. part of the project. It was built simultaneously with the main structure, to which it is connected directly by an 8 x 11½-ft. tunnel 275 ft. long, through which the heating lines and the power and light wires are brought.

The General Motors Building and power house were erected by the Thompson-Starrett Co., under the general supervision of the architect's superintendent, R. A. Denell. The steelwork was fabricated by the American Bridge Co. at its plants in Ambridge, Canton, Toledo, Detroit and Chicago (Lassig), and was detailed under the personal supervision of George E. Poucher at the Ambridge plant. The architectural, mechanical and construction plans and specifications were prepared by the several departments of the office of the architect, Albert Kahn, of Detroit.

Some Practical Details of the Railway Wage Regulations

IN ORDER for each reader to judge for himself of the possible effect of current agreements in railroad circles upon labor other than that employed by the railroads, a few of the more pertinent incidents brought out in testimony presented to the Railroad Labor Board at recent hearings in Chicago, are given in the following paragraphs. The testimony was given by various railroad executives in support of their contention that national agreements, rules and working conditions, put into effect during the latter months of government control, should be abrogated. The material herein set forth is taken from various bulletins issued from the office of the Association of Railway Executives, New York City.

Operation of Regulations

As illustrative of the operation of Rule 7, which provides that "for continuous service after regular working hours, employees will be paid one hour for forty minutes service or less . . . employees required to return to work will be allowed five hours for three hours and twenty minutes service, or less," a case was cited in which six men composing a gang completing repairs of an engine in shops of the Chicago, St. Paul, Minneapolis & Omaha R.R., were each paid five hour wages for one half hour's work. There was no interruption in work, but the extra half hour was claimed and allowed to be an additional shift. The circumstances of the case were, that at the close of the regular working day, the testing of the engine on which the six men were working had not been completed. A leak developed which made it necessary for the gang testing the engine to work thirty minutes past the ninth hour of their employment. It was decided that this thirty minutes work entitled each of the men employed on this job to five hours wages.

Another angle of Rule 7 is set forth in the following circumstance explained at the Labor Board hearing. A machinist, used to relieve an engine-house foreman, and employed by the Michigan Central R.R., received pay for 19½ hours, although he gave only 11 hours service. The inexperienced substitute got $16.57 for a day's work, as compared to $10.66 received by the regular forman for the same day's work. The rule here applying is given in the records of the Labor Board hearing as follows: A machinist used to relieve an engine house foreman must work the same number of hours as the foreman whose place he is filling. The regular time of the machinist is from 8 a.m. to 4 p.m., and the regular time of the foreman is from 7 a.m. to 6 p.m.

Illustrating Rules 157 and 158, which provide respectively, that "wrecking crews, including engineers and firemen, shall be composed of regularly assigned carmen, and will be paid for such service as per general rules, from time called until return to their home stations"; and "when wrecking crews are called for wrecks or derailment outside of yard limits, the regularly assigned crew will accompany outfit," a case was cited in which a railroad was compelled to award each man in a wrecking crew 13 hours pay during which time no actual service was performed. At regular and overtime rates the men received 37½ hours pay for service all performed within 24 hours. Of the 24 hours for which they received 37½ hour's wages, the men were off duty or asleep for 11 hours, and were riding or eating for 2 hours while receiving pay. Under a related rule claims are constantly made by men who do not actually accompany the crews, but assert that according to the rules they should have done so and therefore are entitled to pay.

Further testimony before the Railroad Labor Board indicated that three employees of the Marquette R.R. received back pay totaling $9,333 merely because their titles were changed from pumpers to electricians. For the same reason, they received an increase in pay, although they continued to perform precisely the same work. The circumstances of the case, as stated in the records of the Labor Board hearing are as follows:

Before Nov. 4, 1918, two attendants were employed at a small power plant at Baldwin, Mich. They were paid at the rate of $84 and $60 per month. On the date stated, a third man was employed to be put to work on an 8-hour shift, the pay being increased to $90 for one man and $80 for the other two. These men had always been classed as pumpers and had no knowledge of electrical matters prior to their employment at this point; they could not qualify as electricians for any work except as attendants at this particular station. Their principal duties were to keep the machinery oiled, start and stop waterwheels and watch that no breakdown occurred.

Under Rule 141 of the shop-craft agreements, these men claimed to be entitled to pay as motor and generator substation attendants and switchboard operators. The decision rendered by the director general of railroads not only awarded back pay, but fixed the compensation of these men in the future at the rate of 72c. per hour for one man and 68c. per hour for the other two men, making the total to be paid for their services more than the value of the water pumped and current generated.

Hourly Pay and Decreased Efficiency

Various executives were present before the Railroad Labor Board in Chicago to testify that, from personal observation, the efficiency and output of car repairmen had been materially impaired through the abolition of piece work and the substitution therefor of a guaranteed hourly rate.

R. L. Kleine, assistant chief of motive power, Pennsylvania R.R., submitted exhibits showing that in less than a month after the guarantee-pay system went into effect the efficiency of the men in terms of output per hour decreased 11.6 per cent. W. I. Langford, of the Union Pacific R.R., presented further evidence in the endeavor to prove the contention that the substitution of the hourly basis of pay for piece work had greatly decreased shop output. Instances cited were as follows:

Time required to perform work in the blacksmith shop at Omaha increased 35.5 per cent, and the output was reduced 26.2 per cent. In the wheel shop at Omaha the time required for the same work was increased 31.9 per cent and the output was cut down to 24 2 per cent. In the wheel shop at Denver, Colo., the time required to perform the same amount of work increased 40.5 per cent; the output fell 28.8 per cent. The time required for certain work in the paint shop at Omaha increased 42.4 per cent and the ouput decreased 29.8 per cent.

Similar testimony was given by representatives of the Union Pacific R.R., of the Chesapeake & Ohio R.R., and other railroads.

Alaska Railroad Location Surveys Through Broad Pass

Locating in Sixty-Mile Gap in Existing Line—Methods and Troubles—Organization, Equipment and Camp Outfit

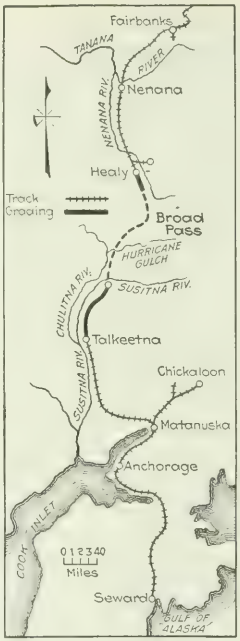
By T. W. Secrist
Location Engineer, Alaskan Government Railroad

Between the operated southern and northern divisions of the Alaska Railroad, which is being built for the United States Government by the Alaskan Engineering Commission, is an uncompleted stretch of about 100 miles which is partly under construction (see "Engineering News-Record," Jan. 2, 1919, p. 46). This stretch includes the Broad Pass district, where the line will reach its highest elevation and where the location surveys have been made only recently. Col. Frederic Mears is chairman and chief engineer of the Commission.—Editor.

A ROAD PASS DISTRICT on the route of the Alaskan Government Railroad comprises the region lying between Indian River (mile 266) and Jack River (mile 327). It includes not only Broad Pass, which is the main divide between the coast and interior of Alaska, but also Chulitna Pass, which is a minor grade summit between the Susitna and Chulitna rivers. Broad Pass proper is nearly eight miles wide, and for five miles the railroad will be practically level. The highest elevation attained is 2,362 ft. above mean sea level. The principal topographical features are high mountains on the east and west sides of the pass, rolling low ridges, some of which are timbered and others are covered with heavy arctic and reindeer moss, numerous lakes and much swampy ground or muskeg.

Route—After crossing the Susitna River (mile 264) the line follows up the Indian River canyon and traverses Chulitna Pass (mile 274), leaving Indian River to the east. Thence it climbs on a compensated maximum grade of 1.75 per cent to the high benches east of the Chulitna River and (at mile 284) crosses Hurricane Gulch, which is a canyon 300 ft. deep and over 600 ft. wide. Then the line descends on a grade of 1.50 per cent to the Chulitna River bottoms, which it traverses to the crossing of the East Fork of the Chulitna River (mile 292) and then climbs on a 1.75 per cent grade to the high rolling bench lying between the East Fork and Middle Fork of the Chulitna, crossing the latter fork at mile 306. Thence the line climbs on a 1 per cent grade to Broad Pass summit (mile 310) and descends northward on a 1 per cent grade, crossing the Cantwell River (mile 317) and Windy Creek (mile 323) and following down the Jack River to its confluence with the Nenana River (mile 327).

The south approach to Broad Pass offered several different routes which were fully developed before a line was finally adopted, the region around Hurricane Gulch being especially difficult. This gulch will be crossed by a steel bridge 700 ft. long and some 300 ft. high, with a main arch span of 284 ft. Four separate location lines were run and comparative estimates of cost were made over a section of about ten miles of heavy work involving different crossings of the gulch, before a choice was made from the lines. Before making a final selection, careful estimates of cost were worked up and compared, but greater stress



ALASKAN RAILROAD

was laid on the maintenance and operating features of the lines.

From June 1 to Oct. 1 is the working season for survey parties, so that as the country was without roads or trails of any kind and was practically unexplored, it took several seasons to develop the region thoroughly. A locating party consisted usually of a locating engineer, assistant engineer, transitman, topographer, levelman, draftsman, office man, two rodmen, four chainmen, one rear flagman, two cooks, ten axemen, four packers, one hunter, and a pioneer crew of about six men to build trails.

Transportation — From Indian River (mile 266) transportation was by pack train, some 36 head of horses and mules and four packers being required for this purpose. Horses were loaded with about 200 lb. of supplies, and pack trains made from ten to twelve miles per day. Each animal was fed 10 lb. of oats per day. At night they foraged on the native grass, which is very nutritious until the frost kills it in September. The trails were usually very heavy on account of the swampy country, and considerable difficulty was experienced in fording the numerous rivers and creeks during the high water from the heavy rains.

The pack rigging consisted of saw-buck pack saddles with Humboldt rigging and alforgas, or pack boxes with canvas covering, were used in which to put the small articles. Horses were troubled a great deal by mosquitoes and flies. Various fly ointments were used, but the best results were obtained by greasing around the ears, eyes and nostrils of the animals, and building "smudges" so they could stand in the smoke when they were not grazing.

Equipment and Subsistence

Under these conditions, the equipment of the party and the personal effects of the men were held down to absolute necessities. The cooking outfit comprised a 16 x 24-ft. dining tent and a 14 x 16-ft. cook tent, both of 12-oz. canvas and with 4-ft. walls, granite-ware cooking utensils and dishes and two sheet-iron stoves weighing 125 lb. each. For the office there was a 14 x 16-ft. tent, a knock-down drafting board, a Sibley stove and two stationary chests of a size to balance on a pack horse. Mosquito tents 9 ft. square with 3-ft. walls were used for sleeping quarters. A mosquito tent is a lightweight duck or silk tent with cloth floor and a drawstring cloth door. Three men were assigned to a tent and camp fires were depended upon for warmth and for drying out.

Baggage and Clothing—Each man was limited to 50 lb. of bed and baggage. Ordinary blankets with a canvas

tarpaulin were used, and spruce boughs made splendid mattresses. Clothing consisted of hunting shoes, rubber shoe packs, khaki and mackinaw coats and trousers, wool underclothing, wool sox and gloves, and mosquito head nets. Mosquitoes and different species of gnats and flies were a great pest. They carry no disease germs, but are exceedingly energetic and annoying. Mosquito head nets and gloves were the best protection, although each man had some pet mosquito preparation, composed of different proportions of oil of citronella, peppermint and wintergreen, but in most instances the scorched faces and awful odor of the remedy were as bad as the mosquitoes.

NENANA RIVER VALLEY ON ALASKA RAILROAD LOCATION

Subsistence consisted almost entirely of the ordinary staples of flour, ham, bacon, rice, sugar, dried fruit, dehydro potatoes, canned and powdered milk, evaporated eggs and some canned fruits. A limited quantity of fresh eggs and fresh potatoes was packed as far as seventy miles. A hunter and two pack horses kept the party fairly well supplied with bear, caribou and mountain sheep, and as the streams abound in greyling and trout there were many messes of fish. In August and September the blueberries were plentiful, so blueberry pies were almost a daily feature.

Instrument equipment was of the ordinary character, with vertical-arc transits reading to thirty seconds and wye levels with target rods reading to thousandths of a foot. Steel tapes 50 ft. long, steel marking pins, hand levels and 24-oz. plumb bobs were used for chaining the line.

Reconnaissance of route was made by the locating engineer and the preliminary lines were run by him as closely as possible to where he thought the location should go. An accurate preliminary line was run. Hand levels and plumb bobs were used in chaining, and all angles were doubled and back sights set in transit work. The leveler took elevations at every 50-ft. station and at intermediate breaks as necessary to show a correct profile of the ground. On turning points and bench marks the readings were to thousandths of a foot. The topographer followed on preliminary with a rodman, two chainmen and one axeman. Actual 5- and 10-ft. contours and slope notes were taken, but in most places a few side notes and additional information on controlling points was sufficient.

Topography—No attempt was made to make an elaborate topographical map of the country. As the located line usually held very close to the carefully run preliminary, accurate local topography within a short distance of the preliminary line was all that was needed. On location the topographer plotted the line and in the field amplified the accurate topography by sketching in the general topography of the country. An aneroid barometer was used for approximating the elevations, prismatic compass and foot traverses being used for the direction and distances.

On the located line well-made stakes were placed at 50-ft. intervals, substantial hubs being set at every curve point and as often as necessary on tangents. Bench marks with the elevations marked upon them were set at about half-mile intervals. All curves from two degrees to the ten-degree maximum were spiralled with the Southern Pacific Railway's system of taper curve. In plotting the line, a scale of 100 ft. to the inch was used, except in short sections of light work where a scale of 400 ft. to the inch was used. Co-ordinates were used in the mapping, and the projected location was figured by independent traverse, a check being made through the map co-ordinates.

Mapping—The draftsman made all the maps and kept a traverse book of the courses of the preliminary and located lines. He was checked in the computation of the map co-ordinates by the office man. Profiles were plotted on profile paper, and it was the duty of the office man to keep up the profiles. The profile of the line of definite location showed the alignment, hub points, rates of grade, grade points, location and elevation of bench marks, side slopes of the ground, timber notes, and classification and vegetation notes.

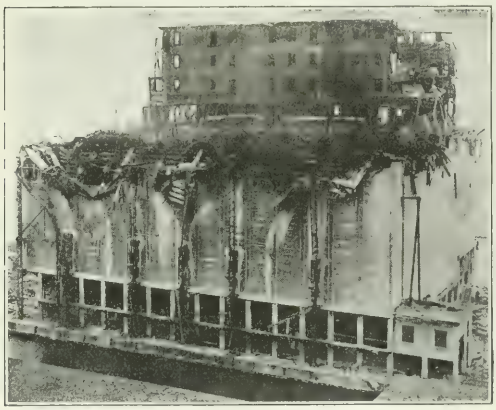
As the topography of the country was quite rugged in places and the whole area was covered with a fairly dense growth of spruce, birch and cottonwood trees, besides a heavy undergrowth of willow and alder brush, the progress of the party depended a great deal on the axemen. About two-thirds of the days were rainy, which made the work progress slowly, although work was done every day except Sunday, whether it was in rain, sunshine or snow. Preliminary lines and levels varied from 2,000 ft. to two miles per day, and location lines and levels from 1,500 ft. to one mile per day.

Dust Explosions: Cause, Effect and Prevention

Structural Design and Mechanical Equipment Needed to Check Loss of Life and Immense Loss of Property

By David J. Price
Engineer in Charge Development Work, Bureau of Chemistry, U. S. Department of Agriculture

MANY engineering problems have been developed in the study of dust explosions, their causes and prevention. Before these explosions can be prevented, it is necessary to determine the various causes and circumstances under which dusts can be ignited, the manner in which the explosion spreads or propagates, the ignition temperature of the various dusts, the pressures developed and also the effectiveness of any methods which may be designed for prevention. Dust explosions have occurred most frequently in plants



GRAIN ELEVATOR DAMAGED BY DUST EXPLOSION

where grain or grain products are milled or handled, such as grain elevators, flour mills, feed and cereal mills, and starch factories. They have occurred also in sugar refineries, cocoa and chocolate plants, candy factories, spice works, wood working establishments, paper mills and printing plants, shoe factories, fertilizer works, cork grinding plants, drug and herb works, and other industrial plants where dusts are created. Explosions of aluminum and magnesium dusts have also taken place. Many disastrous smut and grain dust explosions have occurred in threshing machines in the Pacific northwest, while a large number of fires have occurred in cotton gins during the ginning process.

Since May 1919, several disastrous explosions have occurred in the United States and Canada, resulting in the death of over 94 people, injury to a large number and property damage in excess of $10,000,000. Four occurred in grain elevators, two in flour mills, one in a feed mill and one in a starch factory, this last resulting in 43 deaths and over $3,000,000 damage. In three grain elevator explosions, 14 lives were lost in the first, ten in the second and six in the third, all explosions being violent and doing extensive damage. In an explosion of aluminum dust six girls lost their lives and as many more were injured. An explosion of hard rubber dust resulted in the death of eight workmen.

FACTORY DESTROYED BY EXPLOSION OF STARCH DUST (43 LIVES LOST)

The disastrous explosion on March 19 in the Chicago and Northwestern Elevator operated by the Armour Grain Co. at South Chicago has attracted the attention of engineers of the United States and Canada. (See *Engineering News-Record,* March 31, 1921, p. 560.) The elevator, which has a capacity of 10,000,000 bushels, was built entirely of fire resistive materials and embodied the latest modern engineering principles. The explosion, which caused the loss of six lives and property and grain damage in excess of $3,000,000, has been fully investigated by the Bureau of Chemistry and will be reviewed in a later article.

Ignition and Propagation of Flame

A dust explosion appears to be very similar to a gas explosion, although particles in a dust cloud are larger than the minute molecules in a gas. Both require a proper mixture of air and ignition by some external source of heat or flame, it being impossible to produce "spontaneous" explosion. In the study of dust explosions by the U. S. Bureau of Chemistry ignition temperatures resulting in propagation were determined as follows: 2,363 deg. F. for wheat elevator dust, 2,300 deg. for flour, 1,821 deg. for oat and and corn elevator dust, 1,868 deg. for oat hull dust and 1,877 deg. for yellow corn dust.

Two theories are prominent in explanations of the action that takes place during the progress of dust explosions; (1) That a distillation of flammable gases occurs when the dust becomes heated; (2) that the explosion is nothing more than a rapid communication of flame or fire from one particle to another, depending to a large degree on the fineness of the dust. That is, the finer the dust and the lower the moisture content the more rapid the propagation and the greater the violence of explosion. This seems to establish very definitely a relation between fire and explosion.

In many cases a primary explosion, which is nothing more than a small puff, is followed by fire in which the property is extensively damaged or destroyed. In other cases a series of increasingly violent explosions follows, indicating that if dust is present to feed the original flame an explosion will follow. In plants where little dust is in suspension and where "good housekeeping" is practiced, the occurrence merely assumes the proportions of a fire and no violent explosion results. Reference is made to this phenomenon to emphasize the fact that a disastrous dust explosion may occur during the course of any fire if sufficient combustible dust is present to feed the flame and allow it to propagate. The dust that accumulates throughout the plant is thrown into suspension by slight concussion, with the

result that a primary "ignition" or explosion develops into a secondary explosion of large proportions.

The rate of propagation or flame travel in a dust explosion depends upon the flammability of the dust and the amount of it in suspension. Reports of the U. S. Bureau of Mines give the average velocity of flame in coal dust explosions as 2,270 ft. per second; British and French investigators report 2,114 and 3,300 ft. per second respectively. The velocity is usually more rapid in gas mixtures than through dust clouds. Limited tests indicate that the velocity through a cloud of wheat-flour dust is practically the same as through coal dust and that through a cloud of powdered starch it is several times as rapid as through coal dust.

Tests conducted on a large scale by the Bureau of Mines show a pressure of 103 lb. per square inch with coal dust. British investigators report from 100 to 120 lb. A French investigator reporting 227 to 270 lb. states that at a steel testing gallery with an estimated breaking strength of 570 lb. per square inch the gallery gave way and pieces of sheet steel were thrown up a distance of 472 ft. From extensive laboratory tests by the Bureau of Mines and the Bureau of Chemistry, based on only 75 mg. of dust in standard laboratory apparatus, the results shown in the accompanying table have been obtained.

The values shown there are much smaller than those obtained in full sized tests but interesting as a comparison of the behavior of different materials. That grain dusts are more flammable than coal dust is confirmed by tests on a large scale. In recent tests conducted in co-operation with the Bureau of Mines in its testing galleries it was found that flour and coal dusts acted similarly. Starch dust propagated more rapidly, produced higher pressures.

Dust	Lb. per Sq. In.	Dust	Lb. per Sq. In.
Lycopodium	17 5	Sugar	12 2
Wheat smut dust	15 9	Potato flour	11 7
Yellow corn	15 2	Fertilizer	10 5
Dextrine	14 6	Coal (Pittsburgh)	10 1
Tan bark	13 3	Cocoa	9 1
Wheat elevator dust	13 0	Sulphur	8 8
Wood dust	12 8	Cork	7 4
Corn starch	12 7		

Efforts are being made to establish proportions of dust in suspension necessary for an explosion. Laboratory tests indicate that only 10 lb. of dust in suspension would be needed in a closed room containing 4,466 cu.ft., or a room 10 x 30 x 15 ft.

The first dust explosion to attract attention in this country occurred at Minneapolis in 1878. Professors Peck and Peckham, of the University of Minnesota, in experimental work for the investigation which followed the explosion, found that by blowing 2 ounces of dust upon an open flame in a box containing 2 cu.ft. of air, sufficient pressure was developed to lift two men standing on the cover. This would mean diffusion at the rate of one ounce of dust to 1 cu.ft. of air space. From the known chemical composition of flour and a calculation of the approximate mechanical work which a given mass of flour can perform, it has been found that the contents of an ordinary sack, when mixed with 4,000 cu.ft. of air, will generate force enough to throw 2,500 tons mass to a height of 100 ft.

The relation of humidity to the frequency of dust explosions has been markedly noticeable in the investigational work. This is especially true of explosions where static electricity has appeared as a probable cause. Although this relation has not been definitely determined in industrial plants, it is reasonable to conclude that the dust explosion hazard is greater during periods of continued low humidity.

A close relation between the construction of a plant and the extent of an explosion within it has been developed by the investigation of a number of disastrous dust explosions in grain handling plants, especially in the large terminal grain elevators. This was considered at a conference of men engaged in a grain dust explosion and fire prevention campaign, conducted by the U. S. Grain Corporation in co-operation with

REFINERY WRECKED BY EXPLOSION OF SUGAR DUST (12 LIVES LOST)

the Bureau of Chemistry, U. S. Department of Agriculture (see *Proceedings* of the U. S. Grain Corporation, July 1, 1920).

The following matter refers to the possible changes in construction and in the installation of mechanical equipment suggested by recent explosions and their relation to dust explosion prevention. Common sources of ignition, such as matches, torches, lanterns and similar open flames have been accepted for some time, but recent investigations have associated certain types of mechanical equipment with the cause of the explosion. Explosions have been caused apparently by metallic sparks produced in dust collecting fans and in various types of grinding machinery. Broken incandescent lamp bulbs in dusty atmospheres, dust settling on the bulbs and sparks from static electric discharges produced by the operation of various types of machinery have also been responsible for the ignition of flammable dust clouds.

Dust collecting equipment is one of the effective methods of controlling explosions, as an accumulation of dust throughout the plant permits the propagation of flame from the time of the original ignition until the secondary or larger explosion occurs. But a number of

explosions have been directly associated with the manner in which the exhaust fan was installed. A disastrous explosion of aluminum dust was caused by a piece of wire entering the fan.

Exhaust fans are installed frequently in connection with the removal of dust from buffing or polishing wheels, grinding rolls and similar equipment. In such cases the fine dust is drawn usually from the source of production through pipe trunkings into the fan and then blown into the collecting device. As a flammable mixture is usually formed in the exhaust fan, explosions may originate from the ignition of the dust by sparks from foreign material striking the fan blades, or from loose blades striking each other or the casing. This has suggested the practicability of placing the fan beyond the collecting device, so that the dust will be drawn through rather than blown into the collector. The Industrial Commission of Wisconsin, co-operating with the U. S. Department of Agriculture, has designed a system of primary and secondary air currents for dust removal, which has recently been installed in a factory, and investigation made as to its practicability.

Changes in Construction

Walls, Windows and Doors—To prevent high pressures from being built up within heavy concrete wall construction, consideration might be given to the use of a thin wall offering little resistance to the great volume of gases produced by the ignition of the dust. In such a building all the working stresses would be placed upon the concrete columns and beams, the walls serving only as a filler or curtain. Large window area, or the daylight type of building construction, affords another means of preventing high interior pressures. Recent explosions in two different lines of industry were localized as a result of this type of construction. Windows of the steel sash type, self supporting and extending from the ceiling to the floor, would be preferable. Steel curtain doors have been used on the working floors of grain elevators. They can be opened during the day, providing good ventilation to the working floor and a vent for any explosion on this floor.

Bin Construction—A recent dust explosion occurred in a large grain elevator having the sides of the steel bins formed in horizontal trough or corrugations, this construction being claimed to strengthen the bins. Each corrugation was 8 in. deep with a vertical side 8 in. high and top and bottom sloping at 41 deg. from the horizontal, the corrugations being 15 in. c. to c. The intensity and extent of the explosion was increased apparently on account of the large amount of dust accumulated on the inclined plates. Although this type of construction may have its advantages, it is hazardous from a dust explosion standpoint. Smooth sides on which dust could not collect would be safer.

Explosions have propagated over extensive areas and assumed large proportions when grain storage bins were connected by open air spaces. Where the bins are extended and the bin floor is placed directly on top of them, so that each one is isolated, the extent of the explosion is usually limited. Ventilation of the bins, which is necessary at the time of filling and emptying, may be provided by perforated iron covers or grids for the manholes. If this is not sufficient, ventilators may be led from each bin through the wall or roof.

Vents and Lofters—To keep an industrial plant clean, it is necessary to make provision to remove the dust at points where it is created. If regulations will not permit of such a dust removing and collecting system, as in grain elevators (owing to apparent loss in weight of grain), consideration might be given to extending the head of the lofters through the roof, capping them so as to keep out the storms but to allow for ample ventilation. Where this is not advisable, some type of vent from the head of the lofter to the outside would be beneficial in removing the dust from the grain and keeping the elevator clean.

If suction or draft cannot be placed on elevator legs and bins, it is desirable to provide natural vents. Scale hoppers and garners especially should be vented to the outside, for the reason that when grain is run into a scale hopper the dust-laden air in the hopper is forced out and will enter the elevator building unless the hopper has vent.

The intensity of the primary or original explosion in some instances has been due in part to the size of the chamber in which the explosion occurred and partly to the amount of dust present. This has been demonstrated clearly when large lofter wells are installed in grain elevators. If the lofter is of the continuous double leg type instead of having the large lofter well, the chamber is much smaller. With a completely double legged lofter or even with a well having smooth sides, the extent of the explosion would be limited. Steel elevator legs from the boots to the head are more desirable than the combination steel and tile leg bins, as they prevent the accumulations of dust that are usually found in tile or concrete leg bins.

Friction of pulleys and belts at the head of elevator legs has continued for a period sufficiently long to cause the belt to burn and weaken, with the result that it parted and fell to the bottom of the leg. It is possible that the explosion caused by the ignition of dust by the flame from the smoldering belt, might have been prevented by some device for extinguishing the fire. Automatic sprinklers have proved effective for incipient fires of this nature and with sprinklers in the heads of the lofters the explosion might be controlled.

From investigation of explosions in grain elevators attributed to the rubbing of belts and pulleys at the head of elevator legs resulting in "choke-ups," it appears that friction at the head could have been prevented by some provision for shutting off current from the motor operating the elevator leg. A circuit breaker which would be thrown out as soon as there is a definite overload on the motor might be considered.

In some instance "chokes" have occurred in elevator legs due to over-feeding at the boot. If there had been some way of giving warning to the man in the basement who had control of the feeding of the grain, he might have stopped the flow of grain and thereby have prevented the choke. It is suggested that an idler or guide pulley might be employed to make an electrical contact or give some other signal when the belt slows down to a certain speed.

Birmingham Water Contract Extended

The contract between the Birmingham Water Works Co. and the City of Birmingham, Alabama, that expired Dec. 31, 1920, has been extended for 30 years. Under the new contract Birmingham will have the right to purchase the plant at any time at the base valuation of $7,750,000 as of Jan. 1, 1921, while for rate making purposes, the value fixed is $7,000,000 as of Jan. 1, 1920.

Chemical Analyses of Cement as Indicators of Behavior

Rearrangement of Stock Analyses Recommended So as to Show True Content of Active Agents

IN a paper entitled "Judging the Quality of Portland Cement," recently read before the American Institute of Mining and Metallurgical Engineers, R. J. Colony of the Department of Geology, Columbia University, discussed the necessity for additional tests to supplement the standard physical tests for portland cement, and the possible methods which will aid in judging the quality of cement. Mr. Colony states that in his opinion the most promising mode of attack makes use of chemical, mechanical and petrographic

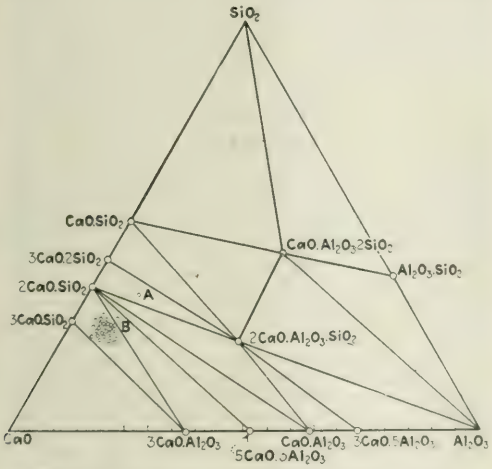


FIG. 1. TRIANGULAR CONCENTRATION DIAGRAM SHOWING END PRODUCTS OF CONSOLIDATION IN PORTLAND CEMENT

Normal portlands are restricted to the triangular area bounded by $2CaO.SiO_2$, $3CaO.SiO_2$ and $3CaO.Al_2O_3$. Diagram is after the one used by G. A. Rankin and F. E. Wright in article in *American Journal of Science*, vol. 4, 1915.

methods. He points out that the interpretation of the results of such procedure has already reached a development which permits conclusions of considerable value, and which, in connection with the standard physical tests gives a better basis for the rejection or acceptance of a given cement. The methods, with the conclusions, are summarized in the paper, from which the following extracts are made:

Normal portland cement is composed of mechanical mixtures of definite chemical compounds having constant chemical and physical properties. In the order of their cementing qualities these are: Tricalcium silicate, $3CaO.SiO_2$, tricalcium aluminate, $3CaO.Al_2O_3$, tricalcium ferrite, $3CaO.Fe_2O_3$, and calcium orthosilicate, beta form, $2CaO.SiO_2$. In addition, there is a certain quantity (generally about 3 per cent.) of gypsum. The magnesia, MgO, is in a state of solid solution in the other components and is apparently without much effect in the quantities found in cements. Both potash and soda exist to a small degree, and flakes of quartz from the ball mills, metallic iron from the machinery, particles of semi-fused coal ash from the fuel, etc., are sometimes found.

When mixed with water the components mentioned are hydrated, with the production of amorphous hydrated silicates and aluminates of lime, and a very considerable quantity of calcium hydrate which appears in both crystalline and amorphous forms.

Not all of the components mentioned hydrate with equal ease, since calcium orthosilicate, $2CaO.SiO_2$, resists hydration to a marked degree, persisting in unchanged aggregates in set cement and in concretes, thus decreasing the efficiency of the cement.

Chemical analyses of cement do not give the actual composition of it, since all analyses are reported in terms of oxides, which do not, of course, exist in that form in cements. A comparison of the analyses of two cements throws no light on their actual composition unless the analyses may be converted into percentages of the actual components as they exist; that is, in terms of tricalcium silicate, calcium orthosilicate, etc. It is necessary, therefore, to "recast" the chemical analysis.

As the components of portland cement have a definite composition, the various oxides found by chemical analysis must be uniformly distributed and united with one another according to fixed laws of chemical combination. Hence it should be possible to recast an analysis in much the same manner as rock analyses, and to obtain the percentage composition of the cement in terms of the actual compounds, instead of the oxides of the elements forming the mass. This is accomplished by dividing the percentages of the various oxides by their molecular weights, obtaining thus their molecular numbers, or ratios, and then allotting the proper quantities of silica, alumina, lime, etc., to each in accordance with the various compounds that should form under the conditions of burning. Thus, sufficient lime is allotted to satisfy the requirements of CO_2, Fe_2, SO_3, and Al_2O_3; the remaining lime is allotted to the silica to form both tricalcium silicate and calcium orthosilicate. This should be preceded, however, by a petrographic study of the cement in order to determine whether or not any abnormal components are present. For example, a cement analyzes as follows:

SiO_2, 23.40 per cent.; Fe_2O_3, 3.46 per cent.; Al_2O_3, 5.54 per cent.; CaO, 60.79 per cent; MgO, 2.46 per cent.; H_2O, 2.59 per cent.; SO_3, 1.71 per cent.; CO_2, 0.45 per cent. A "recast" of the analysis will then be as in Table I.

TABLE I. CEMENT ANALYSIS RECAST BY COMPONENTS

			Molecular Ratio	CaO CO_2	CaO SO_3	3CaO Fe_2O_3	3CaO Al_2O_3	3CaO SiO_2	2CaO SiO_2
SiO_2...	23 40 ÷	60	0 390					0 049	0 341
Fe_2O_3..	3 46 ÷	160	0 021			0 021			
Al_2O_3...	5 54 ÷	102	0 054				0 054		
CaO....	60 79 ÷	56	1 085	0 010	0 021	0 063	0 162	0 147	0 682
MgO.....	2 46				in solid solution				
SO_3.....	1 71 ÷	80	0 021		0 021				
CO_2....	0 45 ÷	44	0 010	0 010					

The percentage composition, in terms of the components, may be found by multiplying the molecular numbers allotted (or component constants) by the molecular weights of the compounds; thus, the molecular weight of tricalcium silicate $3CaOSiO_2$, is 228, which, multiplied by the component constant (0.049) gives as a product 11.172, or 11.2 per cent. The componental composition of the cement is thus found to be: Tricalcium silicate, 11.2 per cent.; calcium orthosilicate, 58.7 per cent.; tricalcium aluminate, 14.6 per cent.; tricalcium ferrite, 6.9 per cent.; gypsum, 3.6 per cent.; calcium carbonate, 1.0 per cent.; magnesia, MgO, 2.46 per cent.

It has been established by experiment that the component of greatest cementing value is tricalcium silicate, and the component most difficultly hydratable is calcium orthosilicate. It follows, therefore, that the cementing value of any mixture of these components, such as portland cement, is dependent on the proportions existing between the components, and the fineness of grinding of the mixture. In the example given, as the cement has only 11.2 per cent of tricalcium silicate (the best hydraulic component) and 58.7 per cent of calcium orthosilicate (the most difficultly hydratable component), particularly if relatively coarse, it should be regarded with suspicion.

A long series of studies of the ternary system, lime-silica, alumina, and the system of alumina-silica-magnesia,

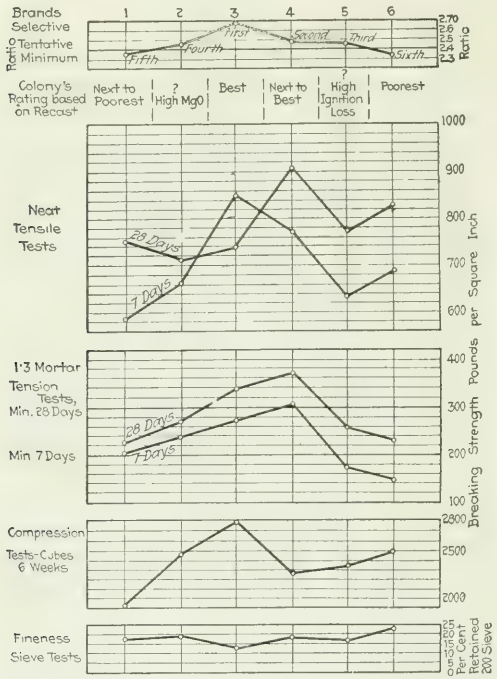


FIG. 2. COMPARATIVE BEHAVIOR OF PORTLAND CEMENTS

as well as studies of binary systems of the same components, by physicists, physical-chemists and chemists of the Geophysical Laboratory, the Bureau of Standards, and different universities, and a comparison study of portland cements has shown quite definitely that the three constituents that form the bulk of normal portland cement—lime, CaO, silica, SiO_2, and alumina, Al_2O_3—exist as fixed components with definite chemical composition and constant optical properties.

A study of the analyses of standard brands of normal portland cement will show that their percentages of lime, silica, and alumina amount to over 90 per cent. Perfectly sound portland cement has been made of these three constituents alone; hence if the percentages of these constituents are recalculated to a basis of 100 per cent, neglecting the ferric and other oxides that are always present in small amounts, the resulting percentages may be plotted on the ternary concentration diagram.

Points thus plotted will fall within a restricted triangular area within the diagram, with three compounds forming the apices of the small triangle; viz., tricalcium silicate, $3CaO.SiO_2$, tricalcium aluminate, $3CaO.Al_2O_3$, and dicalcium silicate (or calcium orthosilicate), $2CaO.SiO_2$, beta modification. Differences in the percentages of lime, silica, and alumina, within certain limits, do not cause the appearance of a fourth and new compound; they merely change the proportion between the three compounds mentioned; this is an important point. If, however, the difference in percentage composition is great enough, on recalculating the percentage of the three constituents (SiO_2, Al_2O_3, CaO) to a 100-per-cent basis and plotting the result, the point will fall outside of the area mentioned and different compounds may be expected to occur, some of which may be nonhydraulic.

The results of about fifty analyses made in the laboratory of the Board of Water Supply of the City of New York have been recalculated and plotted on the accompanying triangular concentration diagram (Fig. 1) in the manner described (some of the dots cover a number of plotted points); all the points so plotted fall within the triangular area mentioned except two, *A* and *B*. One of these *A* is a cement with abnormally high silica (33.01 per cent) and low lime (52.73 per cent); the other *B* falls within the limits of the composition usually set for portland cement, but it also is a little too high in silica and too low in lime.

Importance of Fine Grinding

The fineness of grinding is an important feature and one not properly determined by the standard sieve test; although three-quarters of the cement may pass the 200-mesh sieve, the bulk of it may be, and frequently is, too coarse for efficient work, especially if it is high in orthosilicate and low in tricalcium silicate. When a relatively coarse cement of this character is used in concrete work, a petrographic study of thin sections cut from the concrete will prove the presence of a large amount of unhydrated cement clinker. In many cases from 25 to 40 per cent of the cement is unhydrated or partly hydrated, resulting in a weak, permeable concrete mass that readily lends itself to attack by the agents of disintegration.

Fineness of grinding is best determined by means of the air analyzer, which separates into various fractions the cement which passes the 200-mesh sieve.

Since the quality of a cement is in large part dependent on the proportions existing between the components (not oxides) of which it is composed, and since these are determined by the quantity of lime, silica, alumina and ferric oxide present, it is possible to establish a selective ratio based on a minimum tricalcium silicate content. If the percentages of lime, silica, alumina, and ferric oxide, the sum of which in all normal portland cements always exceeds 90 per cent, are converted to molecular ratios, the quotient obtained by dividing the molecular ratio of the lime by the sum of the molecular ratios of the alumina, silica, and ferric oxide, may be used as a selective ratio. The writer suggests 2.4 as the limiting ratio. All cements having a lower ratio than this should be regarded with suspicion.

The limiting ratio provides a simple, easy method of judging the quality of portland cement, when used in connection with the usual standard tests; especially if the fineness of grinding is determined with the air analyzer. A more elaborate and careful study of the quality may be pursued by using petrographic methods in addition.

Application of Recast and Selective Ratio

As an example of the practical application of this method there are included in Table II and Fig. 2 tests and analyses of six standard brands of portland cement. These

TABLE II. TESTS AND ANALYSES OF PORTLAND CEMENTS

Standard Tests	1	2	3	4	5	6
Normal consistency	22.5	22.75	23.0	22.75	23.0	21.0
Time of set, initial	4 hr., 0 m.	5 hr., 30 m.	4 hr., 20 m.	4 hr., 0 m.	2 hr., 45 m.	5 hr., 45 m.
Time of set, final	8 hr., 5 m.	8 hr., 10 m.	6 hr., 30 m.	5 hr., 30 m.	6 hr., 0 m.	7 hr., 15 m.
Specific gravity	3.160	3.155	3.118	3.119	3.130	3.127
Soundness, normal	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Soundness, accelerated	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Tensile strength, pounds per sq. in.:						
Neat, 7 days	581	669	859	776	635	690
Neat, 28 days	755	716	742	913	778	832
1 : 3 mortar, 7 days	203	240	273	306	175	150
1 : 3 mortar, 28 days	224	273	348	377	254	236
Per cent retained on 200 mesh	20.0	21.4	17.0	19.8	17.6	22.4
Per cent retained on 100 mesh	1.0	1.4	4.0	2.0	2.2	1.6
Compression Tests						
2 in. cubes, 1 : 3 mortar, 6 weeks	1,920	2,448	2,756	2,280	2,380	2,560
Chemical Analysis						
Silica, SiO_2, per cent	23.79	22.61	19.88	21.43	22.14	23.40
Ferric oxide, Fe_2O_3, per cent	2.64	2.51	3.97	2.90	3.17	3.46
Alumina, Al_2O_3, per cent	4.86	6.00	6.73	6.80	5.47	5.34
Calcium oxide, CaO, per cent	61.31	61.37	63.48	62.14	61.80	60.79
Magnesia, MgO, per cent	3.83	4.88	1.25	1.67	2.19	2.46
Water, H_2O (by loss), per cent	2.53	2.10	2.76	2.72	4.00	2.59
Sulphur trioxide, SO_3, percent	1.45	1.41	1.75	1.79	1.24	1.71
Carbon dioxide, CO_2, per cent	0.48	0.33	0.57	0.59	0.59	0.45
Recast						
Calcium carbonate, per cent	1.1	0.8	1.3	1.3	1.3	1.0
Gypsum, per cent	3.1	2.9	3.8	3.8	2.6	3.6
Tricalcium ferrite, per cent	5.2	4.9	7.9	5.9	6.6	6.9
Tricalcium aluminate, per cent	12.7	15.7	17.8	18.1	14.6	14.6
Tricalcium silicate, per cent	19.4	22.1	37.8	23.9	26.2	11.2
Calcium orthosilicate, per cent	53.5	48.2	28.4	43.3	43.7	58.7
Selective ratio	2.38	2.43	2.69	2.50	2.49	2.33

were rated solely from the interpretation of the chemical analyses; the cements themselves were not seen, no micrometric measurements for fineness were made, and the results of the tests were unknown at the time of rating. On the basis of the recasts and the ratios cements Nos. 3 and 4 were judged to be the best; Nos. 2 and 5 the next best; and Nos. 1 and 6 the poorest. The standard tests shown were made subsequently by the Testing Laboratory, Columbia University. The table and diagrams were compiled by the engineers for whom the ratings were made, and are used by their permission.

Portland cement is composed of a mechanical mixture in fine aggregate form, of definite compounds. The proportions in which these exist vary directly as the percentages of lime, silica, alumina and ferric oxide vary. The quality of cement depends upon the proportions existing between these components and upon the relative fineness of the cement. A limiting ratio, based on a minimum content of the best hydraulic component, tricalcium silicate, has been established. Cements falling below this ratio should be looked on with suspicion, especially if relatively coarse, since too high a percentage of the most difficulty hydratable component, calcium orthosilicate, is thereby indicated.

Fluorescein an Aid to Tracing Waters Underground

HOW to use fluorescein in tracing ground water and some of the characteristics of that chemical are noted in the March *Reclamation Record* by Herman Stabler, chief engineer, Land Classification Board, U. S. Geological Survey. The following abstract is given:

Fluorescein, a coal-tar product, stands at the top of the list of chemicals and dyes used for tracing water underground. It has a reddish-orange color but when dissolved in water and diluted appears by reflected light a brilliant green. Its preëminence as an aid to tracing ground water lies in the fact that minute quantities can be detected by the eye without resort to chemical analysis. If material of good quality is used one part of the fluorescein in 40,000,000 parts of water will be visible to the naked eye and one part in 10,000,000,000 can be detected with the aid of a long glass tube. It is useless for waters containing free mineral acids, which render it colorless, and is unsuitable for percolation tests on peaty soils for this reason. With this exception it is available for practically universal application. Some mineral constituents of ordinary waters, particularly carbonates, will reduce the visibility of fluorescein, some of the coloring matter will be absorbed by soils through which it passes slowly and a part tends to settle out in pools or basins, perhaps later to be washed out on agitation by a large inflow of water. These effects are small in most cases but should be considered in determining the "dose" of the indicator to be used. Generaly speaking, the dose should be computed to give about one part in 10,000,000 in the effluent if results visible to the naked eye are desired. The conditions under which the individual experiment is to be undertaken will, of course, furnish some guide to the dosage.

If simple tracing of an underground connection is desired, the proper method is to dissolve the calculated dose of fluorescein in a small quantity of water and place it in a single charge at the point where water disappears underground. Then watch all possible springs or wells for results, collecting samples and examining them in a long tube of colorless glass (long to get the color of a great depth of water, and colorless to avoid confusion with the anticipated green) at reasonably frequent intervals. Seepage from a canal can be traced by placing fluorescein in pits or borings alongside or in the bed of the canal, or, if the canal is closed down, by impregnating a minimum amount of stagnant water in the suspected part of the canal prism. In such cases the rate of underground flow is likely to be only a few feet per day, and there may be a wide diffusion of the waters. A calculated over-dose of fluorescein should therefore generaly be used, and observations should continue long enough to make sure of a result.

Water Chlorination Control by the Absorption Method

Two Years Tests and General Observation Prove That Excess of Residual Chlorine May Be Used as Factor of Safety

By Abel Wolman
Division Engineer, Maryland State Board of Health, Baltimore

THE publication of a paper on "Chlorine Absorption and the Chlorination of Water" (*Jour. Ind. Eng. Chem.*, Mar., 1919, Vol. II, No. 3) by myself and Linn H. Enslow, occasioned at that time considerable inquiry as to the principles and methods of water chlorination control employed in Maryland. In that paper, a general

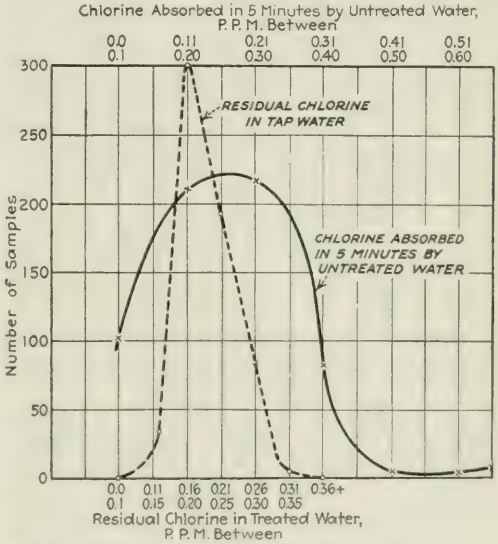


FIG. 1. CHLORINE ABSORBED BY UNTREATED WATER AND RESIDUAL IN TREATED WATER

system of control was outlined in which the essential basis was the effort to hold in a chlorinated water an amount of residual chlorine, after five minutes, equivalent to 0.2 p.p.m. In other words, a hypothesis was set forth that a proper dosage for the effective disinfection of a water was an amount equal to that absorbed by the water tested after contact of five minutes, plus a factor of safety of 0.2 p.p.m. (as a tentative value.)

To demonstrate the validity of this hypothesis, a detailed and adequately controlled series of observations, on a practical scale, was started at Luke, Md. The water supply of Luke is obtained from the Potomac River, a polluted stream. The water is settled without a coagulant and is then filtered. Since that water supply is used for industrial purposes and the present filters are inadequate to furnish the requisite amount of water for such purposes, it has been necessary to filter the water without preliminary coagulation. This combined with the inadequacy of the settling period (about ½ hr.) and high rates of filtration (not less than 125 m.g.d.) produces a poor final effluent made evident by the frequent turbidity. It is essential, therefore, that the chlorination be effective at all times and meet adequately unexpected and sudden changes in the quality of the

filter effluent. For this reason, it was determined to make use of the "chlorine absorption" method in the treatment of this supply. The supervision of the routine testing and the control of the treatment, under the general direction of the Maryland State Department of Health, is in the hands of Mr. Patrick, of the chemical laboratory staff of the West Virginia Pulp and Paper Co., which controls the public water supply at Luke.

Tests—The procedure adopted for the control of the disinfection of the water consisted in general of the following steps: (a) The determination of turbidity in all the waters under study. (b) The determination of the amount of free chlorine absorbed in five minutes by the different waters at various stages in purification.

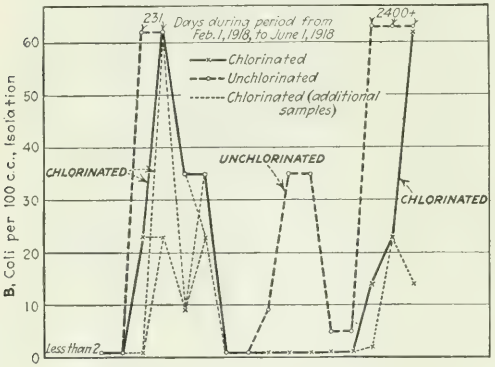


FIG. 2. VARIATION IN B. COLI IN UNCHLORINATED AND CHLORINATED WATER AFTER CHLORINE CONTROL

(c) The determination of the amount of free chlorine remaining in a tap located at a point approximately five minutes' distance of water travel from the point of application of the liquid chlorine. In the case of the supply under discussion, chlorine was supplied to the suction of the pump. The tests listed under (a), (b) and (c) were carried out in the morning and afternoon of each day of the week. Adjustments of the chlorine machine were made after each test so as to obtain a residual chlorine value of approximately 0.2 p.p.m., at the five-minute tap.

The determinations of chlorine were made with orthotolidin. Although the chemist at Luke found this indicator entirely satisfactory, at a number of other plants in Maryland the starch-iodide-thiosulphate method is preferred. In determining the amount of chlorine absorbed during five minutes after the addition of chemical, the following procedure is employed: To 200 c.c. of the water sample (at 20 deg. C) to be treated, add a sufficient volume of available chlorine solution to give a resulting dose of 1 p.p.m. Shake vigorously after stoppering and allow to stand 5 minutes. Immediately shake again for a second and transfer 100 c.c. to a beaker containing 1 c.c. or ortho-tolidin reagent. Place the beaker containing the sample and color reagent in a warm place for 10 to 15 minutes. Dilute 20 to 200 c.c. volume and compare with permanent standard. The residual chlorine in the tap water found as outlined in Standard Methods for Water Analysis, A.P.H.A., 1917.

Results—The Luke chlorination data have been collected for about two years. In this brief discussion, however, it is unnecessary to report all of the values

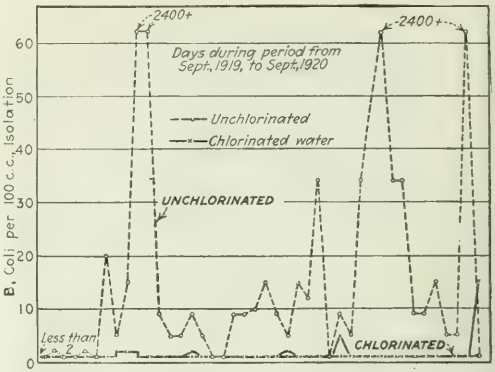


FIG. 3. VARIATION IN B. COLI IN UNCHLORINATED AND CHLORINATED WATER BEFORE CHLORINE CONTROL

obtained. The material here presented includes only those figures accumulated during the year ending Aug. 31, 1920. They are typical of the previous data and illustrate adequately the conclusions which may be derived. During this period of one year, 622 samples were examined for chlorine absorbed in five minutes and 615 for residual chlorine. The distribution of the values obtained in each case are shown by Fig. 1. Of 615 tap waters examined, 577, or 94 per cent, showed residual chlorine not less than 0.16 and not more than 0.30 p.p.m., while 100 per cent showed not less than 0.11 nor more than 0.35 p.p.m. These results indicate clearly the success with which the chlorine dosage was manipulated to meet varying requirements, since, during the same period, the amounts of chlorine required in five minutes by the water under treatment varied from less than 0.10 to more than 0.60 p.p.m.

The data in Fig. 1 emphasize the variability of the amounts of chlorine which may be consumed by a water during a period of time. Whereas approximately 100 samples of untreated water absorbed less than 0.1 p.p.m. in 5 minutes, 84 consumed between 0.3 and 0.4 p.p.m. and an appreciable number even more than 0.4 p.p.m. Obviously a standardized dosage of 0.3 p.p.m. for such a water as the above would be too low or too high about 75 per cent of the time the water was being treated. Such a dosage would necessarily result in the production either of an unsafe or an unpalatable water during this period.

That these adjustments were satisfactory from the standpoint of bacterial efficiency is shown by the data presented by Fig. 2. Here the B. coli isolation results for filtered unchlorinated and filtered chlorinated waters are presented. During the annual period 82 tap waters were examined. Of these, only two showed more than 2 B. coli per 100 c.c. by the confirmation test (lactose broth, endo, secondary lactose broth). Previous to the institution of the chlorine absorption tests and the regulation of dosages thereby, every fluctuation in bacterial content of untreated water was followed by corresponding rises in that of chlorinated water. (Fig. 3.). The constant chlorine dose, low enough to prevent taste or odor, was a failure from a sanitary standpoint. It is significant to mention that, with the improved method of control, no complaints regarding tastes, odors or corrosion in pipes have appeared in the two years since its initiation.

Conclusions—After two years of operation, the con-

trol of chlorination of a water supply by means of residual chlorine tests has proven a success. This finding is in agreement with that indicated by the treatment, within the past few years, of waters elsewhere than in Maryland.

It appears safe to dose the Luke water at a rate of 0.2 p.p.m. in excess of the amount of chlorine absorbed by it in five minutes. This factor of safety of 0.2 p.p.m. may vary from water to water, but the fundamental principle of chlorination control should remain the same. Although 0.2 p.p.m. may be necessary or undesirable in some waters, yet the method should not be eliminated on this account. The factor of safety may be increased or reduced by varying the period of test

CHLORINATION REPORT SHEET, LUKE WATER SUPPLY
(Figures in parts per million)

January, 1920.			5	6	7	8	9	10
Turbidity	Unsettled	a m	0	25	5	7	80	48
	Water	p m	4	8	7	9	74	42
	Filtered...	a m	0	0	0	0	11	20
	Water.....	p.m.	0	0	0	0	14	13
Available chlorine absorbed in 5 min	Unsettled...	a m	0 36	0 35	0 38	0 33	0 65	0 60
	Water	p.m	0 36	0 38	0 37	0 34	0 65	0 30
	Filtered.....	a m.	0 33	0 34	0 35	0 31	0 19	0 44
	Water....	p.m.	0 34	0 34	0 35	0 31	0 19	0 26
Residual chlorine	Tap.....	a m.	0 19	0 20	0 18	0 23	0 20	0 10
	Water.....	p.m.	0.22	0.23	0 18	0 20	0.16	0.22

for chlorine absorption of unchlorinated water. In general, however, the simplest form of chlorination control, and the one which should give complete satisfaction, would consist in maintaining a quantitative residual of chlorine at a definite station near the point of application of the chemical. What this quantitative residual should be is dependent upon the supply. In the case of the supply here reported upon, 0.2 p.p.m. appears satisfactory. With another water, more or less than 0.2 might be preferable for the best sanitary and aesthetic results. But in each case, it certainly appears wise to recognize the fundamental principle of variability of chlorine consumption of water from day to day and hour to hour before attempting to meet this variability by invariable dosage. In the primary equation of chlorination, the factors on one side are "chlorine demand" and "chlorine supply" and, on the other, bacterial content and taste and odor. If "chlorine demand" varies, and it always does, while "chlorine supply" remains constant, as it usually does in the average treatment plant, why should it be expected that increased bacterial content and tastes and odors would not come and go?

The maintenance of the equilibrium of the factors in the equation here described gives rise to the interesting query to the writer by Dr. William Mansfield Clark of the U. S. Public Health Service: "Why not a chlorine apparatus which will feed automatically a dosage varying with the absorption of the water being treated?"

Acknowledgment—The careful analytical determinations and supervision here reported upon were made possible by the interest displayed in the experiments by Mr. Patrick. The foregoing discussion has been considerably clarified through valuable criticism and suggestions by the Robert B. Morse chief engineer, Department of Health, whose broad interest in such problems has made their study possible.

Problem of Better Harbor Freight Handling Methods

Ship's Gear and Cranes Working Simultaneously—Tractor-Trailers for Pier Sheds and Warehouses—Car-Lighter Transfer

WHILE THE LACK of freight-handling machinery at the port of New York is by no means as pronounced as is generally believed, there is ample opportunity for improvement in installations and methods, according to the New York, New Jersey Port and Harbor Development Commission as set forth in the chapter on freight-handling machinery in its recent report. It is recognized that a large percentage of cargo transfer at New York is and will remain to and from lighters on the offshore side of the ship, where wharf machinery is of no avail. Nevertheless wharf cranes for use simultaneously with ship's gear together with tractors and trailers to move the goods within the pier shed, the commission believes would materially reduce the turn-around of the average ship, provided other changes in pier operation were made that would relieve the pier shed of warehouse duty. The commission compares at some length tractor-trailer operation with overhead monorail operation and finds in favor of the former for both transit sheds and warehouses.

More general improvement in methods of loading and unloading coastal vessels with side ports is suggested by the successful application at a few points of gangplank boosters and the practice of carrying the freight on the vessel in loaded trailers handled by tractors on the piers. For loading and unloading canal and other barges better waterfront equipment, such as cranes, grab buckets and hoists, is needed, particularly for canal barges and for some quarters in handling special commodities in large quantities. In the case of warehouses, resulting economies will warrant liberal investments in large elevators, conveyors, chutes, tiering machines and outside hoists, in addition to tractors.

Ship's Gear Versus Cranes

In view of the respective advantages and disadvantages of ship's gear and wharf cranes, the commission believes both should be available to promote the most rapid discharging and loading of the average cargo carrier.

With respect to ship's gear, it is standardized equipment. Almost every ship has it, to enable it to operate in ports not equipped with cargo-handling machinery. Its use is understood the world over, and no very high intelligence is required to operate it. It can operate on either the pier side or the off side of the ship, and working in conjunction with cargo masts it can function with little loss of time while the ship is breasted off for coaling.

On the other hand, the average ship has not enough gear to work all hatches to capacity. In the ordinary burtoning operation without the aid of cargo masts two booms are required for one hook, and studies made by the commision of typical ships showed that in many instances several cranes could have worked to advantage in addition to all of the ship's tackle. The cranes can work from the pier while the ship's booms work the same hatches from the offshore side, or the cranes and booms can work in team, the crane handling the load between pier and ship's deck, the latter between the

deck and the hold. The latter combined operation, while only one of the possibilities where both cranes and ship's gear are available, has been used to some extent at certain European ports.

Wharf cranes have certain other advantages over ship's gear. The crane is ordinarily designed for a larger load than ship's gear can handle, and usually two cranes can be worked together to handle loads of double the capacity of the single draft. The traveling crane is not restricted to a certain spot, as is usually the case with ship's gear. Wharf cranes can be used effectively transferring goods between pier and lighter when no ship is in berth.

Saving in Ship's Turnaround

"Simultaneous working of ship's gear and cranes," states the commission, "would effect a saving in the ship's time, but without improved layout and provision of ample transit floor space the benefit of cranes would not fully materialize. With such provisions, together with adequate regulation to insure deliveries of goods to and removal from the pier at the proper times, it seems conservative to say that the present average time of discharging and reloading can be cut in two.

"Twenty days is about the average time required [for average freighters] for the two operations of discharging and loading. Less than one-fifth of the total time the ship is at the pier is actually used in working the hatches. . . . Evidently there are reasons for the waste of ship's time in the harbor other than the lack of machinery. The rehandling of freight on account of lack of transit floor space for incoming cargo, insufficiency of space to assemble outgoing cargo, and the untimely arrival of outgoing cargo stand prominent among these reasons, and cause relatively greater delay than could be made up by any crane installation."

The commission gives figures of $1,000 and $4,000, between which lies the charter value per day of the average ship of 4,000 net vessel tons. An average saving in turnaround of ten days might therefore be the interest on either $200,000 or $800,000, but in either case, considering the number of dockings in a year at one pier, the commission thinks high first cost need not bar the installation of machinery.

It is pointed out that cranes can be installed successfully only where the piers are strong enough to carry them, where the sheds are set back far enough to permit unhampered operation and where the piers are wide enough for prompt movement of the goods to and from the ship. These conditions do not obtain at most of New York's existing piers. The commission recommends the building of new piers of such dimensions and design as will accommodate cranes, the nature of the traffic to determine whether the cranes should be at once installed.

Transit-shed layout and operation may largely nullify the benefits of cranes. Narrowness of piers, abuse of storage privileges in transit sheds and insufficient use of handling machinery—tractor-trailers or monorail systems—within the shed may be contributing causes.

The commission holds that a basic necessity if machinery is to be effective is the provision of adequate and accessible warehouse space and the restoration of the pier or transit shed to what its name implies—a covered space for goods moving to and from the ship.

Assuming, then, that the transit shed is to be put to its proper use, the commission points to two systems as best meeting the controlling requirements—the tractor-trailer system and the overhead monorail crane or adjustable loop system. It is believed that electric tractors and trailers, supplemented by hand trucks for short distances and limited space, and by electric load carrying trucks in exceptional cases, afford the best means available, based upon the monorail and the tractor-trailer systems as at present available for pier use.

In speed and cost of operation the commission finds little choice in the two systems. In flexibility and in adaptability to commercial practice, however, the advantage is thought to be decidedly with the tractor-trailer operation.

Tractors and trailers can go anywhere. Monorail systems are restricted to one-way operation, and are further restricted by columns and other interior obstructions that make it difficult to reach all parts of the building. Adjustable loops only partly overcome the difficulty. If there is only one loop, only one or two hatches can be worked successfully; if there are more than one, each restricts the scope of the others.

The ordinary cargo consists of every manner of commodity, in every manner of size, shape and strength of package. It can best be classified on a wide pier, where it can be spread out. Tractor-trailers work best on such a wide area. Because of the high cost of traveling monorail bridges, however, sheds where they are used must be kept narrow and the goods must be tiered high to get the capacity. This is often unsafe, and the relative inaccessibility of the goods in the high piles adds to the difficulty of sorting them.

Serving Coastal and River Vessels

Even though coastal and river vessels individually represent a smaller investment than trans-oceanic steamers, their operation on fixed schedules requires prompt unloading and loading. In maintaining schedules with side-port loading of vessels, with single or multiple decks, there is little opportunity for other machinery than power trucks and trailers supplemented by a large amount of hand labor. Improvements are gangplank boosters, use of tractor-trailers and the carrying of loaded trailers on the boat between ports. The adjustable ramp or gangway equipped with an inclined conveyor is simply an endless motor-driven chain carrying at frequent intervals lugs that engage the axles of the hand trucks and "boost" them up the incline. The tractor-trailer system has been developed to a considerable extent on piers serving broad, low-sided, shallow-draft vessels for sheltered waters, with extension of the system by receiving all outbound freight to the steamer by trucks, in connection with tractor-trailer distribution on the pier.

An advance use of the tractor-trailer system for pier work in loading vessels of the side-port class, but not applicable to all cases, is that the trailers are left on board the vessel and taken off at destination, handled by tractors at each port. Since most freight cannot be tiered successfully on top of a succession of loaded trailers, there is a considerable amount of unused volume space, suggesting the possibility of inserting decks between those existing.

Harbor and canal craft barges in general include such a variety of boats in various services that it is difficult to outline specific needs for betterment of practice. In the case of lighters it has been seen that wharf cranes will facilitate their operation. While the pres-

ent volume of lighterage transfer at the port of New York has been criticised, it should be realized that the capacity of the port to use them is an element of strength and not of weakness, since wide ranges of type and capacity seem to conform to the demands of service and the high capacity derrick boat has proven an excellent medium for transferring heavy parts to and from piers, ships or cars.

A special field for the canal is the transportation of low-grade bulk freight naturally carried in hold barges or boxes. Loading and unloading can best be accomplished by shore equipment and there is a crying need for such equipment and for cranes to handle package freight, as well as for the wharves themselves to handle the canal traffic. Hold barges used for carrying coal, grain, sand, gravel and other bulk freight operate not only from the canal but also between various points within the harbor. The whole question of better machinery for serving them is tied to the larger question of a more rational selection of terminal sites for handling the various commodities.

Railroad Transfer

There is some but not much direct transfer between car and ship at the piers of the port of New York. Miscellaneous package freight is handled mainly at the covered lighterage piers, unloading cars to hand trucks which run aboard lighters. The problem peculiar to the port of New York is the transfer of heavy pieces for export and import to and from cars, performed mainly by cranes at open piers, but very little to and from ships.

The two general classes of equipment in use for this service are the locomotive crane and the overhead crane. The lower cost of the locomotive crane is one of its strong points, together with its flexibility by use on any existing track without pier modifications. Overhead cranes now in use—both straight line and revolving—range between 10- and 30-ton capacity, some with 5-ton auxiliary hoists. It is believed that the revolving type is preferable at uncovered lighterage piers because it can reach additional trackage and so reduce shifting. Either type is more efficient than the locomotive crane for frequent and intensive service on an open pier.

Since the heavier types of crane on open railroad piers at the port of New York are used almost exclusively for transfer of freight between cars and lighters, mostly at shallow water, they are in no way comparable to those at some foreign ports or to those here recommended for general cargo at steamship piers, and finally because such cranes are of altogether too high capacity for general cargo transfer. The advantage is not wholly with the pier crane in heavy transfer between ship and car direct. While no material difference in operating cost can be observed between the pier crane and the floating crane, the advantages in flexibility of operation rest with the latter.

Observations made of comparative performance of pier cranes and floating cranes for the handling of heavy drafts from open railroad piers indicate little difference in labor cost, the floating crane having a slight advantage. In the matter of dispatch, however, the floating crane made decidedly the best showing. In one comparison a floating crane taking a small number of drafts of about six tons each averaged 45 tons per hour, while a 20-ton pier crane taking an average draft of 5½ tons averaged only 18 tons per hour, and a 10-ton pier crane taking an average draft of 2,200 lb. averaged only 13 tons per hour. Cost figures are not illuminating since floating-crane operation involves lighterage operation also. The conclusion is drawn that the field of the open-pier railroad crane is between that of the recommended wharf crane for general cargo and the high-capacity floating crane.

Warehouse Machinery

In the well-ordered multiple-story warehouse there are some five requisites to the business of storing and handling goods: (1) Means of handling goods in and out and to and from other transportation units; (2) means of conveying goods about the floors; (3) means of getting them from one floor to another; (4) means of tiering and removal to conserve space, and (5) facilities for weighing.

While virtually all warehouses are accessible to street trucks, many lack railroad service and only a comparatively few are on the water front accessible to lighters.

In movement about floors some of the disadvantages of the adjustable loop monorail system for wharf-shed purposes are not so evident, but the need for utilizing full cubical capacity is more pronounced than in the wharf shed. Hence the monorail system wastes much more space overhead than the tractor-trailer system wastes in wider aisles, except possibly in the case of commodities that can be tiered high. Generally the warehouse should be contiguous to the wharf shed or nearly enough so that tractors and trailers can operate between. Where this access is not available, conveyors or moving platforms may be especially desirable in connection with multiple-story wharf sheds.

Tiering machines and their complement, de-tiering machines, are needed for full use of warehouse capacity with high ceilings. A good machine for warehouses of this type is the portable inclined conveyor, taking the package at the floor or track level and delivering it to any desired height.

Transcontinental Radio Signals in Moving Automobiles

Signals sent out by Atlantic Coast radio stations were received recently by apparatus carried in an automobile moving along the streets of San Francisco. The antennae consisted of a stranded copper wire aërial hung about 10 ft. above the ground by means of bamboo poles at the front and rear of the automobile. Nothing but the frame of the machine was used for a "ground." The signals were clearly audible without the use of amplification, only one bulb being used. Except for a six-volt storage battery the receiving set was entirely contained within a small cabinet of about the same size as an ordinary suit case. The set was not specially made up for this purpose, but is a standard product turned out by a San Francisco radio manufacturer.

The first tests were made on top of Twin Peaks, an eminence in a part of the City where power lines and street cars would not interfere with the signals. The test was so successful there that the automobile was driven down into the City and the signals continued to be clearly audible even when the automobile was driven close to electric cars in operation. Some of the distant stations heard were Marion, Mass.; Annapolis, Md.; New Brunswick, N. J., and Pearl Harbor, Hawaii. E. A. Portal and Colin B. Kennedy conducted the demonstration.

Concrete Road Building Delays in Illinois Analyzed

By A. W. Consoer,
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ROAD and paving contractors seldom realize how few days they are actually engaged in the essential work of their contracts and how much avoidable delay and increased cost there is in their construction operations. The accompanying table shows the amount of time lost through delays on nine typical concrete road contracts in Cook Co., Ill. Much of this delay was, of course, due to causes over which the contractor had no control and some is entirely justifiable, but the differences in the records of the various contractors in the same county show that much of the delay in these nine instances can be correctly classed as avoidable. The cost of a high priced organization is a serious matter when no dirt is being moved, or when no concrete is being laid.

The principal delays in most of the nine contracts are classified under the heading "Administration." Under this general heading are included all delays in starting or suspending any part of the work for reasons not otherwise covered.

TABLE—TABULATION AND ANALYSIS OF CONSTRUCTION DELAYS ON NINE ILLINOIS HIGHWAY CONTRACTS

Description of Job (All Pavement) 18 ft. wide	Operations	Delays (Days): Administration	Rain and Wet Grounds	Cold Weather	Short Gang	Lack of Material	Hauling Delay	Waiting for Grade	Cutting Out Grade	Machinery and Moving	Waiting for Mixer	Waiting for X-Culvert	Preparation	Building Culverts	R.R. Strike	Teamster's Strike	Truck Driver's Strike	Shut Down	Building Plant	Total Delays	Actual Days Worked	Possible Days	Work Performed	Av. Size of Gang	Actual Av. per Man per Day	Total Av. per Man per Day	High Run	Low Run	[illegible]
No. 1	Excavation	92	12	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	106	49	155	10,000	9	23	7			
2-bag mixer	Hauling material	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	155	....	..	..	..			
10,240-ft. long	Paving	54	14	..	..	17	..	31	..	3½	..	..	2	..	..	..	..	..	..	121½	34	155	5,388	15	11	2	275	37	163
Contract Let	Shoulders and ditches	130	..	..		..	..	..	..	..	..	..	..	..	..	..	..	..	..	130	25	155	4,000	8	20	3			
May 5, 1919																													
No. 2	Excavation	38	16	4	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60	114	174	28,106	15	64	11		..	
2 & 3-bag mixers	Hauling material	27	16	4	1	12	.	7	..	..	..	..	..	..	..	..	..	..	..	67	107	174	....	12	..	..		..	
28,106-ft. long	Paving	27	16	4	2	17	2	7	..	2	..	..	..	..	..	..	..	..	..	77	97	174	28,196	27	11	6	412	27	287
Cont. Let	Shoulders and ditches	113	16	4	1		.	..	..	..	8	..	..	..	..	..	..	..	..	142	32	174	18,000	15	38	7	..	..	
May 21, 1919																													
Completed																													
Nov. 22, 1919																													
No. 3	Excavation	27	3					..	..	..	..	..	..	19	..	..	..	..	..	49	52	101	16,123	12	26	13	..	..	..
2-bag Mixer	Hauling material	22	4			10	4	.	..	..	..	..	..	19	..	..	..	..	..	59	66	125	....	8	..	..	..	..	
16,123-ft. long	Paving	22	5			10		10	..	6	..	..	..	19	.	..	..	..	..	72	53	125	16,123	37	8	4	420	25	304
Cont. Let	Shoulders and ditches	93					.	.	..	..	..	.	..	19	.	..	..	..	..	112	.	112	.....	..	..	..	..	..	
Apr. 1, 1919																													
No. 4	Excavation	40	3					..	..	..	..	..	..	..	..	..	..	..	..	43	94	137	13,755	4	37	25	..	..	
1-bag Mixer	Hauling material	36	2			..	..	..	..	..	..	..	..	..	..	..	..	..	..	38	99	137	....	10	..	..	..	..	
13,755-ft. long	Paving	41	3			..	1	..	..	1	..	..	..	..	..	..	..	..	..	46	92	138	13,755	14	11	7	204	47	150
Cont. Let	Shoulders and ditches	142	1		.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	143	41	184	13,755	10	34	7	..	.	
June 1, 1919																													
Completed																													
Nov. 20, 1919																													
No. 5	Excavation	67	58	78	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	204	57	261	16,323	12	24	5	..	..	
3-bag Mixer	Hauling material	98	56	50		..	..	..	..	..	..	..	..	..	..	..	..	..	..	204	57	261	....	..	.	..	..	.	
16,323-ft. long	Paving	70	58	78	1	..	..	6	..	..	..	..	..	..	..	..	..	..	..	213	57	270	16,323	34	[illegible]	2	448	106	28[illegible]
Cont. Let	Shoulders and ditches	152	58	59	.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	269		275	....	..	..	..		..	.
Sept. 16, 1918																													
Completed																													
July 15, 1919																													
No. 6	Excavation	22	32	73	0 3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	128	66	194	11,372	8	22	8	..	.	
2 1-bag mixers	Hauling material	19	32	73	0.3	..	..	17	.	..	..	..	..	..	..	..	..	..	..	142	52	194	.	..	.	.	.	.	
11,372-ft. long	Paving	29	33	73	2 7		.	9	..	..	..	..	..	..	..	..	..	..	..	147	40	187	11,372	25	11	3	458	24	282
Cont. Let	Shoulders and ditches	54	31	73			..	..	..	..	..	..	..	..	..	..	..	..	..	158	..	158	.. ..	..	..	..	..	..	
Sept. 23, 1918																													
Completed																													
May 30, 1919																													
No. 7	Excavation	12	.				.	..	..	..	..	..	..	..	..	..	..	..	..	12	17	29	2,687	9	18	10	..	..	
2-bag Mixer	Hauling material	12	.	.				..	..	..	..	..	..	..	..	..	..	..	..	12	31	43	.. ..	..	.	..	..	..	
2,687-ft. long	Paving	27	.					..	..	..	..	..	..	..	..	..	..	..	..	29	14	43	2,687	15	13	4	252	149	192
Cont. Let	Shoulders and ditches	53	.					..	..	..	..	..	..	..	..	..	..	..	..	53	5	58	.. ..	..					.
May 5, 1919																													
Complete																													
June 25, 1919																													
No. 8	Excavation	29	38	4	1	1		.	..	1	..	..	..	..	.	6	..	..	..	81	97	178	30,000	14	22	12			
4-bag Mixer	Hauling material	19	38	4	2	.	2	.		1	..	.		..	5	1	1		.	73	105	178							
31,784-ft. long	Paving	38	42	4	2	1½		.		5	.	.	..	.	6	2	2	1	..	105	73	178	23,054	30	11	4	470	47	317
Cont. Let	Shoulders and ditches	132	31	4				.	.	..	..		.		..	1	.	..	..	168	10	178	1,200	8	15	1			
May 5, 1919																													
No. 9	Excavation	48	9	2					.	1				.	..	.	.			60	109	169	44,056	12	34	22			
4-bag Mixer	Hauling material	30	8½			10½		.		3	..	..	..	..	..	..	..	..	43	95	55	150			.	.			
49,263-ft. long	Paving	30	5½			10½				3				..	.	..	.	..	43	92	58	150	21,482	23	16	6	751	81	370
Cont. Let	Shoulders and ditches	134	9	2										..	..	..	..	..	..	.	..	..	.....	..	..	..	..	..	
May 5, 1919																													

NOTE—Work performed is expressed in lineal feet of road. Delays are expressed in days.

Delays of administration in excavation work include, for example, the time required for the formalities of signing the contract, procuring bond and obtaining approval of the sureties, shipment of equipment and organization of the construction forces after the award of contract. Delays of administration under paving include the days when no paving was done after suffi-

cient grading had been done and sufficient material had been spotted to warrant the beginning of concreting.

Most of these contracts were awarded in May or June, 1919, and there should have been no unnecessary delay in starting the work, as cold weather causes a cessation of concrete paving work in Cook Co. usually about Nov. 1. The fact that so much delay was required for organization work is a direct appeal for awarding contracts early in the season, in order that organization can be done in the winter and early spring.

Surprisingly little delay was caused by lack of materials. On 1920 contracts the lack of materials has frequently caused considerable delay, and has converted many contractors to the practice of storing reserves of material before commencing work, in spite of the additional cost involved. It is common practice on state and county road contracts in Illinois and neighboring states for the engineer to give estimates on material stored near the work, but in municipal paving work this method for encouraging the storing of cement and aggregates has not been so generally adopted.

A striking example of avoidable delay is given under Contract 1, where 31 days' were lost in the actual paving by failure to have the subgrade prepared in time to permit continuous operation of the mixer.

On Contract 9, 43 days were used in building and equipping an unloading plant and industrial railroad, and only 55 days were actually utilized for laying pavement. If this contract had been awarded on March 1 instead of May 5, the contractor might have completed the 49,263 ft. of road in 1919 at a good profit instead of having to face the increased cost of labor when he resumed construction in the spring of 1920 on the uncompleted portion of his contract.

Many highway engineers and contractors favor awarding contracts in sections about 5 mi. long. A study of the table indicates that such a contract can be completed by the usual contractor's outfit in one season in Cook County, if the work is let early enough to allow construction operations to begin as soon as weather conditions permit. In Contract 2, the contractor was able to complete all of the 28,106 ft. of pavement, but had not completed the earth shoulders and ditches when cold weather forced him to suspend operations.

On all these contracts there was a tendency not to have more than one or two major operations under way at one time. In none of these cases was a real effort made to complete the earth shoulders and ditches as rapidly as the curing of the finished pavement was completed. The table shows also how long the average contractor in this county delays starting his concreting operations after sufficient grading has been done and sufficient material hauled to warrant a start. A certain length of time is always required to assemble and organize working force and equipment.

A number of contractors when shown these figures were startled by the conditions revealed. While they all realized that much time is lost by delays, none of them had known what a small part of the total working time was effectually utilized on the average contract.

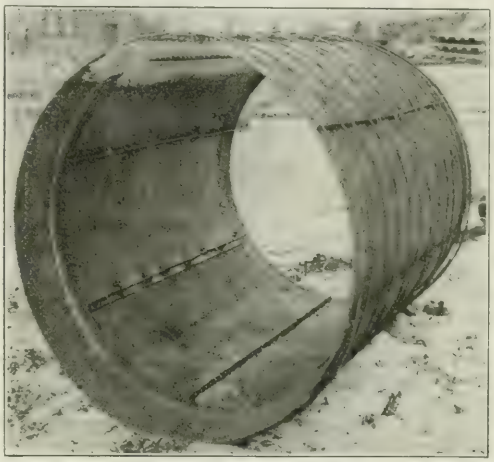
Paint Value Diagram by E. O. Johnson

The diagram for carrying out cost and value calculations of paint, in *Engineering News-Record* of April 7, p. 601, was originated by E. O. Johnson, East Orange, N. J., whose name should have appeared as author of the article referred to.

Test Concrete Pressure Pipe With Encased Steel Diaphragm

Inside of Reinforced-Concrete Shell Is a $\frac{3}{16}$-in. Steel Pipe Which Is Welded at Joints Between Cast Sections

TESTS have recently been made at Cleveland, O., on a 36-in. precast reinforced-concrete pipe of a new type, in which an encased $\frac{3}{16}$-in. steel cylinder acts as a water barrier for high pressures. The pipes are cast in sections 4 ft. long with the encased steel cylinders projecting and the joint is made by electrically spot welding the steel and pouring concrete in the joint. On both



BELL END OF STEEL SHELL WITH OUTSIDE REINFORCEMENT IN PLACE

inside and outside faces of the encased steel are welded perforated strips of metal which serve as spacers for wire-mesh reinforcement, No. 153 on the outside and No. 032 on the inside. The concrete shell is 4 in. thick.

The bell and spigot ends of each section were built up of developed sheets of $\frac{3}{16}$-in. steel plate. The bell end was constructed of a strip of the material so patterned that when developed it formed a conical shaped cylindrical ring $7\frac{3}{4}$ in. wide, which was attached to the end of the main cylinder by means of a continuous outside welded joint. A somewhat similar ring was developed for the spigot end of the pipe. Into the small end of this ring, however, was rolled a crimp expansion joint, which in section had the form of a half circle of $\frac{1}{2}$ in. diameter. This ring was welded to the opposite end of the main cylinder.

The pipe sections were cast on end. Steel forms, which were set up on an accurately machined cast-iron ring, were used. This ring also served as a template on which the bell section of the steel diaphragm was centered The spigot, or upper end, of the diaphragm was held accurately centered by means of removable steel lugs.

Concrete was mixed one part of portland cement, two parts Pelee Island sand and four parts roofing gravel by volume. It was poured rather wet and was spaded with a flexible ramming rod. After the pipes were cast they were steamed, when the temperature was around freezing, and stripped after from 2 to 9 days.

Four pieces of the pipe were erected on timber skids for an internal pressure test. The steel diaphragm of the several sections were connected by means of a continuous electric weld made from the inside, and steel bulkheads were welded to the diaphragm protruding from the ends of the test sections. The pipe was designed for an internal pressure of 115 lb. per square inch, using 12,000 lb. stress in the steel. Water pressure was applied by means of a boiler test pump and the pressure was raised to 230 lb. per square inch, at which point horizontal cracks were noticed in the concrete of the two end sections. At 240 lb. per square inch pressure horizontal cracks were noted in the concrete of the remaining two sections.

SPIGOT END OF ONE PRE-CAST SECTION

The cracks were apparently caused by the fact that the steel diaphragm was being stressed to a point beyond a safe working load. The stress in the $\frac{3}{16}$-in. steel shell, at 230 lb. per square inch pressure would result in a total stress of 24,572 lb. per square inch.

Failure occurred in one of the end pipes when the internal water pressure was increased to 255 lb. per square inch, or 27,243 lb. per square inch stress on the steel diaphragm. The rupture was caused by the failure of a large portion of the longitudinal lap weld which extended through the length of the main cylinder of the 4-ft. section. In breaking, the concrete on both the inside and outside was shattered. It is of interest to note that the concrete was but twenty-three days old when the test was made.

FOUR SECTIONS OF CONCRETE PIPE BEING TESTED

In regard to the test the engineer's report reads:

"The concrete pipe used in this test was designed and constructed to withstand an internal working pressure of 115 lb. per square inch. Observations made at the time of the test showed that a longitudinal crack developed in the two end pipes at 230 lb. per square inch pressure. Subsequent investigation proved that the cracks occurred over the lap welded horizontal joint The lap used in standard welding practice of four times the thickness of the sheet, or $\frac{3}{8}$ in. in this case, was used. Undoubtedly, the type of lap weld joint used in the longitudinal seam intensified the strain on the weld. However, a satisfactory butt weld or a double welded lap joint will undoubtedly develop the full strength of the shell. The results of the tests indicate that in the design of the pipe the wire mesh reinforcing might well be assigned a portion of the stress. In fact, it might be given the greater part of the stress, in which case it would seem advisable to increase the thickness of the concrete on the outside in order that the wire mesh may be spaced a great distance from the steel cylinder. In such a design the steel cylinder could be made as light as practicable to handle, thus serving almost entirely as a continuous imperforated diaphragm. We understand that the thick sheet was used in the test only in order that the welded joints might be more effectually tested."

The test was conducted by the United Concrete Pipe Co. of New York City, which manufactures the pipe, and was reported on by Morris Knowles, Inc., Engineers, Cleveland, Ohio.

Construction Costs of 1920 and 1921

IN THE submission of estimates for the construction of a three-story apartment house in Illinois, the bids submitted on Jan. 10, 1921, showed a decrease of approximately 15 per cent in cost over the bids submitted on the same type of building on May 20, 1920. The apartment building contained a basement, and eighteen apartments, each apartment consisting of six rooms and three baths. The size of the living rooms were 18 x 25 ft., dining rooms 16 x 20 ft. and bedrooms 14 x 17 ft. There was nothing unusual in the construction and equipment of the building, and medium high-grade standard material was specified. The low bids received on Jan. 10 were not from the same contractors who submitted low bids in 1920, although all estimates were presented by reliable firms. The figures herewith presented were included in an article by S. E. Davidson, president of the Illinois Society of Architects in a recent issue of the *American Architect*. In the same article Mr. Davidson presents figures upon a small manufacturing plant located in Chicago, showing the comparative costs of its construction on July 19, 1920, and Jan. 19, 1921. This comparison indicates that 1921 prices are 9 per cent under those of July, 1920.

In the figures upon the construction of the apartment house, the following itemized cost is given:

Classification	Cost as of May 20, 1920	Cost as of Jan. 10, 1921	Per Cent of Increase or Decrease
Masonry	$44,300	$40,220	— 9.4
Carpentry	74,000	55,700	—24.7
Concrete	5,200	4,650	—10.5
Stone	5,578	6,200	+11.1
Plumbing	28,100	25,870	— 7.9
Heating	11,250	10,600	— 0.6
Electric	4,525	4,300	— 0.5
Plastering	22,200	17,400	—21.6
Steel	4,629	4,209	— 9.1
Sheet metal	2,890	2,960	+ 0.2
Painting	14,920	12,300	—17.6
Glass	2,113	2,200	+ 4.1
Tile	5,843	5,700	— 2.4
Total	$225,548	$192,309	14.7

The small manufacturing plant was composed of a number of one, two and three-story standard mill, sprinklered buildings, including a separate power house. The plant was designed to secure the most economic construction costs. The figures here quoted are from the same contractor in each case:

Classification	Cost as of July 19, 1920	Cost as of Jan. 19, 1921	Percentage of Increase or Decrease
Masonry			
Concrete	$281,480	$249,740	−11 2
Carpentry			
Radial brick chimney	5,930	5,870	− 1 0
Water tube boilers	14,590	14,224	− 2 5
Furnaces	3,400	3,400	0
Structural steel	32,330	25,740	−20 4
Miscellaneous iron			
Steel sash	21,814	24,569	+12 6
Fire escapes	2,872	2,738	− 4 8
Fire doors, etc	6,525	6,310	− 3 3
Hollow metal doors	1,857	1,857	0
Sheet metal work	5,076	4,560	− 10 2
Glazing	19,920	21,980	+10 3
Plastering	7,715	7,715	0
Cut stone	1,360	1,250	− 8 1
Elevators	5,200	4,500	−13 5
Roofing	16,570	16,400	− 1
Tile flooring	102	92	− 9 8
Painting	13,763	12,662	− 8 0
Heating	70,000	61,000	− 12 8
Pipe covering	5,063	4,556	10 0
Electric wiring	24,336	21,006	− 13 6
Sprinkler equipment	34,956	32,115	− 8 1
Gravity tanks	7,075	6,297	− 10 9
Plumbing and drainage	20,290	19,276	− 4 9
Fire pump	3,125	3,425	+ 9 6
Total	605,348	551,282	− 8 9

Formula for Determining Settling Periods in Basins or Tanks

By Thorndike Saville

Associate Professor Hydraulic and Sanitary Engineering, University of North Carolina, Chapel Hill.

THE design of horizontal-flow settling basins for the treatment of water or sewage is usually based upon the time of settlement, which in turn is governed by velocity of flow. The cross-sectional area of the basin or chamber is a function of these two elements.

The writer, as a post graduate student in two of the better known technical schools in the East, well remembers arduously computing the settling period for various cross-sectional areas and lengths of horizontal-flow settling basins. It is on this account only, and because of absence of any similar computations in textbooks on water or sewage treatment that he ventures to outline the following brief formula for readily calculating settling periods. A similar formula has no doubt been developed by many practicing engineers, but the one presented below may be of some use to younger engineers on account of the absence of similar formulas in texts. The method is of especial use where it is desired to calculate directly the settling periods for various dimensions of tank without finding the velocity of flow. Let

C = Contribution of sewage in gallons per capita per day
P = Population tributary
$Q = CP$ = total flow in gallons per day
q = rate of flow in cubic feet per second
V = Velocity of flow through tank in feet per second
A = Cross-sectional area of tank
L = Length of tank
N = Number of hours during which flow is assumed to occur
S = Settling period in hours

Then $V = q/a$

$q = CP/(N \times 3{,}600 \times 7.5) = Q/(N \times 3{,}600 \times 7.5)$

$V = A/(AN \times 3{,}600 \times 7.5) = Q/(27{,}000\,AN)$

$S = L/(V \times 3{,}600) = L/(Q/27{,}000\,AN)/(AN \times 3{,}600 \times 7.5) = (7.5\,LAN)/Q$

For example: A sewage district of 1,000 population contributes 80 gal. per capita per day to a settling tank 15 ft. x 10 ft. in cross section and 25 ft. long. If the entire flow is assumed to occur in 18 hours, what is the rate of flow and settling period in the tank?

$V = Q/(27{,}000\,AN) = (1{,}000 \times 80)/(27{,}000 \times 150 \times 18) = 80{,}000/(72{,}900{,}000) = 0.0011$ ft. per second.

Thence:

$S = L/(V \times 3{,}600) = 25/(0.0011 \times 3{,}600) = 6.3$ hours or directly,

$S = (7.5\,LAN)/Q = (7.5 \times 25 \times 150 \times 18)/(1{,}000 \times 80) = (506{,}250)/(80{,}000) = 6.3$ hours.

Ditch Design for Prevention of Silt Deposit

Mean Velocity of Stream Must Increase with Depth To Maintain Silt—Carrying Capacity—Formula for Velocity

IN THE FLOW and sedimentation of drainage ditches there is a close relation between velocity, depth and width, particularly at junctions and sharp breaks in grade. If the velocity can be controlled at these critical points it is possible to eliminate much sedimentation and thereby to reduce maintenance costs. These statements summarize a paper on "Ditch Design and Prevention of Silt Deposit," presented at the annual meeting of the Iowa Engineering Society by Q. C. Ayres, Iowa State College. An abstract follows:

The silt-supporting power or silt-carrying capacity of a stream is derived from the upward component of the velocity of eddies. As eddying is aggravated by high velocities and shallow depths, the silt carrying capacity is likely to vary directly with some function of the velocity and inversely with the depth. Width is a factor because the wider the stream the greater the number of eddies.

For uniform flow in a stream there will be a constant value for the sum of its potential energy and kinetic energy, represented by depth of flow and velocity head respectively. If the depth is increased the velocity head is decreased automatically; and if the depth is decreased the velocity head is increased, provided that the slope remains constant.

As silt carrying capacity is largely a function of velocity head, the problem at ditch and grade junctions is to keep the kinetic energy above a certain minimum value by varying the depth of flow, which implies increasing the width of ditch to care for a given discharge. The velocity which is high enough to prevent silting and low enough to avoid erosion, and which varies with the depth but is independent of width, may be designated the "critical velocity."

In order to avoid silting, the velocity must not be kept constant throughout, but must be increased with the depth. This fact is an argument against the common practice of suddenly increasing the depth of ditches to take care of deep tile outlets without providing for an increase in velocity, as under ordinary conditions the deeper section is almost certain to collect large silt deposits.

A formula to express the relation between critical velocity and depth is given by R. G. Kennedy in a paper on "The Prevention of Silt in Irrigation Canals" (*Proceedings*, Inst. C. E., Vol. CXIX). Here v is the critical velocity in feet per second, d is the corresponding depth in feet and c and m are constants to be determined by experiment. From observations in India on canals of various sizes which have reached a permanent condition of silt equilibrium he deduced values of 0.84 for c and 0.64 for m, giving the equation as shown:

$$v = cd^m, \text{ or } v = 0.84\,d^{0.64}$$

The claim that this formula is applicable to all ditches, without regard to size or to the character of silt, is supported by E. C. Thrupp in a paper on "Scouring Power in Relation to Velocity and Depth" (*Proceedings*, Inst. C. E.,

Vol. CLXXI). Good judgment calls for further supporting investigations, but the formula may be accepted tentatively. He gives values of mean or critical velocity corresponding to different depths, as shown in the accompanying table. Information along the same lines may be found in a paper on "Prevention of Silting and Erosion of Watercourses," by S. W. Frescoln, drainage engineer, U. S. Department of Agriculture June, 1915.

TABLE OF CRITICAL VELOCITIES FOR DITCHES

Depth	Velocity Ft. per Sec.	Depth	Velocity Ft. per Sec.	Depth	Velocity Ft. per Sec.
1 ft.	0.84	5 ft.	2.35	8 ft.	3.18
2 ft.	1.30	6 ft.	2.64	9 ft.	3.43
3 ft.	1.70	7 ft.	2.92	10 ft.	3.66
4 ft.	2.04				

After a ditch section has been determined in the ordinary way it may be tested by application of the formula. If this shows that the mean velocity is less than the critical velocity, the section may be redesigned, reducing depth of flow and increasing width so as to increase the velocity to a safe value. Then the increment in cost of this section over the ordinary section may be compared with the cost of annual dredging operations necessary to maintain the latter section.

Motor Bus Operates Successfully on Short Line Railroad

OPERATION of a motor bus in passenger service on the rails of the Winchester & Western R.R. from Winchester, Va., to Wardensville, W. Va., has proved highly successful, according to officials of the line. The distance covered is 42 miles, at a speed of 25 miles per hour, negotiating grades of 3 per cent and curves of 14 deg. The bus body is mounted on a 2½-ton truck chassis and has a capacity of 34 passengers. Flanged iron tires are used. It is now operated 84 miles per day and this schedule will be doubled when traffic warrants.

MOTOR BUS WITH FLANGED WHEELS FOR SHORT LINE PASSENGER TRAFFIC

In actual service the total cost of operation per day, covering 84 miles, is about $11. Gasoline consumption is 1 gal. per 10 miles. The car takes all grades at full speed with only partial opening of the carburetor throttle. Since the track is new, speed is now restricted to 25 miles per hour, with the intention of increasing speed as the track is improved from time to time in the near future.

A 4-ton trailer is to be added to the equipment. The front end of the trailer will seat about twelve people and the remainder of it will be used for mail, baggage and express. As soon as the traffic warrants, it is intended to make two round trips per day, covering a total distance of 168 miles, including 76 possible stops, thus affording people along the line an opportunity to come to the towns in the evening.

Bus Adapted to Rail Service

The photograph of the bus, on the rails at the Winchester station, shows the sanding equipment, including sand boxes and jets for rear driving wheels operated by the motorman. A pilot of heavy construction has been built onto the front of the car. The car is heated from the exhaust by a special register that can be cut in and out by the motorman. An ordinary automobile register was first tried, but later rejected since it caused objectionable back pressure.

Previous to operation, the question was raised whether excessive nosing motion of the car would be experienced if operated without a pony truck. Experience has shown that there is no such motion. The steel tires, which are pressed onto the truck wheels, are of standard cross-section for locomotive tires, but ½ in. extra wide and 1 in. thick.

In the opinion of the operators of the Winchester & Western R.R., the handling of passengers on a short-line country railroad, under steam operation, with mixed trains, is a liability rather than an asset. It is believed that expansion of the service now being undertaken will demonstrate that such lines, in many cases, can be operated profitably by motor.

W. B. Cornwell is president of the railroad company and personally supervised the installation. The 2½-ton truck was furnished by the Service Motor Truck Co., Wabash, Ind. The tires were pressed on the wheels by the Midvale Steel & Ordnance Co.

Activated-Sludge Plant for Shanghai

A large-scale experimental activated-sludge plant for Shanghai, China, has been authorized at a cost of about £32,000 on the recommendation of C. H. Godfrey, engineer-commissioner of public works. According to *The Surveyor* of London this project "is largely in the nature of an experiment on a larger scale than the installation in operation for eighteen months."

Terms of Port Compact Between New York and New Jersey

UNDER the terms of the port compact bills which have become law in New York and New Jersey, designated commissioners are authorized to sign a treaty or compact creating the "Port of New York Authority" and pledging the two states to "faithful co-operation" in the future development of the Port of New York. The second Port Compact Bill, now law in New Jersey but at this writing not yet enacted in New York, provides the means of appointment of the six members of the Port Authority, three from each state. The New Jersey bill names as appointees the three New Jersey members of the New York, New Jersey Port and Harbor Development Commission which has submitted a "comprehensive plan" for the development of the Port of New York, at the same time recommending that a port treaty be enacted. The second bill in New York State delegates the power of appointment of the three New York members to the Governor, with confirmation by the Senate, but provides, as does also the Compact itself, that two of them shall be resident voters of New York City.

The agreement creates the "Port of New York District" including Jamaica Bay to the east, White Plains at the north, Paterson, Summit and New Brunswick on the west, and Sandy Hook on the south (see comprehensive plan of bi-state commission, *Engineering News-Record*, Feb. 10, 1921, p. 271). The Port Authority shall have power to purchase, construct, lease or operate any terminal or transportation facility within the port district and such additional powers as may later be conferred upon it by the two legislatures or by act of Congress. However, under powers now delegated by the agreement, no property shall be taken by the Port Authority without the consent of the state, county, or municipality where located, nor shall the powers of any municipality to develop port and terminal facilities be impaired.

All the foregoing powers may not be exercised by the Port Authority until the legislatures of both states shall have approved a "comprehensive plan" for the development of the port and either state may withdraw from the compact if such a plan is not adopted by both states before July 1, 1923. The second bill states that the Port Authority shall report to the two legislatures before Jan. 1, 1922, the results of studies, investigations and public hearings, which it is charged to conduct previous to that time, and shall submit a "Comprehensive Plan for the Development of the Port District" based upon such results. As soon as practicable the legislatures of the two states shall adopt plans for the development of the port, according to the compact.

From time to time the Port Authority will make plans for development and submit them as recommendations to the legislatures of the two states or to Congress. When adopted by the legislatures such plans shall be binding with the same force as if incorporated in the treaty.

The Port Authority is authorized to petition any governmental body in matters of transportation development of the port and "it may intervene in any proceeding affecting the commerce of the port."

Each state obligates itself only to an expenditure of $100,000 per year until revenues from operations conducted by the Port Authority are adequate to meet all expenditures. The Port Authority shall not pledge the credit of either state, except by authority of its legislature.

In addition to outlining the terms of the Port Compact, the first bill in each state authorizes the commissioners signing it to obtain the approval of Congress.

The second bill, providing for the appointment of members of the Port Authority in each state, appropriates the sum of $100,000 for the expenses of the Port Authority. In New Jersey the power of appointment is vested with the Senate of the Legislature. In New York this power is delegated to the Governor. The members are charged with the duty of taking up and studying the joint report of the New York, New Jersey Port and Harbor Development Commission and "more especially the recommendations contained therein," conducting investigations and public hearings. Terms of office of the three New York members of the Port Authority expire July 1, 1924, 1926 and 1928, and terms of the three New Jersey members expire as follows: J. Spencer Smith, July 1, 1923; De Witt Van Buskirk, 1924; Frank R. Ford, 1925. However, each member shall hold office until his successor has been appointed or qualified.

L'Enfant, a Tribute to City Planner

THE Digges-L'Enfant-Morgan papers on the beginnings of our National Capital have been added to the Library of Congress by bequest of Dr. J. Morgan. The following tribute to L'Enfant, with some information regarding the papers, taken from the Report of the Librarian of Congress for the year 1919-20, will be of interest to engineers and city planners:

Pierre Charles L'Enfant was born in or near Paris in 1754. With other young French officers he came to this country to fight in the Revolution; he was severely wounded while leading an attack on Savannah and later was captured at Charleston. He was known personally and as an engineer by Washington, Lafayette, and the French officers; after peace came, L'Enfant altered the New York City Hall and designed a house for Robert Morris in Philadelphia; and when Congress entrusted to President Washington the task of planning the permanent capital, L'Enfant applied to be appointed and was entrusted with the work. He brought to his task a first-hand knowledge of the plan of the royal city of Versailles, a comprehensive grasp of the elements that go to make up a seat of government, and an imagination which a century and a quarter of unprecedented national growth has not outstripped. His plan is the basis of all that is noble in the design of Washington, and also the guide for future development. Hence the papers that embody his ideals have an increasing significance as the City of Washington develops as one of the great capitals of the world. If struggles with landowners and speculators exasperated George Washington, it was to be expected that the high-spirited French visionary, whose lively imagination saw beyond today, would go down before them. He did no great work after 1792; yet he lived until 1825, and his tall, well-proportioned figure, arrayed in bell-crowned hat, long coat, and knee breeches, was daily seen making its way over the stump-strewn streets of the new capital which he designed but for which others were getting the credit.

During his last year L'Enfant—proud, penniless, but always a gentleman—found a home first with his bachelor friend, Dudley Digges, of Warburton (near Fort Washington), and after the death of Mr. Digges with his nephew, William Dudley Digges, of Green Hill, Md., just beyond the District line. From this grandfather, Dr. James Dudley Morgan inherited the papers left by L'Enfant, and to them he added many other gathered during the long years he spent in bringing about the removal of L'Enfant's body from its obscure burial place on the Digges estate and its interment at Arlington, after imposing ceremonies in the Capitol.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Reasons Advanced Against Laws Requiring Registration of Engineers

Sir—On March 30, at the request of President Aertsen, of the Engineers' Club of Philadelphia, I appeared before the Pennsylvania House Ways and Means Committee at Harrisburg as a member of a delegation from the club in connection with House Bill 204, providing for the registration of professional engineers and land surveyors.

The club having expressed itself through criticisms which had been embodied in amendments suggested to the committee, I was left to address the committee as an uninstructed individual. As I had not seen the bill until late on the preceding afternoon, I was uninstructed in more senses than one.

Ostensibly the object of the bill is "to safeguard life, health and property." I expressed the conviction that not only that particular bill, but registration in general, is unnecessary and impotent to that end. I submitted that engineering works of sufficient magnitude to menace life, health and property to an extent calling for special legislation were usually in the hands either of governmental departments or of capitalists who, in their own interest, would employ only engineers who could easily pass the examinations which the proposed registration commission would be likely to set up.

As notable cases where engineering operations had wrought large-scale injury to life, health or property—injury which a registration act would not have prevented—I mentioned (1) the collapse of the Quebec bridge, whose engineers would easily have qualified under any probable registration commission, and (2) the cave-ins of Scranton, Pa., over coal mines whose pillars had been robbed to such an extent as to cause the disaster, a disaster which would probably have occurred in spite of the pending bill, if it had been in force.

I submitted that the safeguarding of life, health and property might be more simply and more effectively accomplished by so heavily penalizing those responsible for accidents as to render the accidents improbable. Of course, I pointed out (although idly, under the circumstances) the absurdity of tolerating 48 different registration acts, passed by as many little sovereign states, for the hamstringing of engineers and for the emolument of their brethren of the legal profession.

I left the committee room better instructed than when I entered it. My instruction came through the arguments of the gentlemen (mostly or all not of the Philadelphia Engineers' Club) who spoke in unqualified support of registration. These arguments showed me that, in speaking of the ostensible object of the bill (the safeguarding of life, health and property), I had been merely beating the air, that the primary object of registration is the transformation of engineering from a profession into what Dr. Herbert Snow, addressing the committee, aptly called a "craft," and that what its supporters primarily desire is that the State of Pennsylvania shall erect about certain members of our common profession a protective barrage, through which other members shall not be able to penetrate.

There is a suggestion of "craft" in the urging of registration as being primarily for the safeguarding of life, health and property. The arguments advanced before the committee in favor of the registration of engineers left me, more than ever, a free-trader.

JOHN C. TRAUTWINE, JR.,
Civil Engineer.

Philadelphia, April 2.

Professional Engineering Laws vs. "License Laws"

Sir—In the open letter from a consulting engineer of Springfield, Mass., in *Engineering News-Record* of March 31, p. 565, under the title "Does Licensing Make for Responsibility," objection is taken to statements in a recent editorial of yours on the subject; and the statement is made that "license laws . . . so far as I have been able to determine, have never accomplished anything except bothering competent engineers."

The unfortunate part about the acts which regulate engineering practice is that they are so frequently termed "license laws," probably due to the fact that the pioneers in the movement were not careful enough in the selection of the title to designate the purposes of the act instead of the method of enforcing. To an engineer jealous of his vocation the term license is objectionable, but should not be so when considered in its proper meaning of "liberty to do." The term "registration" is equally objectionable in the idea conveyed as to freedom or liberty to do as one pleases. Requirements of registration and licensing are merely means to the end and it is extremely unfortunate that the laws have come to be known by these names.

In all states the practice of law, medicine, dentistry, and other vocations affecting life, health and property, is controlled by law. There are violations of the law and always will be.

These do not vitiate it, but are rather the exceptions that prove the rule. In only fourteen of the forty-eight states have laws been enacted to control the practice of professional engineering and to protect professional engineers.

To the advocates of engineering practice acts this thought stands out in bold relief: Work which is fundamentally that of the professional engineer should be, by law, required to be done by properly qualified engineers; the engineer should be registered and the practice of professional engineering controlled by license. The public pays; the public should be protected.

The engineer should always be encouraged and protected in his vocation that he may better serve his country, his state and mankind.

Those who practise in different states may be inconvenienced at times, but must forget their personal selfishness and realize that such laws are for the greatest good of the many.

It seems like a propitious time to change the names of these laws from the misnomers of "engineers' license law," "engineers' registration law," etc., to something that will more nearly designate the purport and which will at the same time add dignity and prestige to the profession, such as "professional engineering practice law," or "professional engineering law."

GEORGE L. BEAN.

Philadelphia, April 5.

How Shall Engineering Practice Be Limited?

Sir—How will you fairly shut off practice by an "engineering corporation"—and also shut off practice by a single engineer who runs an outfit just as large?

Many engineers operate a large staff of engineers and non-engineer assistants. I consider New York Senate Bill 147 based upon selfish motives and hence unwise. It will cost the taxpayers more money and favor a certain class, which is dangerous.

LOUIS E. BUFF.

Jamaica Plains, Mass., Apr. 6.

[The issue is not one of size, but of legal classing among engineers those who have no engineering qualifications. To do that would not only destroy a possible professional status before the law, but would negative the fundamental purpose of the licensing act, which is to restrict engineering practice to qualified engineers. The issue will be found more fully stated in *Engineering News-Record* of April 7, p. 577.—EDITOR.]

The Antioch Plan

Sir—I have been very much interested in the articles and letters appearing from time to time in reference to the Antioch plan, especially those written by Mr. Morgan and Mr. Morrison.

The conception of Mr. Morgan, in many respects, is a new departure in American education and the plan which has evidently been carefully formulated reminds one of some of the outstanding aims of the German *gymnasia* and *real schulen* of pre-war days in that it apparently contemplates providing training for a selected group of presumably superior intelligence. It is difficult to add to the plan or to make constructive criticism of it. The idea should increase the respect which engineers already hold for Mr. Morgan because of his achievements as one of them.

It is not clear to me, however, that such a plan is fully applicable to the conditions governing state institutions. In these, it is not possible to make a careful selection of student material since entrance to them is not limited to those of super-average ability. As a result the enrolled student body is made up of a relatively large number of those having average ability and smaller and about equal numbers of those having in the one case super-, and in the other sub-average intelligence.

In Mr. Morrison's letter, *Engineering News-Record*, Feb. 24, 1921, p. 349, there is much excellent criticism of our present educational organizations and methods, but also several statements with which many educators will not agree.

While "the average engineering student never has a thought of anything but a good technical job," isn't the answer to be found in the word "average"? Isn't it a general rule that the leaders in business, industry and other human activities are those of superior ability or intelligence? Training men for subordinate positions is not the aim of faculties of engineering of which I have knowledge; if it is, they have failed signally with their brightest students. Certainly, the young engineer must first serve as an assistant until he has acquired experience and judgment.

I am very reluctant to believe that it is the general opinion that the main object of an engineering course is "to shoot the student full of facts, and knowledge, and methods." I do not believe that this aim is that of a large majority of engineering or of general educators. Rather, I am inclined to believe that they seek to train the young (1) in developing and maintaining a healthy body; (2) in perfecting them in the use of the mother tongue; (3) in preparing them to be self-supporting; (4) in preparing them to be good active citizens; (5) in spiritual matters, and (6) for the proper enjoyment of leisure.

Since a large part of engineering education falls under (3) above, it is not easy to compile a curriculum which will not contain a certain amount of narrowness. The time for the mastery of the fundamentals of engineering and business is, after all, so short that but little remains for training designated under the other heads, though a first rate educational organization will avail itself of every opportunity to direct attention to and emphasize the importance of these aims.

Such subjects as algebra, analytical geometry and calculus are surely not as useless as Mr. Morrison believes. There is nothing in engineering that cannot be worked out by arithmetic if one but lives long enough to do the work that way. If graduates in engineering do not recognize the opportunity for time saving in the use of higher mathematics, the blame cannot be placed upon the subject.

Mr. Morrison's reference to the resemblance between the present day college and an automobile factory is certainly true and very amusing, although the automobile factories usually operate in summer. A course in engineering does not consist of so many credits which make a grand total. It is a four- or five-year course made up of subjects which should be closely correlated. The entire curriculum should be carefully considered in detail and the sequence of courses with overlapping and repetition, to emphasize the fundamental principles, should be carefully planned.

I agree heartily with the statement that training in etiquette should be provided—perhaps by confidential heart to heart talks with the classes, by correction whenever necessary, and at all times when conditions are right for driving home such points.

In the course in Civil Engineering given at the Oregon Agricultural College it is the aim to develop character and appreciation, and to make the students as expert as possible in the fundamental subjects in engineering; to provide training in the fundamental principles of business, and government; to provide practice in the use of both oral and written English by means other than those furnished in formal English classes, and to provide training in scientific and efficient methods of analyzing, computing, and recording data. Attention is also given to the necessity of doing one's part in local, state and national movements whenever possible. The attitude of the students in this work is most gratifying. They seem to be very enthusiastic and alert.

It is to be regretted that more engineers do not, as Mr. Morrison has done, offer constructive criticism on educational matters. The national engineering societies have not taken the active interest in engineering schools that they should. They could and should do for engineering colleges what the American Medical Association has done for schools of medicine.

STUART SIMS,
Head, Department of Civil Engineering
Oregon Agricultural College.

Corvallis, Oregon, March 21.

Pin Tests Open to Question

Sir—The article "Higher Stresses for Bridge Pins," in *Engineering News-Record* of Mar. 24, p. 502, seems to demand some comment.

Partial test data are given for bending tests on wrought-iron and steel "pins." For one set characterized as "comparatively short" cylindrical beams the ratios of length to diameter range from about 6 to about 16; for another set 8 to 16; and another 2 to about 10. Certainly it is going far to characterize a beam, the maximum depth of which is $\frac{1}{6}$ the span length, as a short beam or as a pin. This point is brought out to show that so far as the ratio of length to depth is concerned, the test specimens would appear to have been in most cases ordinary, or comparatively long, beams.

No information whatever is given as to the methods of the tests in the very important features of kind and character of supports, point of application of load, and method of determining elastic limit and ultimate strength.

Referring to the diagrams, I can see no justification for suggesting that the elastic-limit points lie on inclined lines. To my eyes they show moderately small deviations from horizontal lines, which is in accordance with our accepted theory of the strength of beams. The elastic limits, however, being double those obtained in tensile tests, certainly seem open to suspicion, either that there was something wrong with the test data or derivations, or that our theory of the strength of beams is entirely wrong. It is noted that elastic limits are not shown for the Watertown Arsenal tests. It is, of course, well known and explained by theory that the ultimate strength of such beams is greater than indicated by the theory which applies within the elastic limit, although it is necessary to define what is meant by ultimate strength. In the case of wrought-iron and structural steel beams of this form there should be no such thing as *rupture* from such tests.

The author's explanations of the high stresses confuse the tests with the general case of pins in structures and do not seem to satisfy regarding the abnormal elastic limits shown.

In view of the above I believe it must be generally agreed that there is much to be explained in the test data before they can be accepted either as sustaining the author's deductions or, what is more important, as upsetting the established theory of flexure. The tests should be further investigated, and it is hoped that the author will do so and publish in your columns all the additional information possible to aid in checking the data furnished and their application to practical use.

In the determination of the strength of pins in bridges there has always been the great difficulty of determining the true bending stresses. As ordinarily figured these stresses have been found extremely high without visible signs of overstress as noted by the author of the article. The prevailing thought among bridge engineers has been that the stresses have not existed, but were merely fictitious results of erroneous methods of figuring. There are some cases, however, where the packing of pins is not close and it is certain that the bending stress can be closely approximated by theoretical computation. If the stress is too high, especially if the elastic limit is exceeded, it may be the cause of changing the distribution of the loading among the members connected and thus causing overstrain in some of them.

A. W. CARPENTER,
New York Central R.R.

New York City, Apr. 4.

Rammed Earth as a Building Material

Sir—I was interested in the article in *Engineering News-Record* Feb. 10, p. 267, on the use of rammed earth as masonry in building construction. The author of the article writes as though the idea is new. In fact it is one of the most ancient methods of wall construction. I have run across such buildings in China, Japan, Egypt and France, some of them having been standing for centuries.

Early in 1917 I was sent to France on a mission which led to the making of a careful study of building methods there. On the first trip to the devastated regions I was struck with the complete demolition of buildings by shells. It seemed odd that stone buildings should have fallen into heaps and that two years' rain made them assume the appearance of heaps of dirt with stones sticking out here and there. On examination I found that the majority of stone buildings had been laid up in clay mortar; and that the joints had been raked, only an inch or so in depth of the face of each joint consisting of regular lime or cement mortar.

I discovered hundreds of buildings constructed of rammed clay. Some had heavy wooden frames, like our well-known half-timber construction, the interstices of which were filled with tamped clay. I also observed natives erecting new houses with this material, which is known as *pisé*. Some of the houses were made of tamped clay containing considerable grass and straw, while others were entirely free of all vegetable matter. Over the face of each wall was laid a thick plaster coat of lime, or cement mortar for protection against the rain.

From *La Construction Moderne Pratique*, by Henry Guedy, architect, and consultant to the council of the prefecture of the Seine, published in Paris, the following paragraphs are taken, to illustrate the knowledge French builders have of the material.

Pisé is a method of building with earth which is even more simple than building with hollow tile. This economical method forms solid structures proof against fires. Whenever walls of pisé are well made they consist of but one piece, and when covered with a good coat of mortar they will last several centuries provided they are not exposed to moisture. This mode of construction is employed only in those localities where stone is hard to find, and then only for structures of no great importance.

All earths which are neither too fat nor too lean may be used for the making of pisé. The best is a clear earth with a little gravel, for it will hold together in a ball while being put into the wall and it is necessary to break it to get it out. To prepare the earth it is necessary to crush it and then put it through a screen of average size to take out stones larger in size than a nut. If the earth is too dry it is moistened by sprinkling.

One may also make a mixture of clay and sand, with clear earth in the following proportions: (1) 4 parts clay, 1 part of sand, 1 part of small gravel; (2) 2 parts clay, 1 part sand, 2 parts vegetable earth; or (3) 1 part clay, 1 part small gravel, 2 parts vegetable earth.

In many departments there is added to these mixtures, by kneading into them, some straw or hay to prevent fissures in the construction when it dries out.

Walls of pisé are made in two ways: (1) By depositing the mixture of earth and straw in positions determined by stretching cords; (2) by placing the masonry between two panels about 2 meters x 0.80 meter, held in position at a distance equal to the thickness of the wall. Between these plates the pisé is placed in well-tamped layers. When one level is filled the supports are withdrawn and the box is replaced for the next layer. The holes left in the wall by the pieces connecting the wall forms are filled with the earth.

A coating formed of 1 part of lime to 4 parts of clay and sufficient hair to bind the mass well together makes the pisé resistant to the action of air and rain. This coating should not be applied until the wall is very dry; the drier it is the better the coating adheres. A coating of plaster may also be used. No matter how well the coating is applied this style of construction is very susceptible to absorption of moisture. The walls should have a foundation of brick or stone.

I noticed at Abainville a number of buildings of pisé constructed by our men for use as barracks, etc. Such construction was used at other points as well. Coming back to our own country I ran across tamped earth buildings in the western part of Kansas, in Idaho and in California, built by early homesteaders. Remains of such structures may be found today near the more prosperous appearing farmhouses which succeeded them.

FORMER LIEUTENANT-COLONEL, A. E. F.

New York, Feb. 12.

Too Great Concern Over Sea Water Concrete

Sir—The article in *Engineering News-Record*, Jan. 20, 1921, entitled "More Observations of the Effect of Sea Water on Concrete" provokes the complaint that a great deal is being written on this subject with very insufficient and often without any reliable data as to the quality of the concrete which is deteriorating so rapidly in the presence of sea water.

The author of "More Observations" keeps assuring us that the concrete he examined had every appearance of being the very best or as good as could be expected under ordinary inspection. He sits as judge and jury and condemns concrete generally on the visual evidence, while he admits that "no attempt was made to trace the history or learn the precise design of the structure."

The failure of concrete structures is by no means confined to the sea coast. Many more millions of dollars have vanished in failures than are represented by the concrete structures on the Pacific Coast and many are the millions involved in steel structures that have failed, to say nothing of stone and brick that have failed as ignominiously. The reports of these failures add very little to our knowledge and do little toward preventing a recurrence of such failures, unless they are accompanied by detailed information as to the sufficiency of design, quality of materials, workmanship and supervision.

The Pacific Coast piers mentioned are, with one exception, pleasure piers built by development companies in about the same manner as all such structures have been built for these companies the country over. They all look woefully alike a year after they have served the purpose for which they were built.

The only pier mentioned which could serve as a criterion as to what to expect from properly made concrete in the presence of sea water, has been dismissed with the observation that while it did not show signs of disintegration, this was probably due to the presence of a coating of scum from the oil floating in the harbor which no doubt acted as a protection. This certainly suggests a very cheap method of overcoming the difficulty, if a coating of oil is all that is needed.

The truth of the matter is that if we take, out of stock, cement of dubious origin, waive inspection, mix it with sand varying in quality from broken shell to disintegrated feldspar and broken stone, which may range in fitness from marl to mica schist, whirl it once or twice round in a mixer with water from the handiest source added until the mass is soupy enough to satisfy the foreman, and then dump it into leaky forms with little or no spading, we will have a concrete which cannot be expected to stand up under any circumstances, in sea water or out. The commission of all of these offences is by no means absolutely necessary to account for the conditions observed on the Pacific Coast. One or two are amply sufficient.

The San Pedro piers were designed and built under the supervision of the municipal engineers of Los Angeles. The plans and specifications were carefully prepared and their intent secured by proper inspection from the time the cement was being manufactured until the forms were removed from the finished concrete. Some of these piers in the Outer Harbor have been in place since 1914 and it would be interesting to hear from those who are now responsible for their maintainence just how this concrete is being af-

fected by its exposure. It would also be interesting to know whether the choice of creosoted wooden piles for the Santa Monica pier took into account the well-known appetite of the Pacific teredo for creosoted lumber.

A cement, whose manufacture, according to standard specifications, is assured by sufficient inspection and testing, with a fairly clean siliceous sand, clean, hard and sound gravel or broken stone, mixed in the proportion of 1:2:4 for at least 1¼ minutes in a power driven mixer, with just enough water to make a free flowing velvety mass, placed in tight forms and thoroughly puddled with spades or rods, and then wet down periodically for a week after it has set, will produce a concrete which need cause no anxiety, though exposed to sea water. If the concrete is reinforced with steel, this should be so placed and held in the forms that none of the metal or its fastenings shall come within 1½ in. of the finished surface.

In the case of concrete piles, the reinforcing should be sufficient to amply provide for the bending strains developed in handling. These should cure on shore for four weeks before they are put in the water, and if cast in tiers, should be so supported as not to be subject to bending while green.

Concrete piles should be jetted, or jetted and churned down, in hard material. In fairly soft material, a steam hammer may be used, if a cushion block is inserted between the pile and the hammer. The steam hammer is also useful in bringing a jetted or churned pile to firm bearing. A drop hammer should never be used on a concrete pile. Overdriving, a frequent source of failure, should be carefully avoided.

It is not the purpose of this communication to suggest remedies for the defects observed in concrete, but rather to impress on those who write concerning these defects the need for furnishing sufficient data to enable us to avoid materials and methods which have been found to be pernicious and detrimental to good results. F. J. LITTER,

New York, March 31. Chief Engineer, Snare & Triest Co.

[Mr. Litter reads into the article much that was not in the mind of the writer. Concrete is not condemned generally nor was lack of historical data concerning the structure concealed. It may be that all of these Southern California piers were built of poor material and with poor methods, (though they are by no means all "built by development companies") and a complete study of their condition would require that such investigation be made. But the article in question was frankly only "some observations" of the effect of sea water on concrete which, whatever its antecedents, had superficial integrity. That reinforced concrete which appears to be good can so rapidly break down in sea water is, to our mind, useful information.

It is not quite fair to say that there are plenty of similar failures in inland concrete, for this particular type of failure is peculiar to sea water reinforced concrete. Nowhere else appear the hair cracks over reinforcement, progressing through well defined stages of discoloration and rusting to ultimate breakdown, while the main body of the concrete remains solid and unimpaired. In this type of failure there is no evidence of submission of the concrete itself to sea-water attack. It is merely that there is sufficient porous admission of corrosive salts to the steel to cause rupture of the concrete from expanding rust. Obviously, better—which is denser—concrete will resist such porous admission, but such a remedy is only qualitative and all observations of existing structures show that it is one whose effectiveness is by no means assured. Some rules—as quoted in Mr. Litter's letter—say that it is possible to make the concrete so dense that the salts cannot get beyond 1½ in.; others go so far as 3 in. But if the salts can go ½ in. (and they must go that far, in the minds of the makers of such rules, or else the minimum covering would be made less), why cannot they go farther? The material is homogeneous except for a thin surface skin.

In other words, the problem of sea water reinforced concrete is not to be solved by generalities regarding good concrete. Much work is yet to be done and many more structures studied comprehensively. In this latter contention we are in complete accord with Mr. Litter.—EDITOR.]

Useful Dodges in Surveying

Sir—Some of the statements embodied in Mr. Thackwell's letter in your issue of Feb. 17, p. 313, are so sweeping in character that they should not go unchallenged. I note, with pleasure, that he has specified some fundamental conditions governing map work, but he has not gone far enough. In addition to his "scale, contour interval and topography," I would mention *quality*.

Usually the scale that will best fit the intended use of the map is determined first and then a contour interval is selected. Theoretically this interval should be selected so as most accurately and consistently to portray the terrain. In practice, however, the ideal relation of scale and interval is often not considered. To say it is never advisable to construct a map on a scale of, say, 400 ft. equal 1 in. with a contour interval of 10 ft., where an accurate representation of the terrain would require an interval of 2.5 ft., is too broad an assertion. There may be instances where a "picture map" upon some specified scale is all that is required. Such a map, however, could hardly be called a topographic survey. Why not make such a picture map upon a scale of 1,000 ft. equal 1 in. with the 10-ft. contour interval? Then with the same expenditure of money a map would be consistent—that is, no accuracy would be indicated which was not inherent in the map.

One of the controlling factors in mapping comparisons, which Mr. Thackwell mentions, is topography. I must take exception to his statements that the "mapped area was a fairly rough section," and "the distance between shots should average a distance in feet equal to the scale of the map in feet per inch." Both of these things may be true in any particular case, but the distance between shots is not a function of the scale alone, but is dependent upon the frequency with which critical points or breaks in the ground surface occur. This distribution and frequency of critical points is best described by the term "texture"; the area referred to, doubtless, was of coarse texture. Aside from the relative advantages of the plane-table or transit there is no room for debate upon this question: The distance between shots should *not* average a distance in feet equal to the scale of the map in feet per inch for any or all types and textures of topography, unless a picture map is all that is being constructed.

It is difficult to define exactly what constitutes a good—or the best—topographic map. It should be defined in some way, however, before comparisons as to methods and speed are entered into. In general, a map that, upon actual test, shows an average vertical error greater than the contour interval should either have a larger interval or be made over again. There should be a balance between the field procedure and the results obtained which would insure that the average error in the horizontal or geographic position of points should not greatly exceed the smallest distance which can be plotted upon the given scale. I believe that the average vertical error should not exceed half the contour interval and that the horizontal error should *in no case* exceed twice the smallest plotting division and should, *in the average*, be within one division.

It should be borne in mind that the map Mr. Thackwell discusses is a map of a particular type of country and his conclusions as to the best methods can only apply to that same general type of country. No definite statements are made as to accuracy. I assume that it was of sufficient accuracy to fully serve his purposes, but it would even be hardly fair to assume from that, in the absence of any such definite statements, that it would serve every other use equally well.

Regarding methods I am of the opinion that if any combined method is to be followed it would be better to flatten out the top of the "easel" (thus making it a plane-table) and in place of a protractor use a small sight alidade with a compass attached, eliminating thereby the useless reading and setting off of the horizontal angle with its two chances of error; also place the topographer at the table and the recorder at the transit. This combined method is suited to all types of topography where the contour sketching is light enough so that a skilled topographer can keep up with the instrument man's data. It is the speediest

method known, but the unit cost will generally be no lower than that obtained by a trained topographer using a plane table, *no* recorder, and two or more rodmen. Therefore, where the area to be surveyed is uniformly light sketching, use the combined method, transit and plane table. Where it is for any considerable portion heavy enough to justify the reading of many vertical angles and the use of a recorder, use the regular plane table party of topographer, recorder and one or more rodmen; and in the light portions, where the recorder is not necessary, hand the recorder a rod.

In support of the plane-table method as herein advocated I quote the following examples with which I am personally familiar and the complete facts regarding which are matters of record:

In the course of the topographic survey of Flint, Mich., now being made (see *Engineering News-Record*, April 8, 1920, p. 700), the record progress for a day's work by one plane table party was 194 acres in 8 hours. This survey is on a scale of 1 in. equal 200 ft. and a contour interval of 1 ft. The area covered was in the outskirts of the city, and was fairly level farming land. One main road ran through it, with its consequent ditches, private drive crossings, culverts, etc., and included in the area were fields of corn and some timber. The party consisted of a topographer, a recorder, and two rodmen. The number of shots was 746, or 3.8 per acre and the cost per acre was approximately 13 cents.

The record day's work on the topographic survey of Lucas County, Ohio, was 280 acres, the party consisting of a topographer and two rodmen, the scale 1 in. equal 400 ft., and the contour interval 1 and 2 ft. This area was very similar to the Flint area mentioned above in respect to the type of topography, visibility, etc., and is on the outskirts of the city of Toledo. The cost per acre of this day's work was slightly over 6 cents. As to the accuracy of these surveys, reference is made to the account of the Flint survey above mentioned and to the table given below.

Survey	Scale	Contour Interval	Length of Profile	Relief	Number Points Tested	Average Error per Point
Dayton, O.	1:2400	1	3162 ft.	51 ft.	50	0.55 ft.
Jackson, Mich.	1:2400	1	3150 ft.	38 ft.	52	0.53 ft.
Lucas Co., O.	1:4800	1, 2	8035 ft.	26 ft.	105	0.41 ft.
Flint, Mich.	1:2400	1	6423 ft.	30 ft.	130	0.26 ft.
Akron, O.	1:2400	1, 2, 4	2851 ft.	70 ft.	41	0.47 ft.

I do not agree with Mr. Thackwell, and in answer to his attack upon the plane-table method I can say that I have never known the transit to win out in competition with the plane-table method, but have repeatedly known it to fail in side-by-side comparisons; that the combined plane-table and transit method recommended herein is essentially a plane-table method and is fully equal, if not superior in speed and excellence of results, to the method described in his letter and for use in the type of country with which he has to deal; that in topography that is rougher or finer textured the regular plane-table method in the hands of a trained topographer will make a better map for the same money than his method; that regardless as to whether or not "expressive delineating" is ever inaccurate, it is not within my knowledge that a "wooden" map ever made for accuracy. In short, while I have no desire to detract from Mr. Thackwell's work or to imply that it was in any way any thing else than entirely satisfactory for the purposes for which he made his maps, I take exception to all his claims of exclusive superiority for his method and to his arraignment of the plane table.

The plane-table method, used by a trained topographer, is for all scales and in the vast majority of cases the best means yet discovered for really accurate topographic mapping.

G. D. WHITMORE,
Topographic Engineer, R. H. Randall & Co.

Akron, Ohio,
March 4.

Sir—I have been very much interested in Mr. Thackwell's further explanation of the method he uses in making topographic maps as published in your issue of Feb. 17, p. 313. Engineers, especially the younger men, who are interested in topographic work, are entitled to statements of fact rather than to differences of opinion in regard to the comparative merits of various methods. Since Mr. Thackwell states that "in no case would the Survey use a 1 ft. contour in connection with a scale of 1:24,000," I feel that it is right that topographers should know that the U. S. Geological Survey has adopted precisely the contour interval and scale he mentions. During 1915 and 1916 the Survey mapped Harris County, Texas, on a field scale of 1:24,000, using a 1-ft. contour interval. The resulting maps are published on a scale of 1:31,680. The following quadrangles are some of those now available to those interested—Deepwater, Seabrook, Crosby, Hillendahl, LaPorte.

On my topographic work in Montana, Arizona and elsewhere in the West where I have seen maps which were made by transit and stadia methods, I am convinced that often 30 per cent of the shots taken were wasted and meant nothing either to the project or in making the map. Such waste will continue as long as the fundamental conception of a contour line is that it is a line joining points of equal elevation. When engineers realize that such a definition is not precise and will base their work on the fact that a contour line is a line each point of which has the same elevation, we will have maps made by real topographers who will insist on intelligent control of the rodmen in fixing the critical points of the master lines of the ground.

Further facts in relation to topographic scales to illustrate foreign practice are given in the following table. Comparison of vertical intervals is brought to a common term (the 1-in. scale) by multiplying the contour interval in feet by the scale in inches to the mile.

France 1:50000	32
France 1:80000	52
Great Britain, Ordnance Survey, 1 in.	50
Great Britain, Ordnance Survey, Colonial	50
Great Britain, Ordnance Survey, 1 in.	100
Great Britain, India, 1 in.	50
Great Britain, South Africa, 1:125000	50
Germany, 1:200000	20
Germany, 1:250000	8
Germany, Prussia, 1:25000	41
Germany, Bavaria, 1:25000	81
Italy, 1:50000	20
Italy, 1:100000	101
Spain, 1:50000	81
Mean	49

From this table the following rule may be deduced: The contour interval in feet is found by dividing 50 by the number of inches to a mile in the scale.

Switzerland is an exceptional case where, on account of the mountainous character of the country, hill features are seldom shown by contours alone but by a combination of contours and hill shading. The following intervals are in use there: For the 1:25,000 map, 10 meters; for the 1:50,000 map, 30 meters.

In the United States, the rule in most general use to find the proper contour interval for any scale is to divide 60 by the number of inches to a mile in the scale. While these rules will not always apply to any area it is believed they will be helpful to topographers. Mr. Thackwell and I are certainly in agreement on at least one point, and that is a common pride in good topographic work.

L. B. ROBERTS,
New York Water Power Investigation.

New York City,
March 14.

Current American Shipbuilding

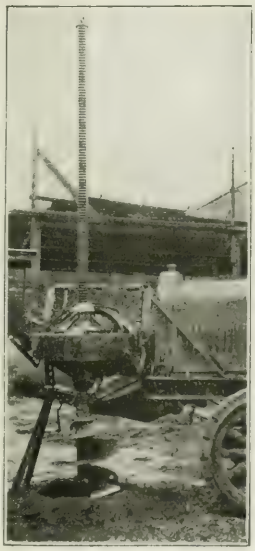
On March 1, 1921, private American shipyards were building, or were under contract to build, for private shipowners 227 steel vessels, of 901,229 gross tons, compared with 252 steel vessels, of 977,903 gross tons on Feb. 1, 1921. The shipyards have reported no new contracts during February. These figures do not include Government ships or ships building or contracted for by the United States Shipping Board.—*Commerce Reports.*

HINTS FOR THE CONTRACTOR

Earth Auger Attached to Motor Truck Speeds Hole Digging

By Marshall Garlinger
San Francisco, Cal.

In 1914, when the first transcontinental telephone line was being constructed, there arose the necessity of an improved method of boring holes for poles. A power-driven auger, mounted on the rear end of a horse-drawn wagon, was purchased and put into use. The machine was driven by a four-cylinder gasoline engine and required a team of four horses to draw it. The difficulties experienced in moving this outfit and in spotting the boring machine over the points where holes were to be dug resulted in the invention by two officials of the Pacific Telephone and Telegraph Co., Motor Vehicle Department, of the device herein described.



AUGUR BORES SIX-FOOT HOLE IN SEVEN MINUTES

The earth-boring machine which is photographically reproduced herewith is mounted on the front end of the chassis of a motor truck. Because of the rough country usually encountered a four-wheel drive truck was found to give the best results.

The mounting of the boring machine is such that it is possible to bore a vertical hole with the truck on any negotiable grade, and it is also possible to bore a hole at any angle up to 45 deg. from the vertical with the truck on the level.

The machine is driven through a universal shaft from the power take-off of the truck transmission. Since there are four speeds and a reverse in the truck transmission the earth-boring machine may be driven at a wide range of speed, thus adapting it for work in soils of different nature, such as adobe, clay, sand, hardpan, etc.

The controls of the machine and that of a derrick situated in the middle of the truck for pole handling are within easy reach of the truck driver. Inasmuch as the left-hand drive on automobile trucks is almost general the auger of the boring machine is placed on the left-hand side of the truck in plain view of the driver.

The driver spots the point of the auger on the surveyor's stake and sets the brakes on the truck, shifts the compound gear of the truck to neutral and pulls in the clutch on the earth-boring machine. The auger is fed mechanically or by gravity. In boring the speed of the auger is usually such that the earth is thrown clear of the hole. A hole 6 ft. deep, 22 in. in diameter, can be bored on an average of 7 minutes, considering all classes of soil.

The cutting edges of the auger, which are replaceable, are two in number, placed at an angle such as is found in a standard twist drill. A feature incorporated in the auger gearing is the immediate and automatic reverse of the auger speed in case the auger strikes a hidden obstruction. This precludes the possibility of any injury to the driving mechanism.

Salvaging Used Bricks With Pneumatic Chipper Tool

A prominent engineering construction company recently adopted a method of salvaging old bricks whereby it was enabled to clean 3,000 brick per day at a saving of 75 per cent in cost over the previous average of 650 brick per day by hand. The work was done with a Boyer chipping hammer made by the Chicago Pneumatic Tool Co., and fitted with extra wide-faced chisels forged from stock blanks. The bricks were more uniformly cleaned than was possible with ordinary unskilled labor, and the number cleaned per day was nearly five times that of former hand methods. The blows delivered by the hammers were not heavy enough to damage the bricks yet sufficiently effective to remove all old mortar and dirt.

PNEUMATIC CHIPPER FOR CLEANING BRICKS

The work was accomplished on tables. About 100 bricks were cleaned at a time. The bricks were laid side by side on the table. When so placed the bricks formed a comparatively flat surface measuring 12 ft. x 3 ft. The arrangement enabled the operator to clean 100 bricks on one side before turning them for cleaning on the ends and other side.

The labor cost of 40c. per hour was the same as for hand methods. The cost of compressed air averaged two cents per hour per hammer. The cost per thousand bricks exclusive of any charge for tools and equipment, hand cleaned, was $5.55, mechanically cleaned, $1.26.

Electrical Indicator on London Subway

An electric indicating device has been installed on the London Metropolitan Underground Railway. At the boarding steps on each car the passenger is confronted by an illuminated list of stations at which no stop will be made; inside the car, within view of seated passengers, is a similar indicator. Along the center of the car is a series of panels each representing a station, each of which is illuminated in turn to indicate the next stop.

NEWS OF THE WEEK

New York, April 14, 1921

Hudson River Bridge Association to Be Incorporated

At a meeting held in New York City April 6, it was decided to incorporate the Hudson River Bridge and Terminal Association following the meeting of prominent business men last December for the purpose of forming a permanent committee to advance the project of building a suspension bridge across the Hudson River according to plans prepared by Gustav Lindenthal.

The decision to incorporate was through a resolution from the organization committee, the chairman of which is Otis H. Cutler of the American Brake Shoe and Foundry Co. Others on the committee are Samuel Rea, president of the Pennsylvania R.R.; Thomas F. Ryan; L. F. Loree, chairman of the executive committee, Delaware and Hudson Co.; Henry D. Walbridge, president of the Pennsylvania Electric Co., and George F. Post.

The purpose of the association is set forth in a statement issued by the committee as follows:

"To obtain public support for the undertaking, projected by Gustav Lindenthal, an eminent bridge engineer, to build a great double-deck highway and railroad bridge from Manhattan Island to Weehawken, with terminal facilities on both sides of the river for passenger and freight."

Four Candidates Nominated for A. A. E. Presidency

Four candidates for the presidency of the American Association of Engineers have been nominated by petitions and will be voted on at the organization's annual convention in Buffalo, N. Y., May 9-11. They are: Clarence W. Hubbell, consulting engineer, Detroit; Frederic Bass, dean of the department of civil engineering, University of Minnesota, Minneapolis; Harry O. Garman, chief engineer, Public Service Commission of Indiana, Indianapolis; and Daniel L. Turner, chief engineer, Transit Construction Commission, New York.

For first vice-president there have been nominated C. J. Tilden, Washington, D. C.; A. N. Johnson, College Park, Md.; A. B. McDaniel, Camp Dix, N. J.; G. M. Butler, Tucson, Ariz.; and W. J. H. Strong, Chicago.

For second vice-president the nominations are: Raymond Burnham, Chicago; A. S. Morris, Oak Park, Ill.; M. Z. Balph, Pittsburgh; and W. J. H. Strong.

Where a candidate has been nominated for two positions he will be required to choose the one for which he desires to run.

First Unit of Seattle Powe. Plant Soon Complete

The first unit of the Skagit River Development project which will furnish 3,000 hp., and which is being developed by the city of Seattle, will be completed and in operation by June 15, according to engineer in charge, C. F. Uhden. The unit is known as the Newhalem Creek plant, and will furnish power through the use of a 2,700-ft. tunnel driven through solid rock, and a 900-ft. 36-in. steel pipe line leading from a dam located ¾ mile up Newhalem Creek, through which water will pass to the main power station of the Gorge Creek development. This station will house a power unit consisting of an impulse waterwheel and a 5,600-volt 3-phase generator. Work on the tunnel has been pushed all winter, and an average of from 100 to 105 ft. per week has been maintained in driving this 6x 7-ft. tunnel through exceptionally hard rock with the use of Leyner drills.

National Highway Traffic Convention April 29

The National Highway Traffic Association will hold its 1921 convention at the Detroit Athletic Club, Detroit, Mich., April 29. Sessions will begin at 10.30 a.m., 2.00 p.m., and 8.00 p.m. The convention will be devoted to the presentation and discussion of progress or final reports of standing committees. The following list includes some of the subjects pertaining to traffic regulations and highway transport which have been assigned to committees:

Traffic limit lines on roadway surfaces; design of curves at street corners to facilitate traffic; widths of roadways and sidewalks in municipalities; regulations covering speeds, weights and dimensions of motor trucks and trailers; regulation of overloading of motor trucks; impact forces; curves.

Complete programs may be obtained from the president, Arthur H. Blanchard, University of Michigan, Ann Arbor, Michigan, or from the secretary, Elmer Thompson, Automobile Club of America, 247 West 54th St., New York.

To Control Kankakee River

Governor McCray of Indiana, has appointed Charles W. Henley, of Rensselaer; William Darrach, of Kentland, and Thomas Grant, of Lowell, members of the Kankakee River drainage commission to confer with a similar commission appointed by the Governor of Illinois to prepare a program for straightening and deepening the Kankakee River to prevent floods.

Want Federal Highway Commission Created

In Interview With President, Automotive Delegates Express Views on Need for New Body

(Washington Correspondence)

A plea for the establishment of a federal highway commission was made to the President last week by representatives of the automotive industries. It was contended that the administration of the federal government's highway appropriations should not be lodged in a bureau of one of the departments. It was pointed out that the U. S. Bureau of Public Roads is administering the expenditure of a fund greatly in excess of the appropriations of the entire Department of Agriculture.

It is understood that the President will insist upon maintenance being a condition of any future highway legislation. He is said to be of the opinion that the entire proceeds from vehicle licenses should be devoted to maintenance work.

FEDERAL AID CRITICIZED

Roy D. Chapin, chairman of the highways committee of the National Automobile Chamber of Commerce, was at the head of the delegation which called on the President. He told Mr. Harding that the Automobile Chamber of Commerce is opposed to a continuance of federal aid in its present form because he believes the public interest is not conserved fully in the expenditure of the large appropriations which have been made. Mr. Chapin and the members of his committee also discussed highway problems with Thomas H. MacDonald, chief of the Bureau of Public Roads, with the Secretary of Agriculture, the Secretary of Commerce and the Secretary of the Treasury. In reiterating what he has said before Mr. MacDonald outlined his position as to maintenance as follows:

"The task today is to provide highway service; we cannot afford to wait for the construction of new and modern types of highways. The maintenance should be carried forward now on roads improved and unimproved. The returns will more than compensate the cost. If there is one problem which the road builders of the United States as a whole must learn it is that of highway maintenance. The continuity and long radius of operation of the motor vehicle require a development of maintenance organizations and maintenance expenditures not heretofore required; but in the same fact lies, because of the service rendered, the justification for the expense involved. We cannot neglect the simple methods of maintenance which have demonstrated their utility. The harrow, the road drag the blade grader, have a high degree of utility in combination with the motor truck and gas tractor. One state engineer remarked that the widespread use of these simpler maintenance tools in his state saved his whole program of higher cost construction because of the better highway service provided over a large mileage.

Hetch Hetchy Tunnel Work Now on Open-Shop Basis

Labor is now plentiful on the Hetch Hetchy project and more men are applying for work than can be employed. In the month of March the six headings were advanced a total of 1,714 ft. The best progress was at Priest portal where, on a three-shaft basis, the heading was advanced 494 ft. during the month.

The strike of unionized tunnel workers called on the project last August, at which time 100 men quit work, has never been declared off. At a conference in San Francisco between labor leaders and city officials on April 6 no agreement could be reached and city officials announced that further conferences would be futile. The work is now on the open-shop basis. For some time past a full crew of 322 tunnel men have been in the employ of the Construction Co. of North America and the subcontractors.

The men who went on strike in August did so against the orders of union labor leaders. In October when non-union crews had been recruited and the work was again well under way, the unions recognized the strike and endeavored to arbitrate it on the basis of making the tunnel work strictly a union job. Efforts of union labor in that direction have not met with success.

Prof. W. K. Hatt Appointed Indiana State Engineer

Appointment of William K. Hatt, professor of civil engineering, Purdue University, as chief of the division of engineering of the Indiana state department of conservation has been announced recently. This office, known as state engineer, was created by an act of the recent session of the General Assembly, as noted in *Engineering News-Record*, March 31, 1921, p. 570.

Prof. Hatt was selected for the position by the state conservation commission with the approval of Richard Lieber, director of the conservation department, out of a large field of applicants. The new state engineer, who took office April 11, will continue as a member of the faculty of Purdue University. The arrangement under which the state engineer is a member of the state school faculty is similar to that under which the state geologist, who is a member of the Indiana University staff, is selected. The division of engineering promises to become one of the most important bureaus of the state department. Flood prevention and drainage questions will be among the important problems to be solved by the new division. Pollution of streams by industrial plants will also be investigated.

Prof. Hatt has been connected with Purdue University since 1893, but has had a wide professional experience outside his college work. For a number of years he was consulting engineer for the U. S. Forest Products Laboratory, at Madison, Wis., and during the war was connected with the educational work of the war department. For two years he was president of the American Concrete Institute.

New Ferry for New York-Staten Island Service Proposed

A new ferry route at New York from Cortlandt St., Manhattan, to Stapleton, Staten Island, with a connection at 39th St., Brooklyn, has been recommended by the committee on finance and budget of the Board of Estimate of New York City. Three new ferry boats would be built and a new slip constructed at Stapleton. At Cortlandt St., Manhattan, the boats would operate from the northern slip of the three now occupied by the West Shore and Pennsylvania Railroads. While the lease on this slip has two years to run, it is expected to secure its use in the meantime by arrangement with the railroads

Dock Commission Would Replace Ferry with Piers

The Dock Commission of New York City has decided to construct four piers of 150-ft. width, with 332-ft. slips, on the Hudson River from 36th St. to a point between 42d and 43rd Sts., according to announcement last week of Dock Commissioner Murray Hulbert. This would necessitate doing away with the 42d St. ferry of the West Shore R.R. and with Pennsylvania R.R. piers Nos. 76 and 77. Since the ferry is used by large numbers of commuters from New Jersey a hard fight against the proposal is expected.

San Francisco Harbor Control

A bill is now before the California legislature, with a fair chance of passage, transferring the control of the San Francisco water front from the State to the city. Supervision of the harbor is now vested in the State Board of Harbor Commissioners, an independent body which has administered the state bond issue devoted to port works to such good advantage that the port is practically on a self-supporting basis. There are interests in the city, however, that feel that San Francisco may be militated against by the power of rival cities in the legislature and demand that the state turn over the waterfront to the city, as it has already done to most of the other coast cities. The shipping interests favor state control and others fear the dangers of municipal inefficiency and political control should the city be given supervision of the port.

Federal Highway Council

New members have been elected to the executive committee of the Federal Highway Council, Washington, D. C., as follows: W. J. L. Banham, Otis Elevator Co.; David Beecroft, president Society of Automotive Engineers; H. W. Alden, Timken-Detroit Axle Co.; and S. P. Leeds, president, Atlantic City (N. J.) Chamber of Commerce.

California Highway Commission Urges Gasoline Tax

The California Highway Commission has issued a statement that begins with the assertion, "The enactment of a tax on gasoline to provide additional funds for state highway purposes is an imperative necessity if the present needs are to be met adequately." Declaring that money now available is insufficient for four needs that have recently arisen and which were not provided for in the $40,000,000 budget, the commission points out that a gasoline tax of 1 cent per gallon will automatically distribute the burden on those who use the highways most.

The four principal needs are enumerated as follows: (1) To widen and thicken main trunk highways where 1,400 per cent increase in motor transportation has made a heavier duty road an imperative necessity; (2) to reconstruct oil-macadam roads taken over into the state system from counties; (3) to assist impoverished cities to construct links of state highway within their incorporated territory, and (4) to supplement bond funds in restoring the balance between 1917-1918 estimated costs and present-day costs in completing the original system and new roads contemplated when the 1919 bond isssue was voted.

The California state tax on automobiles is not only lower than in other states of equal highway development, the commission asserts, but is below the average for the United States. The tax on the average pleasure car in California is $1.58 per annum less than the average. On the 2½-ton pneumatic-tired truck it is $12.53 below average and on the 4-ton solid tire truck $16.12 below average. These figures the commission cites to show that the California tax is especialy low on the type of motor vehicle which is causing the most damage to the highways.

In conclusion the statement says: "California furnishes in return for the taxes exacted from motor vehicles infinitely more in road service than many states of the union, and equals, if it does not lead, the other states in the mileage of improved roads over which a tremendous and ever increasing volume of traffic is handled. In our opinion the motor industry and organizations should welcome a tax adequate to maintain, improve and extend the state system."

Chicago's "Progress" Exhibition

An exhibition representing modern progress in industrial, civic and educational affairs is to be held at Chicago, July 30 to Aug. 14 on the Municipal Pier which extends 3,000 ft. into the lake and provides two parallel buildings or exhibition halls 2,340 ft. long. The building industry section will have a space 250 x 66 ft., and it is proposed that engineers and engineering societies combine in a cooperative exhibit occupying a portion of this space.

Navy Wants Civil Engineers

Applications are being received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., to fill vacancies in the commissioned grade of assistant civil engineer, Corps of Civil Engineers, U. S. Navy, with rank of Lieutenant (junior grade). The pay and allowances at entrance are approximately $3,200 per annum, with increase up to $9,600, depending upon promotions in rank and length of service. The candidate must be an American citizen between the ages of 22 and 30 years on Aug. 1, 1921; must have received a degree in engineering; must have had not less than 20 months practical professional experience since graduation, and must be of good moral character and repute.

Officers of the Corps of Civil Engineers are detailed principally to the various navy yards and naval stations to supervise the work under the Bureau of Yards and Docks, Navy Department, Washington, D. C., consisting of design and construction of all the public works of the naval establishment on shore as well as the maintenance and repair of existing structures.

Move Made To Charter Civil Engineers in Britain

(London Correspondence)

The Institution of Civil Engineers has just issued a notice to its members announcing that steps have been taken to apply to the Privy Council for the grant of a supplementary royal charter to confer the use of the professional description of "chartered civil engineer." This constitutes a new step in the movement on the part of the Institution to define clearly the term "civil engineer." Two alternatives had been previously considered: (1) A private bill, which was found to be impossible; and (2) a public bill, which was rejected by the council of the Institution. It is hoped that the interests of the members of the Institution will be considerably advanced by the establishment of a definite status for the civil engineer.

Seattle Water Department Shows Operating Profit

According to the 1920 report of the Seattle water department, submitted by Superintendent of Water L. B. Youngs, the department showed a net profit for the year of $487,665. The gross income was $1,301,755 and the expenses $810,090. The present water system is valued at $12,011,530, with outstanding bonds of $3,642,135. The report states that in view of the proposed raising of the water in Swan Lake to increase the reserve supply, the department is building dams at the lake to cost $65,000. These dams will permit of the raising of the water level temporarily to test the basin for leakage before beginning the $6,000,000 project, which includes a tunnel and controlling works and new pipe lines. The dam work will be completed next fall, enabling the department to raise the water to its maximum next winter.

Federation's Executive Board To Meet in Philadelphia

The executive board of the Federated American Engineering Societies will hold its next meeting in Philadelphia, April 16, as guests of the Engineers' Club of Philadelphia. A dinner is to be held at the Bellevue-Stratford on the evening of that date and an address will be made by Herbert Hoover, president of the federation.

It is announced by Secretary Wallace that the work of the committee on elimination of waste in industry is progressing according to schedule. Field work will be completed on or before April 15 and the publication of the final report will be undertaken immediately thereafter. It is expected to publish the report some time in June.

Within the last few weeks two societies have joined the federation, the Boston Society of Civil Engineers and the Engineering Society of Milwaukee. The opportunity of becoming a charter member of the federation expires July 1.

I. C. C. Issues Four Supplemental Tentative Valuations

Four "supplemental" tentative valuations, including a report of the Kansas City Southern property, were issued by the Interstate Commerce Commission April 5 as a result of the decision in the Kansas City Southern case requiring the Interstate Commerce Commission to find additional elements of land values such as cost of acquisition, severance damages, etc. In addition to the Kansas City Southern, reports were issued of the Atlanta, Birmingham & Atlantic Co., the San Pedro, Los Angeles & Salt Lake, and the Winston-Salem Southbound Ry.

The reports are issued in the usual way to the carriers, states, and state bodies, with opportunity to protest within thirty days.

University of Colorado Course in Municipal Design

A course in municipal design, embracing the town plan, streets, water-supply and sewer system, is being given in the senior year of the course in civil engineering at the University of Colorado. The course consists of a recitation period and two three-hour drafting periods per week. The recitation period is used to discuss plans made during the drafting periods, the class acting as a board of engineers. The instructor acts only as chairman of the discussions, the students relying on their own judgment in matters of design. The problem consists of laying out lots, blocks, streets, and alleys, and making plans, specifications and estimates of cost for the municipal improvements of an industrial town. This problem is intended to make a useful application of the fundamental courses of surveying, hydraulics, concrete design, engineering materials, and bacteriology as brought out in the courses in road and pavements, sewerage, water supply, plans and specifications, and estimates and costs. J. B. Marcellus, associate professor of civil engineering, is in immediate charge of the course.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27-30.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

The North Carolina Drainage Association will hold its annual convention April 12 and 13 at Elizabeth City, N. C., jointly with the North Carolina Geological and Economic Survey. Dr. Joseph H. Pratt, director of the State Geological Survey, Raleigh, N. C., is secretary of the drainage association.

The Rochester Engineering Society, at a joint meeting with the Rochester Rotary Club April 26, will be addressed by J. A. M. de Sanchez, director of the economic division of the French Embassy, on the situation in France.

The Western Society of Engineers' board of direction has approved the following nominees returned by the nominating committee for officers for the ensuing year: President, Charles H. MacDowell; vice-presidents, J. L. Hecht, F. F. Fowle and B. B. Shapiro; treasurer, Homer E. Niesz; trustee for three years, E. W. Allen; members Washington Award Commission for three years, Prof. John F. Hayford and H. J. Burt. Additional nominations by petition must be filed before April 20.

The Southwest Water Works Association will hold its annual meeting May 9, 10, 11 and 12 in Oklahoma City. Features on the program include a paper on "Water Collections" by Miss Adella Martin, city clerk, Newton, Kan., who has maintained a record of 100 per cent collections. Several other women employees and owners will take part in the discussion. Health officials of these states will cover water protection methods and there will be a series of fifty 3-minute illustrated talks by superintendents.

Personal Notes

C. C. Haire has been appointed engineer auditor with jurisdiction over valuation and capital expenditures, on the Illinois Central R.R., with headquarters at Chicago, Ill.

W. P. Hayes, formerly assistant engineer, Missouri Pacific R.R., has been promoted to division engineer on the Louisiana division, with headquarters at Monroe, La.

R. G. Bush, formerly assistant engineer in the valuation department, Missouri Pacific R.R., at St. Louis, Mo., has been appointed assistant engineer on the Valley division.

W. F. Lineberger, who was employed in the construction of ports and later in railroad and hydraulic engineering, was recently elected a member of Congress from the 9th California district to fill a vacancy caused by the death of Congressman C. F. Vandewater. Congressman Lineberger was, for a time, a member of the Harbor Commission of Long Beach, Cal., and during the World War was a captain, Engineers, with the 1st, 32nd and 40th divisions.

Henry T. Shelley, assistant engineer, Bureau of Surveys, and for fourteen years in the employ of the city of Philadelphia, Pa., on grade crossing removal and sewers and sewage treatment works, has resigned to become chief engineer of materials and construction for the Eastern Clay Products Association of Pittsburgh.

C. R. Dart, bridge engineer, Sanitary District of Chicago, since 1901, has resigned to open a consulting office in Chicago. His early engineering experience was gained on railroad construction for nine years after graduation from Michigan Agricultural College in 1881 and a post-graduate course in Michigan University. Following employment on the World's Fair at Chicago, he was for a time with S. G. Artingstall, then for one year with Alfred Noble and three years with George S. Morison. Mr. Dart served for many years as the treasurer of the Western Society of Engineers.

P. L. Shen, Kiangsu Grand Canal Improvement Board, China, expects soon to be in this country for eight months to look into hydraulic works and the U. S. Reclamation Service projects. This board was instrumental in bringing to China the American Red Cross Board of engineers.

Howard L. King, formerly resident engineer on construction of acid phosphate plant by the Pratt Engineering & Machine Co. at East Point, Ga., is now engineering inspector on the Hudson River vehicular tunnel, New York.

Holton Cook is now resident engineer with the Kentucky Highway Commission on the construction of a federal-aid road and will be located at Dixon, Ky.

Ernest E. Tupes, for a number of years a designing engineer with the American Bridge Co., has opened an office in Chicago, for the practice of law in relation to patents, trademarks, copyrights and corporations.

Johnson & Benham, Inc., consulting engineers, of New York and Kansas City, Mo., announce the reorganization of their business. All contracts and business of the New York office have been taken over by the George A. Johnson Co., Inc., the members thereof being George A. Johnson, Harold C. Stevens, Nelson B. Wolfe, Charles R. Wyckoff and Harry B. Joyce. The main offices of the corporation are in New York City. All contracts and business of the Kansas City office have been taken over by Benham & Mullergren a partnership consisting of Webster L. Benham and Arthur L. Mullergren.

N. S. Sprague, until recently chief engineer of the Bureau of Engineering, Pittsburgh, Pa., is now engaged in general engineering practice with offices in the Wabash Building, Pittsburgh.

W. O. Sherman, formerly with the Chemical Construction Co., Charlotte, N. C., has been engaged as chief engineer, Carolina Steel & Iron Co., structural steel fabricators, Greensboro, N. C.

Walter E. Spear, formerly department engineer of the headquarters department, New York Board of Water Supply, who was granted a leave of absence to make investigations and reports on water supply and sewerage of Athens and Piraeus, has reassumed his duties as department engineer with the water board.

Fred C. Doolittle, civil engineer and construction foreman, has been appointed highway maintenance engineer for Whitman County, Wash.

Eugene E. Haskell, C. E. and M. C. E., Cornell '79 and '90, will retire as dean of the College of Civil Engineering at Cornell University this June, at the end of his sabatic leave.

E. K. Hatten has been appointed assistant engineer of the Georgia & Florida Ry., with headquarters at Augusta, Ga.

G. H. Ballantyne, resident engineer, Western Pacific R.R., with headquarters at Sacramento, Cal., has been appointed acting chief engineer with headquarters at San Francisco, Cal.

J. B. Pridgen, formerly in the engineering department of the Atlantic Coast Line R.R., has been appointed engineer of construction of the North Carolina Highway Commission.

W. L. Affleck has been appointed city engineer of Nelson, B. C.

A. G. Dalzell, recently in private engineering practice in Vancouver, B. C., is now consulting engineer to the Vitrified Clay Pipe Publicity Bureau, Toronto, Ont.

Samuel Moreell, Jr., assistant engineer, structural division, Sanitary District of Chicago, has been made chief structural engineer.

Julius R. Hall, acting engineer of bridge design, City of Chicago, has been made principal assistant engineer, Sanitary District of Chicago.

J. O. Francisco, formerly field engineer, Colorado State Highway Commission, is now road enginer of LaPlata County, Col., in charge of maintenance and construction of 1,600 miles of road.

H. M. Stafflet, recently head of the construction department of Liggett & Myers Tobacco Co., Durham, N. C., and formerly with the Austin Co., has reentered the employ of the Austin Co. as superintendent of construction on a sales and service station to be built for the Hartford Brick Co., East Hartford, Conn.

I. G. Hershey, formerly division engineer with the Du Pont Engineering Co., is now superintendent of highway construction with the Souder Construction Co., Lancaster, Pa.

Leonard Murray, for several years associated with Charles E. Eaton, consulting paper mill engineer, is now in the employ of the engineering department, Watertown, N. Y.

Ray E. Palmer, for the past 12 years connected with the New York State Highway Department, with headquarters in Watertown, N. Y., has been appointed assistant engineer on the staff of the division engineer at Hornell, N. Y.

H. J. Baum, formerly assistant engineer at Johnstown, Pa., has been appointed city engineer of Altoona, Pa.

Thomas Mead, formerly deputy engineer, has been appointed county engineer, Whitman County, Wash.

Major Clyde J. Chaffins, resident engineer of the Idaho Bureau of Highways, Sand Point, Idaho, has been made office engineer in the Cœur d'Alene office under W. J. Bassett, district engineer.

Alejo A. Carreño Y. Sardiñas, a graduate in civil engineering of Rensselaer Polytechnic Institute (1903) has been elected president of the Society of Cuban Engineers. He was born in Calimete, Province of Matanzas, Cuba, March 25, 1878. After leaving college he returned to Cuba and established the Cavodonga sugar mill, of which he is still manager. In 1914 he built a broad gage railway line of 17 kilometers across the Cienaga de Zapata. Four years later he became assistant engineer in the Department of Public Works having to do with the upkeep of thoroughfares and parks in Havana. During this time, with several of his colleagues, he founded the Society of Cuban Engineers. Much of Sr. Carreño's time has been devoted to the development of the sugar industry and he has made special studies along these lines for American companies in Santo Domingo.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Lower Wages in Building Industry at San Francisco

A 7½-per cent reduction has been decided upon as a proper change in the wage schedule of seventeen building trades by the board of arbitration for the San Francisco bay district building industry. The new wage schedule became effective April 11 and will continue for six months. At the end of that time the wages will again be set to conform to what the board members believe to be fair to both employers and employees.

The arbitration of wage rates first came up when labor organizations in a number of the building trades demanded increases last October. It was then agreed that the matter would be submitted to arbitration as announced in *Engineering News-Record* Feb. 3, p. 239, and that any increases allowed would be made retroactive. No statement was included regarding making decreases retroactive. The board of arbitration, which began its work in January, was agreed upon by representatives of the Building Trades Council and the Central Council of the Builders Exchange, and the San Francisco Chamber of Commerce secured the services of the individuals comprising the board. It was agreed by representatives of employers and employees that the decisions of this board would be accepted as final and that such a body would be regarded as "a continuing board."

The report of the board states that the cost of living in San Francisco increased 85.1 per cent from 1914 to Jan. 1, 1921. "In 1914 the lowest wage paid in any trade was $3.00 a day," the report states. "By applying the 85.1 per cent increase in costs, we find that the wage of corresponding purchase power is $5.55. In this particular trade the wage increases to date have been 100 per cent. Therefore a reduction of 7½ per cent of the present wage is necessary to equalize the wage with the cost of living."

Wage Controversies General in Building Trades

Wage controversies continue as the absorbing problem in the building industry the problem being resolved into either opposition to wage reductions, or voluntary cuts, with demands for increases being reported from time to time.

Denver contractors have adopted the open shop plan of opposing building trades labor after unsuccessful means had been tried to force employees to acknowledge the action of the state industrial commission in authorizing a 10 to 12-per cent decrease. Consequent to buliding trades difficulties in Massachusetts, best expressed in the Boston situation where the state arbitration board has taken a hand in the settlement of a strike that was called in January, a move has been started to organize employers all through the state to hold out for a 20 per cent decrease. Employers are using the strike in several Massachusetts towns as a protest against wage cuts.

Fights against wage reductions are acute in other places than Massachusetts, Rochester reporting serious difficulties over a proposed 15-per cent reduction, with the possibility present of the state industrial commission interposing. Failure to agree on 1921 wage agreements has practically tied up building operations in Ohio cities, except in Columbus. The Newark Building Trades Council of some 8,000 members has rejected a proposed wage cut, as has Walla Walla, Wash.

In Chicago some of the building trades unions have voted to accept a 20-per cent reduction, advocated for all trades by the Chicago Contractors Association. Other Chicago unions stand firm against a reduction. Springfield, Ill., carpenters have accepted a decrease of 10 cents an hour. Bricklayers of Spokane, Wash., have voted to accept a 10-per cent reduction and the plumbers of Wilmington, Del., have offered voluntarily to reduce wages in order to stimulate building, other trades promising similar action.

In the face of an announcement that Albany, N. Y., building trades employers would cut wages 25 per cent on May 1, the new proposals of the building trades council members contain a demand for a 10-per cent increase for hoisting engineers.

Department of Justice to Watch Building-Material Interests

The Department of Justice will inform itself as to the prices of building material at important centers throughout the country it has been announced. The Attorney General states that the Department has evidence of the existence of questionable practices in the handling of building materials in Washington, Pittsburgh, St. Louis, Cleveland and Chicago. The Department will lend active aid to the local officials in an effort to break up price fixing and other violations of the anti-trust laws. The Attorney General has made it clear that he will make a determined effort to break up the various practices which look to price raising. In sounding a warning to the building material industry, he stated that it would be well for other business interests to take note.

Steel Corporation Cuts Prices

Structural Shapes Down $5 Per Ton—Rail Prices Unchanged

On April 12 the United States Steel Corporation announced a price cut, effective immediately, by which structural shapes are reduced $5 per ton, plates $9, bars and wire rods $9, plain wire $7, sheets and small billets $8, slabs $4, 4 x 4 and heavier billets $1.50, and $15 for tin plates, all f.o.b. Pittsburgh. In some instances the new prices are higher than those of the independent manufacturers, notably in the case of plates. Again, in the case of billets, the Corporation price is slightly below independent quotations. There were no price reductions on rails or nails. This is the first price revision by the United States Steel Corporation since March, 1919, when prices were fixed by the Industrial Board.

Pennsylvania and New York Open Bids on 162 Miles of Road

On April 1 the Pennsylvania State Highway Department opened bids for the construction of approximately 80 miles of highways. On April 5 the New York State Highway Commission opened bids for the construction of the same mileage. Though there is no basis for comparison in the prices submitted in the two states some interesting details are apparent in the examination of the two bids.

In the State of New York the engineer's estimate for the 80 miles was $3,287,092, and the sum of all the low bids was $3,033,292, or $253,800 below the total engineer's estimate. In other words, the sum of the low bids was 92 per cent of the total estimate. In New York on only one project were no bids submitted, most projects attracting from four to seven bidders. On the 22 projects on which bids were submitted, there was a total of 85 bidders. Inasmuch as the total of the high bids was 97 per cent of the estimate, the range between low and high bidders was necessarily small.

In Pennsylvania, bids were received for the construction of the following types: (1) Bituminous surface on concrete base, or one-course reinforced concrete, 38 miles: (2) one-course reinforced concrete, 18 miles; (3) one-course reinforced concrete and Hillside brick, 21 miles; and, brick, 3½ miles. On Type 1, the average per-mile cost of the low bid was $60,500. The average per mile cost on Type 2 was $67,500, on Type 3, $69,000, and on Type 4 $78,000. The sum of low bids submitted for all types, distributed among 24 projects was approximately $5,400,000. This shows an average per mile cost of all types of about $66,000 per mile.

Road Bids Decrease Six Per Cent in Six Weeks

Same Contractor Low on Both Bids in Two of Fifteen Projects—Many New Bidders

On Feb. 18 the Pennsylvania State Highway Dpeartment received bids for the construction of approximately 100 miles of modern-type highways but the bids were rejected on the ground that they did not reflect the downward trend of prices of labor and materials. Most of the projects included in the Feb. 18 opening were re-advertised and re-opened on March 31, and a comparison of the low bids in the two openings indicates that within the six weeks' period of time a decrease of 6 per cent in the bid price is noted.

In the analysis and comparison of these two sets of bids, shown in the accompanying table, several facts are to be noted. In the first place, in every case but one the low bid of March 31 was considerably lower than that of Feb. 18. In that one case it is apparent that the contractor's estimate was unreasonably low, inasmuch as the next low bidder on Feb. 18 was 20 per cent higher than the low bid. The low bid on that particular project, which is noted in the table as Route No. 95 in McKean County, was considerably lower than the average of all bids received on that project Feb. 18.

When bids were opened on the projects March 31 it was apparent that a number of new bidders were in the list. In most cases the same bidders who bid on the project Feb. 18 revised their bids and submitted them for opening March 31, though in a few cases the first bidders dropped out entirely. The total low bid of Feb. 18 was $5,253,752, whereas the total low bid for the same project March 31 was $4,939,678, a saving of $314,074.

TABLE I—COMPARISON OF BIDS OPENED FEB. 18, READVERTISED AND REOPENED MARCH 31—PENNSYLVANIA HIGHWAY DEPARTMENT

Project	Length in Feet	Type	Low Bid, Feb. 18	Low Bid, March 31	Increase or Reduction	March 31 Bid of Low Bidder Feb. 18
Allegheny Co. Route 246	13,556	A	$212,709	$191,095	— 21,614	$210,611
Beaver Co. Route 204	26,953	A	373,017	347,676	— 25,341	360,449
Bucks Co. Route 156	67,069	A	1,109,520	1,008,567	— 100,953	1,069,582
Bucks Co. Route 151	36,706	A	456,900	417,713	— 39,187	446,070
Bucks Co. Route 28	16,010	A	226,816	211,416	— 15,400	218,991
Clearfield Co. Route 313	25,426	A	334,416	320,665	— 13,751	320,665
Crawford Co. Route 82	24,787	B	283,464	276,022	— 7,442	Didn't bid
Crawford Co. Vernon twp. Route 82	18,619	C	319,966	306,844	— 13,122	307,329
McKean Co. Route 95	32,199	B	382,999	412,117	+ 29,118	Didn't bid
McKean Co. Route 96	6,188	C	119,123	99,743	— 19,380	113,138
Northumberland Co. Route 18	18,957	B	255,185	227,219	— 27,966	Bid rejected
Northumberland Co. Route 161	26,200	A	306,203	294,111	— 12,092	294,111
Tioga Co. Route 196	41,843	B	566,465	538,614	— 27,851	575,813
Warren Co. Route 181	16,137	A	211,255	198,299	— 12,956	198,299
Westmoreland Co. Route 68	6,895	A	95,714	89,577	— 6,137	Didn't bid
Totals	379,545		$5,253,752	$4,939,678	$314,074	

A: One-course reinforced concrete. B: Bituminous surface on concrete base, or reinforced concrete. C: One-course reinforced concrete and Telford base.

Hoover Meets Technical Editors

Herbert Hoover, Secretary of Commerce, discussed with technical and trade paper editors on April 12 the problems of the Department of Commerce with the purpose of developing ideas by which the department might be of greater service to the industries of the country.

Federal Reserve Banks Report Increase in Building

An increase in building is remarked in the March reports of the member banks of the Federal Reserve Board.

The district reports follow:

District No. 2 (New York)—Forty-eight per cent of the value of building contracts in February was for residential purposes as compared with 40 per cent in January.

District No. 4 (Cleveland) — Thirteen cities show 1,335 permits for new construction, with a total value $4,843,916 in February, as compared with 872 permits with value of $4,631,924 in January.

District No. 5 (Richmond—Twenty-three cities show 891 permits issued for new construction during February, in comparison with 624 permits in January.

District No. 7 (Chicago) — Increase in number of building permits. Of 311 permits issued during February in the city of Chicago 181 were for residence construction.

District No. 8 (St. Louis) Five leading cities report further heavy falling off in number and dollar-value of building permits.

District No. 9 (Minneapolis)—Nine largest cities report 783 contracts with a total value of $2,179,784 for February—an increase of 41 per cent in number and of 1[illegible] per cent in value as compared with January, and an increase of [illegible] per cent in number and a decrease of 3 per cent in value as compared with February, 1920.

District No. 10 (Kansas City)—Sixteen cities show 1,352 building permits issued, [illegible] than permits issued in February, 1920. The fact that the total value of permits was [illegible] imately 50 per cent over January, but a [illegible]

District No. 12 (San Francisco)—Twenty cities report during February [illegible] terials [illegible]

Contracts for Past Week Are More than $23,000,000

Due to the number of small contracts let in street and road construction, and the continued strength in miscellaneous building, the aggregate value of contracts for the past week as reported in *Engineering News-Record* is in excess of $23,000,000. The largest figures are: Miscellaneous buildings, $9,865,279, and streets and roads, $8,365,302.

As an indication of how these contracts average in value the total cost of street and road contracts is spread over 95 projects, and miscellaneous building, 58 projects. Industrial building shows a substantial increase over the March weekly average, the total value of contracts let being $3,911,000.

The largest road projects let were nine contracts awarded by the Pennsylvania Highway Department for a total of $1,975,700, those projects being among the ones readvertised March 31.

Power Company Plans Extensive Work in Next Ten Years

In a rate hearing before the California Railroad Commission on March 30, John A. Britton, vice-president and general manager of the Pacific Gas & Electric Co., presented figures to show what the company proposes to do in construction in the next ten years.

From 1910 to 1920 consumers on the company's system increased from 73,500 to 266,132 and based on this previous record and the situation today, Mr. Britton estimated that by 1930 the peak demand would total 570,000 hp.

To meet this expected increase in demand, the company plans to expend within the next ten years a total of $161,000,000 in its power, water, gas and railway departments. Of this total about $138,500,000 will be required for the development, delivery and distribution of power from the Pit River where construction is now under way on a chain of large hydro-electric generating stations.

Record Car Surplus Reported

A record car surplus on March 31, 1921, is shown by tabulations of the Car Service Division of the American Railway Association. On this date there were on sidings throughout the country 495,904 surplus freight cars, the largest number in the history of American railroads, an increase of 36,493 over the total on March 23, or an increase of 82,000 within a month. It is stated that the increase is due entirely to the falling off in coal shipments. Of the total surplus slightly more than half, or 255,055, consists of coal cars, compared with 172,850 on March 1. During the week ending March 26 only [illegible] cars were loaded with coal, the smallest number in one week for some years. The surplus of box cars on March 31 was 171,119, or [illegible] than on March 23, but [illegible] below the total on March 1.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 7, the next, on May 5.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3 33	$4 25	$3 75	$3 58	$3.51	$4 65	$4 45	$5 00	$5 00
Structural rivets, 100 lb	4 85		7 05	5 08	5 30	6 90	7 05	6 25	8 50
Reinforcing bars, ¾ in. and larger, 100 lb	3 23	3 75	3 85	3 48	3 53½	4 22½	2.35	4 50	4 25
Steel pipe, black, 2½ to 6 in. lap, discount	43%	45 65-5%	40@45%	53½%	46 9-5%	29@33%	44@47	40%	5%
Cast iron pipe, 6 in. and over, 100 ton	63 30	64 00	66.20	64 10	67 80	70 00	87 65	73 00	80 00
Concreting Material:									
Cement without bags, bbl	3 10 (del.)	3 00	2 85	2 17	2 41	3 10	3 09	3 10	3 44
Gravel, ¾ in., cu.yd	2 50	2 75	1 75	2 75	2 00	2 50	2 50	1 50	1 50
Sand, cu.yd	1 25	1 50	1 75	2 75	1.00	1.10	1.65	1 50	1.50
Crushed stone, ¾ in., cu.yd	2 15	2 50	3 20	2 75	2 25	3.50	2.50	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48 00	37 50	45 00	55 00	41 00	47 00	27.00	28@30	120 00
Lime, finished, hydrated, ton	21.00	18.00	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.65	2.50	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.00	25.00	12.00	18.00	16.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	0.14	0 21	12	.06	.11	.12½	.13	.28
Hollow partition tile 4x12x12, block	....	.15	19½	096	.104	.11	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	67	.69	.88	.78	.75	97	.88	.79	.95
Common labor, union, hour	75@ 80	35	60@1 00	1 00	50	50@.63½	.81¼	.75	.....
Common labor, non union, hour		25	.40@.60	50	50	37½@.50	.50@.55	.50	.30@ 40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, 16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu. yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir, instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

The continued depression in the construction materials market is ascribed largely to the feeling that is prevalent among prospective builders that prices ought to decline near to the pre-war levels. Such an attitude is of course unreasonable. Before the war, prices were advancing steadily in practically every industry; therefore, had there been no war, prices would now be higher than in 1914. Not only have production costs increased heavily, but handling charges are seriously high. The freight item alone is 138 per cent above the 1913-1914 figure for finished steel products from Pittsburgh to New York. Another reason for normally higher building costs is the more restrictive city and state building codes now in effect.

Common brick producers selling to the New York market are quoting $15 to $16 alongside dock, as against $15 to $17 a week ago. The labor difficulties anticipated have been postponed to Apr. 18. On the basis of $15, the dealers' price is the wholesale price plus 10 per cent plus cartage, about $18.40 per 1,000.

On April 7 the brick interests in Chicago announced a $4 cut, the present delivered price being $12. It is reported that one of the smaller brick concerns in St. Louis has reduced its price $5, to $10 per 1,000, and face brick from $24 down to $12.

The dealers' price for cement in New York is still $3.10 net (40c. per bbl. extra for bags); the manufacturers' price to dealers being $2.40 alongside dock. Changes in effect Apr. 9 are: Detroit $2.43, instead of $2.51; Indianapolis $2.43, against $2.31; Toledo $2.49, against $2.51; Peoria $2.45, against former price of $2.43. The price at Minneapolis is $2.41; delivered, $2.70.

A few weeks ago the independent steel companies cut prices under the Steel Corporation schedule so long maintained. These prices were $2 per 100 lb., and even lower, as compared with the $2.45 base of the Corporation. Following the announcement that the Republic Iron and Steel Co., of Youngstown, would advance bars, plates and shapes $2 per ton, most of the large independents indicated that they would adopt the same schedule, making bars $2.10 per 100 lb. and plates and shapes $2.20. The advance is ascribed to necessity.

That steel business is not brisk is indicated by the fact that unfilled orders on the books of the United States Steel Corporation were 649,102 tons less in March than in February. Total orders on March 31 amounted to 6,284,765 as compared with 6,933,867 tons on Feb. 28 and 9,982,075 tons in March 1920. In an effort to overcome this condition, the United States Steel Corporation on Apr. 12 announced a new price schedule, as outlined on p. 660 of this issue.

The small demand for steel plates has induced the independent steel manufacturers to abolish the 20c. differential, making the price the same as for structural shapes, $2.10 in Pittsburgh. The warehouses are doing the same. New York dealers quote $3.33 for both plates and shapes; Minneapolis, $3.51. Structurals are down, also, in Denver and San Francisco. The only change in cast-iron pipe is a $2 drop in Seattle. Steel pipe is down in San Francisco. Minneapolis expects a drop in both steel and cast-iron pipe in a week.

The lumber market is hardly in a state to be analyzed. Fir in Seattle has declined from $35 per M. ft. b.m. to $28@$30, thus comparing more favorably with the San Francisco price of $27. There were advances of $2.50 and $2, respectively, on pine, in Atlanta and Chicago.

Chicago reports that the Building Trades Council is still balloting on the proposition to accept a 20 per cent cut, and that on April 9 fifteen unions had accepted and a like number had rejected. The carpenters and bricklayers had not then voted.

The new schedule of wages for the San Francisco building trades, as announced on p. 660 of this issue, was effective April 11.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

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Hoover and Engineering Council

MR. HOOVER'S resignation as president of the American Engineering Council will naturally be much regretted. During his service of less than a year he has been an important factor in giving vigor to the council's work, and he has been responsible for inaugurating the industrial wastes survey which promises to be of great value to the country. It would have been helpful had he been able to serve out his term. Nevertheless, it is apparent that he as a member of the Cabinet might be placed in an embarrassing position because of the activity of the council in public affairs. The engineering profession is much indebted to him for his work in successfully inaugurating the council's work.

The Broader View

THE recent death of Ernst J. Lederle, twice commissioner of health of New York City, again calls attention to the fact that to be a successful health officer neither medical education nor experience is necessary. Dr. Lederle was a chemist. John A. Vogelson, for many years chief of the bureau of health of Philadelphia, is an engineer, and so is Henry F. Vaughan, commissioner of health of Detroit, and so also are and have been a long line of health officers in Montclair and other New Jersey towns. Despite all this the New York statutes require health officers in that state, outside New York City, to be physicians. Some day, this bar against men with more real training in matters affecting public health, sanitary engineering, chemistry, bacteriology, sociology, and vital statistics may be removed. Meanwhile the cities of many other states are permitted to draw on all classes of men competent to serve as health officers. The results attest the wisdom of the greater latitude thus afforded.

Foundation and Superstructure

AN EARLY warning of trouble is recalled by the Tempe failure. Just after the bridge was built V. H. Cochrane pointed out in *Engineering News* of June 12, 1913, p. 897, that the piers were inadequate, lacking stability even under unbalanced live load, not to speak of what might happen if one arch were altogether removed. Since the arches are three-hinged, this lack of stability means that the bridge stood up largely because of the continuity of minor structural elements (as the roadway), supplemented by the chance lateral resistance of the earth around the pier cylinders and piers. Undoubtedly the highly eccentric pier thrusts arising from moving loads would tend to rock the piers back and forth, and the weakness would be more likely to show its effect when the supporting soil was removed by scour. While the facts are not sufficient to demonstrate that this action played a determining part in the failure, yet the case as a whole is a most suggestive reminder of the ever present interdependence of superstructure and foundation.

President Harding on Highways

MORE space was given to highways by President Harding in his first message to Congress than was ever before devoted to the subject in a Presidential address. His statements are sound wherever his meaning is not open to debate. It is difficult to know, however, just what the President's position is on a federal-aid versus a "national" system of highways. We take it that he is satisfied to allow the present federal-aid method of appropriation to stand. Yet there is enough indefiniteness about his words to wonder whether he has leanings in the other direction. Again, what does he mean by saying that "the laws governing federal aid should be amended and strengthened"? What does he mean when he says that "the federal agency of administration should be elevated to the importance and vested with authority comparable to the work before it"? The automobile interests have discussed with him the creation of a federal highway commission. Was that in his mind or has he some scheme of putting in more prominent place the present Bureau of Public Roads? Under the circumstances, all that one can say is that it is worth while to have the President display such interest in the highway situation. Later we hope that his views will become more definite, or, at least, be more definitely expressed. Possibly he was seeking to leave the subject so wide open as to fit in with any policy he might formulate.

A Presidential Lapse

THERE was in the Presidential message one lapse which we deeply regret. He said nothing about the proposed Department of Public Works. On the other hand, he devoted, relatively, a great deal of space to the proposed Department of Public Welfare. If this is evidence of the relative importance in the Presidential mind of the proposed departments the outlook for executive pressure for a Department of Public Works is distinctly discouraging. It behooves the proponents of the department to align their forces.

Rating Cities by Water Supplies

A SANITARY rating of the cities of Indiana according to water supplies, as noted on p. 686, shows that even the cities in the highest class have an average typhoid rate of 16.1 per 100,000, a high figure compared with that of nearly all the larger cities of the country. Even the four cities in the highest class that have purification plants operated under the best conditions have typhoid rates of 12.6. Source, purity, treatment and

personnel were the factors by which the plants were classified. The tabulated typhoid rates indicate that there are other factors than water supplies which enter into typhoid causation, but that there is much room for improving the water supplies of Indiana. In this the State Board of Health should lead. The rating tables, after being put into graphic form, showing the favorable or unfavorable position of each town, might well be circulated widely in every municipality in the state, with pointed comment on the lessons they bear for each community.

Co-ordinating Government and Business

AN INTERESTING suggestion is contained in the final report of the War Industries Board which came from the press last month. It proposes that the government continue to get the benefit that accrued during the war from associations of industries, functioning generally through their war service committees. With the aid of these associations, many of them organized at official request, the government was able quickly to mobilize the industries, to get them to introduce measures of economy, to facilitate the working of priorities, to arrange for the curtailment of production, etc. The report makes the point that no less beneficial results can accrue in peace times than during the war. It recognizes also that these agencies may work to the public's disadvantage. They can subtly influence production so as to keep it short of current demand, and thus keep prices high; they may encourage an understanding on prices, and encourage other practices that are against public welfare. To reap the benefits that can accrue to the public from such associations and, on the other hand, to prevent them from being misused, the report urges the development of some plan of relationship between them and the government. At the present the contract is purely a negative one, through the inquisitorial functions of the Federal Trade Commission. The new relation should be a constructive one, "whose duty it should be to encourage, under strict government supervision, such co-operation and co-ordination in industry as should tend to increase production, eliminate waste, conserve natural resources, improve the quality of products, promote efficiency in operation and thus reduce cost to the ultimate consumer." Such a relationship is devoutly to be wished and it would seem to be the function of the U. S. Chamber of Commerce to take the initiative in working out this desirable liaison. The co-operating agency on the part of the government might be the Department of Commerce or the Federal Trade Commission, preferably the former, since at present it is under the leadership of a man who so clearly senses the essential relationship between business and public welfare.

Preparedness

THREE other recommendations are made in the report just referred to which have a bearing not upon the country's welfare in peace, but upon preparedness for war. As a result of the experience of the War Industries Board, the report recommends: (1) That there should be established a peace-time skeleton organization following the lines of the War Industries Board, which could be rapidly expanded in case of military emergency. It would have a chairman and various bureaus corresponding to those built up in the board. (2) That the government should devise a system for protecting and stimulating the domestic production of those things that had to be imported under much stress during the last conflict, particularly nitrogen, manganese, chrome, tungsten, dye stuffs, and coal-tar derivatives. (3) That under the supervision of the proper department of the government, certain war industries should be encouraged to maintain skeleton organizations through which they could develop the rapid manufacture of guns, munitions, airplanes, and other direct military equipment. This might be done, it is suggested, in some cases through government purchases of factories, in others through the placing of sufficient orders to permit the owner to keep the plant in existence. The obvious soundness of these proposals requires no emphasis. Unfortunately, their need does not seem to be appreciated, or, if it is appreciated, the actual procedure in the proper directions is, for some reason, delayed.

The British Strike

GREAT BRITAIN, fortunately, has been spared the disruption and danger of the Triple Alliance strike. The railway and transport workers believed that the miners should enter a further conference proposed by the government last Friday, and when the miners refused to enter such conference unless the national pool should be one of the subjects of discussion the railway and transport leaders withdrew their support and refused to call out their men. Congratulatory remarks in the circumstances are entirely unnecessary. Everybody is interested, however, in making surmises as to the probable effect of the breakdown of the Triple Alliance upon future labor developments. Some see in it a disruption of the solidarity of British labor. Others merely emphasize the triumph of traditional British common sense. At this distance it would seem certain that the circumstances attending the break must impress even the hardened trades unionist that the infallibility of trades-union leadership is to be seriously questioned. In the minds of leaders of two of the strongest labor bodies a third organization has shown so serious a disregard of public interest that pledged support has had to be suddenly withdrawn. It is true that they themselves had perpetrated a vicious indefensible sympathetic strike but they refused to take the final step when some hope of an honorable compromise appeared. If memories were not habitually short we should think that the unreasonableness shown by the miners would seriously deter sympathetic strikes of wide scope in the future. England has been saved by the narrowest margin from a catastrophe which promised to be such a mark in British history that the Friday on which it was to begin had been dubbed, in prospect, "Black Friday." Standing alone and put in a bad position by the failure of their allies to follow them in their unreasonableness, the miners' strike should quickly collapse.

Railway Labor Agreements

HARDLY of less importance to us than was the collapse to Britain of the proposed Triple Alliance strike is the decision of the Railway Labor Board that the national railway labor agreements in this country should be abolished July 1. We were not threatened by a serious stoppage of industry or transportation. There

was no immediate emergency upon us. Nevertheless, the continuance of the national agreements would cast a blight upon our industry of extreme seriousness. As we have pointed out before, the payment nationally of wages determined by living conditions in the high-cost centers was disrupting to the wage situation in every community. Orderly deflation could not be expected as long as the railway workers were a preferred class. Assuming that the members of the Railway Labor Board were honest and intelligent men, no other decision than that rendered could have been expected. Some of the working agreements are so absurd that they cannot possibly be defended. It is a repetition of the old story that those who overstep the bounds flagrantly are quickly brought to account.

The reversion of negotiations to bargaining between each railroad and its employees, moreover, is a counterpart of what seems to be coming in England. There the mine owners seek settlements based upon local conditions in each district. The mine workers, on the other hand, want a national agreement and a pooling of coal profits so that wages can be equalized nationally. On the broad outlines, therefore, the contests in the two cases—local control versus national—are on the same lines. It is significant that decisive actions in the two cases came in the same week and that the actions both tend in the same direction—toward a sound, economic rather than an unsound, uneconomic solution.

"Final" Valuations

VALUATION reports on the properties of four railroad companies, including single sums given as "final" value, have been issued by the Interstate Commerce Commission, as outlined elsewhere in this issue. The reports also include a statement of sums determined by the commission as the additional cost of acquiring carrier lands due to condemnation proceedings, severance damages, etc., over and above values of adjacent lands, which the commission has been required to determine and report by the Supreme Court decision in the Kansas City Southern case. These items are reported separately and with an explanation of the method used to develop them, but no statement is made of the method employed in arriving at the single sums given as final value. The amounts are simply presented with the statement that the various factors "which appear to have a bearing on the values reported" have been taken into consideration, including the additional cost of acquiring lands, appreciation, depreciation, going concern value, working capital, and materials and supplies. For the Kansas City Southern the "final" single sum given as the value of properties owned is some 29 per cent in excess of the sum previously given in the original tentative valuation as cost of reproduction less depreciation. The railroad company has claimed a value considerably greater than that now reported and there appears no doubt that the present "supplemental" report will be strenuously protested. Here the Interstate Commerce Commission will probably be called upon to set forth the method pursued in arriving at "final" value, since the valuation act itself prescribes that methods employed shall be shown. The case is a very important one since precedents set are likely to affect the whole procedure in the federal valuation. So far the issue is very much clouded by the absence of a more detailed statement by the commission of component elements of value and the method pursued. Valuation engineers everywhere will necessarily take a keen interest in the further development of the case since principles finally prevailing will have a governing influence on methods of valuation.

Vehicle Law Enforcement

THIS year has witnessed unusual activity in the matter of state legislation relating to the use of public highways by motor vehicles. With 9,211,295 passenger automobiles and motor trucks registered during 1920, an increase of 1,645,849 vehicles, or 22 per cent, over the 1919 registration figures, the need for insisting upon a reasonable use of state highways is apparent. The mere passage of regulatory measures, however, is no guarantee of their enforcement. State highway departments have begun to appreciate this fact and, while there is still much laxness, an unmistakable trend has developed toward the enforcement of measures which have been placed on the statute books. A case in point is Maryland, which has progressed much further than most of the other states in the matter of vehicle-law enforcement.

The details of the Maryland policy are discussed elsewhere in this issue, but it is worth while to emphasize one or two points. Most vehicle laws specify some maximum load limit for trucks and it follows that violators of this regulation can be punished only if definite evidence is produced to show that a suspected truck is actually exceeding the legal maximum. This can not be done by guesswork; it means, of course, provisions for actually weighing motor vehicles on the roads, as is done in Maryland by permanently located road scales and by mobile inspection crews equipped with weighing jacks or loadometers. Vehicle weighing on the road is a comparatively new field of highway department activity, but the practice promises soon to become widespread. Other states, such as New Jersey and Connecticut, to mention only two, are now weighing vehicles on the roads.

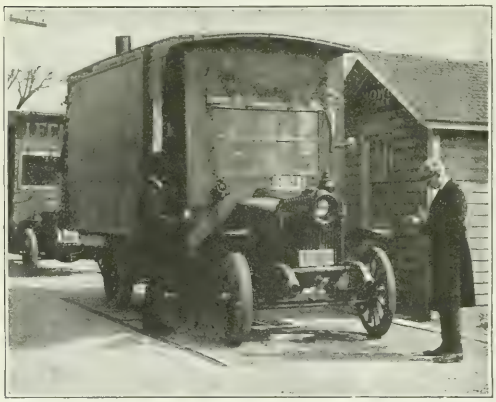
Maryland's experience has demonstrated that the mere imposition of a fine on the driver or owner of an overloaded truck is not an effective deterrent to violators of the law. The remedy has been found in compelling the discharge of the excess weight at the roadside. Where fines only were imposed it was often found profitable to load trucks beyond the capacity specified by law and to pay nominal fines, provided truck movements were not interrupted. Under the policy of removing a portion of the load, however, a great deal of inconvenience and expense is caused to the motor-truck operator. He must send out another vehicle to pick up the load deposited at the roadside, thus incurring delays and increased cost. The method of enforcement is a drastic one, but it is only by this kind of firmness that observance of the law can be secured.

As a matter of fact, right-thinking motor-truck operators are not objecting to policies which will conserve the highways for their use. Motor transport will live only so long as the highways are in a condition to carry traffic. In the end, the interests of the highway departments and of the motor-vehicle operators are one. Motor-vehicle legislation, therefore, should aim not to rule trucks off the road, but rather to strike at those selfish interests which, with a comparatively few trucks of excessive weight, soon render highways useless for other and more conservative operators and the community at large.

How Maryland Enforces Its Motor Vehicle Law

Truck Weights Checked by Scales and Loadometers—Ten Tons the Limit—Excess Loads Deposited at Roadsides

MARYLAND has gone a step beyond the *passage* of a motor vehicle law—*she is actually enforcing it.* When that state recently was forced to spend more than half a million dollars on the reconstruction and repair of a large mileage of main routes damaged by excessively loaded motor trucks, after having been in service only 7 to 10 years, it was decided to put into effect a policy which would definitely safeguard any further capital investments in the state highway system. The result was the passage, last year, of an amended general motor vehicle law limiting gross loads to 20,000 lb.



WEIGHING TRUCK ON PLATFORM SCALES

—a much lower maximum than is allowed elsewhere—and containing other provisions designed to insure a reasonable use of the state's highway system. With this law on the statute books John N. Mackall, chief engineer of the State Roads Commission, in conjunction with the Commissioner of Motor Vehicles, undertook a campaign of enforcement which has resulted in the preservation of existing state roads and a drastic cut in the cost of highway maintenance. The enforcement measures include patrol crews which weigh suspected trucks with loadometers or on permanent road scales, a careful examination of each motor vehicle offered for registration, and measurement of tire widths.

The state highway system of Maryland comprises 1,700 miles of roads out of a total mileage for the entire state, including county and township roads, of 14,810. The principal types of construction on the state system before the enactment of the present motor vehicle law were macadam, surface-treated; concrete; and, in southern Maryland, gravel. It is on this mileage of highways that the State Roads Commission has put into effect its enforcement measures.

Statistics from the Motor Vehicle Department showed that on Oct. 30, 1920, the motor vehicle registration was as follows:

Private passenger cars (pneumatic tires)	101,125
Cars to hire (pneumatic tires)	3,781
Dealers' cars (pneumatic and solid tires)	7,222
Motor trucks (solid tires)	11,194

Motor Vehicle Restrictions—With regard to solid-tire motor vehicles the main provisions of the law are as follows: Maximum gross load, 10 tons; maximum load per inch width of tire, 650 lb.; maximum width of vehicle, except traction engines, 90 in.; maximum rated carrying capacity, 5 tons. For motor trucks equipped wholly or in part with solid tires the speed limits are 25 miles per hour for 2-ton gross loads; 15 miles an hour for gross loads between 2 and 6 tons; 12 miles per hour for gross loads exceeding 6 tons.

One provision of the law is particularly significant. It reads as follows: "No motor vehicle shall be operated with a greater load than that for which a registration certificate has been issued and fee paid." Before the amended law was passed the manufacturers' rated capacity of a motor truck was taken as the basis for the registration fee. It sometimes happened that a manufacturer would attempt to circumvent the law by rating a truck at, say, 2 tons, at the same time giving to the purchaser a tacit guarantee of a 3½-ton load-carrying capacity. Under such circumstances what amounted to a 3½-ton truck was masquerading under a 2-ton load plate. Such practices, however, have been done away with by the restriction of the load to the rated capacity. While a 3½-ton truck can still be rated at 2 tons by its makers, the purchaser cannot benefit, as formerly, by this subterfuge, as he is now limited to the load indicated on the plate of his machine.

Registration Fees

For automobiles with pneumatic tires, for private use, the registration fee is 60c. per horsepower, while pneumatic-tired vehicles for hire are charged $1.20 per horsepower, with a minimum charge of $10.

For motor trucks with solid tires the yearly registration fees, for the capacities indicated, are as follows: 1 ton, $20; 2 tons, $40; 3 tons, $60; 4 tons, $100; 5 tons, $150; 6 tons, $300; 7 tons, $500.

Trailers, if equipped with rubber tires, are charged $10 for the first ton and $20 for each additional ton; if metal tires are used the foregoing fees are doubled. Traction engines or tractors used for hauling are charged a flat fee of $25.

The 6- and 7-ton trucks provided for in the foregoing registration fees are those owned in the state before the amended vehicle law went into effect and are subject to the 10-ton gross load limit. Now, trucks with a rated carrying capacity exceeding 5 tons are ruled off the road, for the law states that "no motor vehicle having a greater rated carrying capacity than 5 tons shall be operated over any public highway in this state, these provisions being absolutely necessary in the opinion of the General Assembly for the proper protection and continued maintenance of the public highways of this state." The actual weights and rated carrying capacities of all trucks are recorded by the motor vehicle commissioner at the time of registration and the machines are properly tagged.

An unusual feature of the field work of inspection is the measurement of the width of the tire in actual contact with the road. This width is determined by running the truck over smooth steel plates on which an impression of the wheel track is secured by white paper

and carbon sheets such as are used in making a copy of a typewritten letter; 650 lb. per inch width is the maximum for solid rubber tires.

For enforcing the motor vehicle restrictions two permanent road scales, each of 20 tons' capacity, have been installed, one on the highway between Baltimore and Philadelphia, and the other on the Baltimore-Washington Boulevard. In conjunction with them a crew of four men—two inspectors and two laborers—equipped with a light automobile and four loadometers, or portable jacks, operates along the different state routes, stopping and weighing any truck which appears to be exceeding the load limits. These inspectors are vested with proper police authority and are generally accompanied by a state policeman, in uniform, deputized by the Motor Vehicle Commission. Experience in this work has demonstrated the desirability of having the weighing crews accompanied by a *uniformed* officer. Without this indication of authority the stopping and weighing of trucks was often delayed by disputes. With the permanent road scales a vehicle is simply run onto the platform and its weight recorded.

When the crew with the mobile weighing devices first started operations it was customary to jack up one wheel of a truck at a time and record the weight. Many truck drivers, however, seemed to think that this method did not furnish a fair test, suspecting some form of deception on the part of the state's inspectors in fixing the recorded load at more than its actual amount. A few experiences of this sort led to a change in policy and to the simultaneous use of four jacks, one at each wheel, by means of which the truck is lifted clear of the road surface. No objection to the determination of the load at the four points in this way developed.

Excess Loads Removed

By frequently changing the roads on which the weighing crew operates an element of uncertainty is introduced which tends to prevent infractions of the law.

Originally, when a truck was found to be overloaded, the driven was arrested, sent before a magistrate and fined, the fines generally running from $5 to $25. This method of enforcement did not produce the results desired. A case in point is that of a large company owning a fleet of 107 trucks operating between Boston and a point west of Maryland. The route used was the National Pike through Cumberland. These trucks carried loads of 7 tons and themselves weighed 6 tons, or a total of 13 tons on the highway. Fines of $50 were imposed for overloading and the trucks were sent to the nearest railroad point where the surplus was taken off and shipped to Boston by rail. The imposition of these fines, however, failed to stop the excess loading. A different policy was then adopted. A weighing station was established and trucks carrying more than 5 tons were compelled to discharge the excess merchandise on the roadside, instead of taking it to a railroad station as formerly. It then became necessary for the operating company to send out another truck from its headquarters 17 miles away to pick up the discharged load. After two trucks had been handled in this way the overloading stopped.

Profiting by this experience the State Roads Commission for some time past has been insisting upon the discharge of excess loads *at the roadside*. The campaign was begun last September and during the first week 60 trucks were held up and fined from $10 to $100. The weighing crew, during the next week, selected a different road and caught 70 overloaded trucks. During the fifth week, however, the number of violations had been reduced to 3 a week, and in the sixth week only 1 truck was found to be carrying more than the legal limit. For several months past the average number of overloaded trucks detected has been less than one a day, and these usually for insufficient tire width. Loads greater than 10 tons have practically disappeared.

WHEN LOADOMETERS SHOW OVERLOADING EXCESS WEIGHT IS REMOVED AND DUMPED AT ROAD SIDE

Mr. Mackall reports that during the last two years there has not been a single road failure. There has also been a marked falling off in the demand for 5-ton trucks. The solution to the problem of road damage by excessively loaded vehicles, the State Roads Commission has found, is to legislate such vehicles off the roads rather than attempt to gain this result by taxation alone. In 1919 it was found that a $500 yearly registration fee was not sufficient to keep 7-ton trucks off the highways. Accordingly when the amended bill in 1920 was passed, it carried a definite load-carrying limit of 5 tons.

The enforcement of a vehicle law can be made effective only with complete co-operation between the state highway officials, magistrates, justices of the peace, and other representatives of the law. Fines for overloaded vehicles now vary generally from $5 to $25, but as previously noted the commission has found that the greatest deterrent to excessive loading is the removal of the excess load on the roadside.

It is of first importance also, according to the Maryland experience, to seek the co-operation of civic bodies, such as chambers of commerce, business men's organizations and automobile clubs, in carrying out the enforcement measures. Mr. Mackall has made it a point to appear frequently before meetings of such organizations and especially to enlist the support of the automo-

bile owners. The broad question involved is one of economical highway transport—not roadbuilding or maintenance of motor vehicle operation, considered individually. The commission's policy is not one of ruling motor trucks off the roads, but rather of insisting upon such reasonable restrictions as to give the entire state the maximum value of its highway system as a transportation agency.

Mr. Mackall believes that the claims for greatly reduced transportation charges by the use of extremely large motor-truck units are generally greatly exaggerated. Recalling that Maryland had to spend $600,000 to repair roads rendered useless by a comparatively few excessively heavy trucks, he believes that, in the year prior to the passage of the amended vehicle law, if all loads on 5-ton trucks had actually been carried on 3-ton units the loss to the operators would not have exceeded $15,000. This amount, insignificant in comparison with more than half a million dollars required to rebuild the state highway system, is cited to support the policy of vehicle load restrictions now in force.

Considering the subject in its economic aspects the position of the Maryland State Roads Commission may be stated thus: If it can be demonstrated that trucks larger than those of 5-ton carrying capacity are able to justify themselves by effecting a saving in transportation costs equal to or greater than the interest and amortization charges for highway bonds plus extra costs for maintenance, and increased widths and thicknesses of road surfaces, then, and only then, should they be permitted. This saving cannot be demonstrated by subjecting roads to loads which they cannot carry.

Financial Statistics of Cities

In all but four of the 227 cities having a population of over 30,000 in 1919, according to advance figures from a bulletin on Financial Statistics of Cities soon to be issued by the Bureau of the Census, the revenue receipts exceeded the payments for current governmental expenses and interest while in 117 (52 per cent) of these cities the revenues exceeded the entire expenditures of the year for all governmental costs, including interest and outlays. The corresponding figures for 1918 showed that the revenues exceeded total expenditures in 80 cities or 35 per cent of the cities covered by the 1918 report.

The total governmental expenditures in 227 cities for the year 1919 were $1,233,111,835. This amounts to $35.58 per capita, divided as follows: For expenses of general departments (legislative, executive, and judicial establishments, schools, police and fire departments, sanitation, etc.), $21.75; for capital outlays, $7.38; interest on indebtedness, $4.52; expenses of public service enterprises (water-supply systems, electric light and power systems, docks, wharves, landings, etc.), $1.92 per capita.

The largest item of revenue except taxes was that from public service enterprises which totaled $127,399,258, against expenses of $66,700,066, thus leaving a net revenue of $60,699,192, or $1.76 per capita. Of the total revenues from public service enterprises nearly 80 per cent, or $95,304,064 was from water-works.

The net indebtedness of the 227 cities was $2,697,551,844 or $77.82 per capita. Of this total, $1,009,309,052 is owed by New York City, and $141,761,941 by Philadelphia, the second city on the list.

Some of the Engineering Aspects of Public Health

Hygiene for the Physician, Sanitation for the Engineer—Many Leading Health Officers Trained as Engineers

By James A. Tobey
Washington, D. C.

The popular conception of the science of public health is that it is entirely a branch of medicine. This idea has prevailed in the past and even persists today, though to a lesser degree. *Engineering News-Record*, in an editorial in its issue of Sept. 2, 1920, remarks: "Once the doctors will point the way, engineers will do their part, if fortunately there is a part for them, to make the world as safe against influenza as it now is against cholera and typhoid and may be made with the engineer's help, against malaria." Possibly this editorial means the term "doctors" to apply not only to doctors of medicine, but also to doctors of science, of philosophy, and engineering. At any rate, public health is not a medical monopoly, essential as is the art of preventive medicine in safeguarding the health of the people. Engineering, especially sanitary engineering, plays an important part in public health and the achievements of engineers have had a notable effect on the progress of hygiene and sanitation.

Statements that public health depends for its success as much on engineers as physicians coming from an engineer may seem biased. Many of the leading medical men of the country take a similar view, however. In an address before the Joint Annual Conference of the Council of Medical Education of the American Medical Association with the Association of American Medical Colleges and the Federation of State Medical Boards of the United States, Dr. Victor C. Vaughan, dean of the Medical School of the University of Michigan, made these significant statements:

> The trend and spirit of medical schools is toward curative medicine. The graduates of our best medical schools today are not fitted to do public health work. The committee recommends that an improvement be made in this direction. During the last two or three years the National Board of Medical Examiners, examining graduates from Class A schools only, and the very best graduates of those schools, has scarcely found men who could get a passing mark, in preventive medicine, although there have been excellent marks in surgery, medicine and the specialties. It is a matter for consideration whether the medical profession should fit men for preventive medicine or turn the job over to somebody else. The sanitary engineer as an all around man is better fitted as an epidemiologist than the average physician. A number of medical schools are now offering courses in public health. They have a very precarious exixstence. The best public health courses are given at Harvard and at the Johns Hopkins schools, and in neither of these places is the attendance large enough to justify the existence of the school. The regulations of most of the states and many municipalities have been changed so that a medical degree is not required for health officers. Some of the best municipal health commissioners today are not physicians. In our opinion the tendency in all medical schools is to teach curative medicine, not prevention. The committee recommends that we insist that medical men who are fitting themselves for health officers should take an additional course of not less than two years. Even to make proper medical men we need more hygiene and preventive medicine in the medical course than we have. We recommend that five hours a week for one year be devoted to preventive medicine—double the amount of time we are now giving to this branch—and we do not expect to make ex-

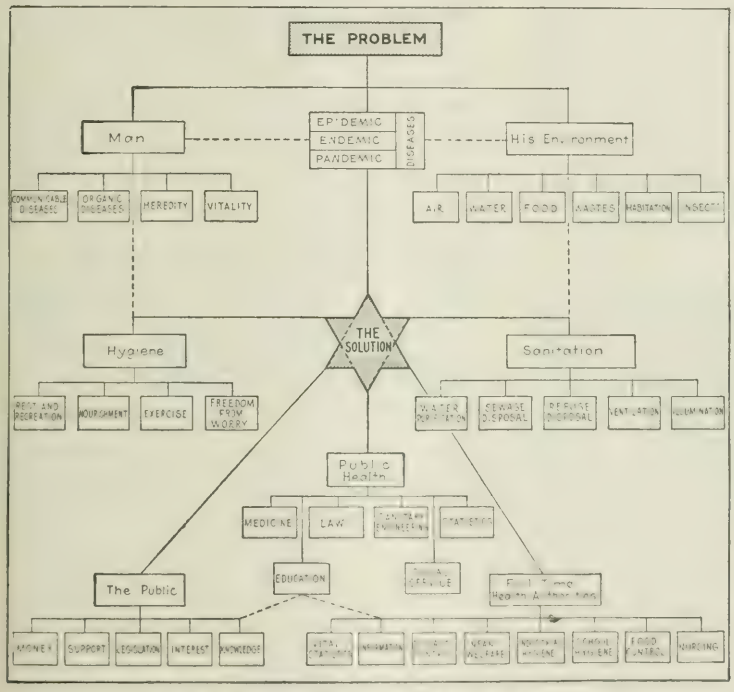
pert epidemiologists in this way, but possibly we can give what the ordinary practitioners need.[2]

The first school in America to make a systematic attempt to train health officers was the School for Health Officers of the Harvard Medical School and the Massachusetts Institute of Technology. Here was a combination of medicine and engineering and this school has been successful and turned out many capable health officials. Its students include both doctors and engineers. Dr. William H. Welch, one of the world's foremost medical men, has publicly[3] stated that any argument that non-medical men can not administer in the field of public health is refuted by the accomplishments of those engineers and other laymen who have already administered in this field. The School of Hygiene and Public Health of Johns Hopkins University, of which Dr. Welch is director, admits non-medical men as candidates for degrees. In fact, of the fourteen institutions now giving degrees in public health, all but two make provisions for non-medical men as students.

In order to understand why the non-medical may qualify in public health, it is necessary to consider what this science, for it is a science in itself, comprises. Prof. C.-E. A. Winslow, head of the Department of Public Health at Yale, and himself educated as a sanitary biologist, has given perhaps the most comprehensive definition. He says:

Public Health is the science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts for the sanitation of the environment, the control of community infections, the education of the individual in principles of personal hygiene, the organization of medical and nursing service for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health.[4]

There are two main factors in the spread of disease, man and his environment. To deal with man we have hygiene, which is a personal thing; to cope with the environment we have sanitation, which is a public responsibility. Obviously, the problems of hygiene belong to the physician, whereas those of sanitation come in the domain of the engineer. But public health includes other factors, too. Besides medicine and engineering, there is education, law, statistics, and sociology. In the accompanying chart are represented the various components of this science. It is a notable fact that we owe most of our modern developments in public health to the wonderful work of Louis Pasteur, who was primarily a chemist.



THE PUBLIC HEALTH PROBLEM AND ITS SOLUTION

The engineering aspects of public health are many. They include the development of pure water supplies, the proper and safe disposal of excreta and wastes, ventilation, illumination, safety engineering and other phases of industrial sanitation, housing and city planning, malaria control, and finally public health administration itself. These aspects of public health and in fact, all branches of sanitation, have concerned the world since the dawn of civilization.[5] That they may concern all nations so that world-wide sanitation may in the future be not only a possibility but a probability and an attainment to be expected is the plea of Prof. George C. Whipple, lately chief of the Department of Sanitation of the League of Red Cross Societies.

The value of pure water is too obvious to need much discussion. The practical eradication of typhoid fever, notoriously a water-borne disease, stands as a monument to the genius of engineering. Cholera and dysentry, other types of water-borne diseases, are on the way to extermination. Sewage treatment and the disposal of waste is of equal importance. The biggest problem of rural sanitation especially, is that of the safe disposal of human excreta. Industrial hygiene and sanitation is, broadly speaking, just beginning. There are many problems in it for the engineer, such as the proper ventilation, illumination and sanitary facilities of shops and factories and the safety of the employees. These are all questions of environment. The matter of safeguarding against industrial hazards is perhaps more in the field of the mechanical engineer than any other. Housing and city planning are factors of importace to the health of the people. With the present day interest in the prevention of the possible spread of plague, rat-proofing

of dwellings and of municipalities themselves is an engineering responsibility. The control of such diseases as malaria and yellow fever is essentially an engineering problem. It was sanitary engineering which made possible the Panama Canal and alongside of the administrative success of Gorgas must be placed the engineering qualities of Le Prince.

A Field for the Trained Engineer

Finally, public health administration itself is a field for the properly trained engineer. Of course, mere graduation as a sanitary engineer does not fit a man to be a health officer any more than does the mere possession of a medical degree. But the specially trained engineer who has a knowledge of pathology, epidemiology and other branches of preventive medicine has a big place in public health administration. Many of our leading health officials are such trained men and include the chief of the Bureau of Health of Philadelphia, the health commissioner of Detroit, the special health commisioner of Delaware, the health officers of Dallas, Texas, and a long line of health officers in Montclair, the Oranges and other New Jersey communities. As a matter of fact the first and one of the leading textbooks for health officers was written by an engineer.

During the war the government realized the value of the assistance of non-medical sanitarians and so established the Sanitary Corps, which was originally composed of engineers, bacteriologists, sanitary chemists and nutritional experts. The U. S. Public Health Service also made provisions for sanitary engineers in its personnel.[8] State departments of health have recognized the importance of engineering in their work, so that there are now twenty-five bureaus of sanitary engineering in states; among these are included all of the more progressive state health departments. At the Conference of State and Provincial Boards of Health in Washington, D. C., last May, the sanitary engineers were in attendance and in some cases, as from Pennsylvania, the engineer was the representative of his state. The League of Red Cross Societies has also established a Department of Sanitation as part of its program of fostering international health.

To recapitulate, public health is a science in which engineering plays as important a part as any other profession. Public health comprises medicine, sanitary engineering, law, education, statistics and sociology. These various elements naturally are more or less interrelated. The ideally trained health official is one who is familiar with all of them. There is so much to be done in the field of public health that there is room for workers from all these various divisions. One important consideration with regard to the control of public health by members of the medical profession is that the physician is at present urgently needed as a practitioner and can not be replaced as such. Certain quacks, faddists and pseudo physicians, such as the osteopaths, chiropractors and naturopaths, seem to think otherwise, but in any alignment between these half baked therapeutists and those whom they impertinently call "allopaths," the engineer strongly supports the regular physician. The doctor can be adequately replaced as a public health official, but no one can take his place as practitioner. In public health the physician and engineer are colleagues; there is and should be the spirit of closest co-operation and mutual respect. Both are working for the welfare of humanity, and both are essential to the great ideal of a better and stronger race.

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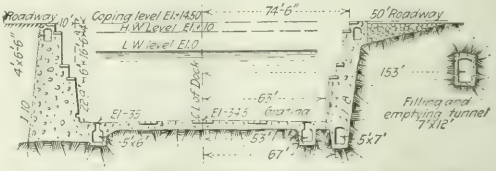
Canadian Government Dry Dock Being Built at Esquimalt

By J. B. Hunter
Deputy Minister, Canadian Department of Public Works

The dry dock now under construction in Skinner Cove at Esquimalt, B. C., is being built for the Government of the Dominion of Canada. The general dimensions are as follows: From caisson stop to headwall, 1,150 ft.; width of entrance, on sill, 125 ft., at coping level, 135 ft.; depth on sill, 40 ft. In addition to



TYPICAL CROSS-SECTION OF ESQUIMALT DRY DOCK

the usual caisson berths at the entrance, the dock will have two inner berths, one of which is to be located 400 ft. and the other 750 ft. from the entrance, thus making it possible to accommodate boats of from 350 to 1,150 ft. in length.

The caissons are to be of the ship-floating type and will be made of steel. Stairs leading to the dock floor will be situated at each corner of the dock, and exposed-timber slides at diagonally-opposite corners.

A passenger elevator with a capacity of 4,000 lb. will be installed on one side, near the center of the dock. The dock is to be filled and emptied through one main tunnel and a series of underground culverts, with two lines of gratings, one on each side of the dock and spaced 10 ft. apart. The whole structure will be made of concrete with the exception of the sills, copings, keel block supports, etc., which will be of granite.

A contract for the construction of the work has been awarded to Peter Lyall and Sons Construction Co., Ltd. The design and all drawings and specifications were prepared by the Department of Public Works of Canada under the immediate supervision of Eugene D. Lafleur, chief engineer.

Panama Canal Slides Quiescent

Curaracha slide into the Panama Canal, which showed a general movement over the entire area from Jan. 1 to 22, inclusive, has since become quiescent says the *Canal Record* of March. 9. Up to Jan. 27, 3,336,400 cu.yd. had been removed from this area since the slide of Feb. 22, 1920. Some material still had to be removed to bring the basin to grade. Culebra Slide showed little movement in January.

Report on Services and Fees of Practicing Engineers

A. A. E. Committee Makes Ideal of Efficient Service the Basis for Rules of Practice and Suggests Fee Schedule

AFTER an extended study of fees and services of engineers in private practice, a special committee of the American Association of Engineers has just rendered a report in which it lays stress on shaping all principles of practice to the ideal of efficient service to the client, and proposes a guide schedule of charges for engineering service. Further study of fees is recommended, especially with a view to compiling a list of fee rates actually used and collected the current forms of proposal and contract for engineering services so that ultimately an authoritative code of fees and practices may be prepared. The committee also recommends that to aid in developing sound methods in the field of private engineering practice a separate department of the association be established for interchange of data and news.

Importance of Service Emphasized

In approaching the subject of proper fee charges, the committee considered the kind and character of service rendered, because "much of the difference in professional practice has arisen from lack of or omission of service in matters upon which the client has difficulty in judging." It states that low fees or free work mean poor service and expresses the belief that the general scale of fees has been held down by artificial causes arising from "the innate modesty of the engineer and certain evils which have crept into professional practice." Engineering fees are declared to be low, compared with those taken by other professional men and financiers, as well as contractors' profits, and do not adequately compensate.

Among the committee's findings or suggestions on service are the following:

Hazard should be eliminated from the engineer's charges, as definite service has to be rendered. The use of retainers is advocated.

Adequate compensation should be paid by the practicing engineer to his employees. Profit-sharing in engineering offices is worth considering.

The indiscriminate use of such titles as consulting engineer has done harm. A reputable engineer will not hesitate to give his client a complete statement of his qualifications for his particular title.

Manufacturers should not be practicing engineers and should not supply plans and advice to customers.

Engineers should not receive commissions or any remuneration from machinery or materials. Special discounts obtained by the engineer should be credited to the client.

The engineer should not act as engineer and contractor simultaneously on the same job, except in so far as he may execute work as agent for the owner under such arrangements that the interests of the two parties are identical.

It is improper for professors, or engineers in public employ, to take work below current professional rates.

Engineering service is so clearly a matter of individual experience and professional achievement that competitive bidding is incompatible with real service and should be thoroughly discouraged.

No professional man or firm should be required to furnish bonds.

Engineers should refrain from offering their services without charge for the sake of prospective work.

Suggested Charges for Service

Consulting and expert engineering service, including consultation, arbitration, professional advice, expert testimony and court work, valuation and appraisal, service and efficiencies tests, and reports, are preferably charged for on a per diem basis. "The amount of the charge" says the committee, "should vary according to the character, magnitude or importance of the work or subject involved or according to the experience and reputation of the engineers," from $50 a day upward. A retainer fee of $250 or more may properly be charged. An additional charge should be made for all actual expenses, plus a profit on this portion of the work of at least 25 per cent. Eight hours of office work are to be considered a day, but when absent from the office each 24 hr. away is to be considered a day. Payment for services should be made monthly or upon submission of report or upon completion of work.

MINIMUM PERCENTAGE FEES FOR ENGINEERING SERVICE
(Estimated Cost of Project in Dollars)

Service Classification	$10,000 to $25,000	$25,000 to $50,000	$50,000 to $100,000	$100,000 to $200,000	$200,000 to $300,000	$300,000 to $500,000	$500,000 to $750,000	$750,000 to $1,000,000	$1,000,000 to $1,500,000	$1,500,000 to $2,000,000	$2,000,000 and up
1 Surveys (Actual Cost Including Overhead Plus a Profit of 25% and Upwards)											
2 Preliminary Reports	2.25	1.75	1.20	.80	.70	.60	.55	.50	.45	.40	.40
3 Plans and Specifications	5.00	4.50	3.75	3.25	3.00	2.75	2.65	2.60	2.55	2.50	2.50
4 General Supervision	2.00	1.90	1.70	1.50	1.40	1.35	1.35	1.25	1.20	1.15	1.10
Total of 2 to 4	9.25	8.15	6.65	5.55	5.10	4.70	4.55	4.35	4.20	4.05	4.00
5 Resident Supervision (Actual Cost Including Overhead Plus a Profit of 25% and Upwards)											
6 Purchasing	2.00	1.80	1.35	1.00	.90	.85	.80	.75	.70	.70	.65
7 Management	5.50	5.00	4.30	3.50	3.00	2.75	2.55	2.45	2.35	2.25	2.15
Total of 2 and 7	7.50	6.80	5.65	4.50	3.90	3.60	3.35	3.20	3.05	2.95	2.80

A fixed total sum may be agreed upon in place of the charge by the day. In fixing this sum the per diem charges should be figured as closely as possible.

What the committee calls "regular engineering service" may be made on a percentage basis according to the table herewith. Such work includes surveys, borings, tests, and other preliminary work; conferences, preparation of preliminary plans, estimates and reports; preparation of working plans and estimates; participation in award of contract and general supervision of construction (not including resident engineers, surveys, field inspection or testing); resident supervision of construction; purchase of materials and equipment; complete management of projects, excluding financing.

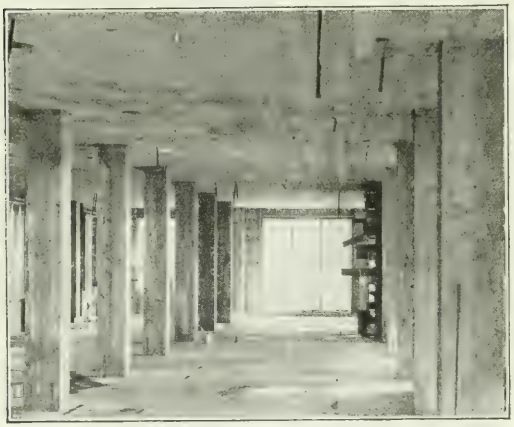
The tabular percentages are to be computed on the cost of the completed work (exclusive of legal and engineering) or (pending execution or completion) the estimated cost. A retainer fee may also be charged.

The committee recommends that an engineer undertaking an engagement should enter into a written contract. Where a specialist is required in connection with an engineering engagement, the cost of the specialist shall be paid by the client. This includes the cost of testing and inspection of materials at factory. Drawings and specifications are to be considered the property of the engineer, but the client is entitled to receive a reasonable number of complete records of them.

Flat-Slab Floors Built Without Drops or Capitals

Uniformity of Panel Spacing and Duplication of Detail Result in Economy for Seven-Story Building

BECAUSE a comparatively small sum was available for constructing a nurses' home in San Francisco, effort was made to work out a design that would afford the maximum space at the lowest cost. The problem was simplified by the fact that only light live-loads had to be provided for and as the building was for dormitory purposes, uniformity of room sizes was permissible. A design for which exceptional economies in space and cost are claimed was accordingly developed for a seven-story flat-slab reinforced-concrete building. Features of the design are the absence of capitals or drop heads on the columns, and the simplicity and uniformity of the floor layout with consequent economy in formwork. The floor slabs were calculated for a dead-load of 110 lb. and a live-load of 60 lb. per square foot.



TYPICAL FLAT-SLAB FLOOR—NOTE ABSENCE OF CAPITALS OR DROPS

The first step toward making the plans as simple as possible was to divide the building area into equal spaces, making all floor panels exactly alike and continuing the columns from basement to roof without break. The building is 101 x 125 ft. in plan and thirty-six 10 x 12-ft. dormitory rooms about 10 x 12 ft. each, are provided on each floor. The room arrangement was worked out so that the columns occur only in partitions, the column spacings being uniformly 10 ft. one way and 12 ft. 4 in. the other. The only exception to this uniformity of column spacing was in a 50 x 50-ft. auditorium on the first floor, at the bottom of the light shaft. Here the roof was carried on steel girders.

Close spacing of the columns and light live-loads permitted a special system of reinforcing for the 6-in. flat-slab floor and made it unnecessary to use floor beams except around some openings left for stairs or shafts. Hence, no hanging ceilings were necessary and ceiling finish was plastered directly on the bottom of the floor slabs. Allowing 20c. per square foot for a hanging ceiling and 5c. per square foot for a plastered ceiling, the net saving, on this score, was figured as 15c. per square foot. The saving in formwork on a flat slab, as compared to a beamed floor slab, was figured as 3c. per square foot. The use of floor beams would have made it necessary to add 10 per cent to the height of the building.

A cement finish on floors was used as more sanitary and cheaper than wooden floors and with a few exceptions, such as in the auditorium, no wooden floors were used throughout the building. The cement finish was put on as an integral part of the slab and troweled within a few hours after pouring the concrete. It was calculated that wooden floors would have added 20c. per square foot to the cost of the building.

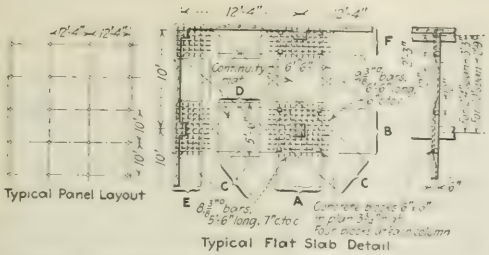
The standard columns were 14 in. square reinforced with straight corner rods and without caps or drop heads. This section provided sufficient area against punching shear due to the live- and dead-load stresses without the use of capital or flare to increase shear area. This feature, which allows the columns to be continued at the same dimensions from floor to the ceiling above, is claimed to afford a considerable saving in the cost of formwork.

The slab reinforcement consists of a combination rod and wire-mesh mat or grillage. As shown in the accompanying drawing, the primary reinforcement consists of a mat of $\frac{3}{8}$-in. bars, nine in one direction and eight in the other direction and spaced respectively 6 and 7 in. c. to c., which are placed in the slab over the column and $3\frac{3}{4}$ in. above the bottom of the slab. These bars in the construction were wired together in the material yard and taken up to place in the building as a pre-assembled unit. The units were convenient to handle and were readily dropped over the column reinforcing which projected above the finished floor level, this projection being the amount of the lap of the reinforcing. The mats were supported at the proper height above the deck on pre-cast concrete blocks which became a part of the slab when the concrete was poured.

With the bar reinforcing in place the next step was the placing of the so-called direct bands of wire mesh. These are 52 and 54 in. wide and run at right angles to the columns. They are indicated on the drawings as strips *A* and *B*. They are of wire fabric containing at least nineteen longitudinal wires per band. For the long way of the panel the fabric was 3 x 16 in. x $\frac{5}{16}$ and for the short way, 3 x 16 in. x $\frac{5}{16}$. These bands pass over the mat of bars at the columns and at a distance 2 ft. 3 in. from the center line of columns they sag toward the bottom of the slab reaching to $\frac{3}{4}$ in. above the bottom of the slab at a distance 3 ft. 3 in. from the center line of columns. Where necessary the transverse wires were cut to allow the fabric to sag below the ends of the grillage bars.

The third system of reinforcement to be placed consisted of diagonal bands of 4 x 16 in. x $\frac{5}{16}$ wire fabric 52 in. wide containing at least fourteen longitudinal wires. These bands passed over the direct band at columns and drop to $\frac{3}{4}$ in. above the bottom of the slab at the center of the panel.

The last system consists of so-called "continuity mats" of 4 x 16-in. x $\frac{5}{16}$ wire fabric 52 in. wide containing at least fourteen longitudinal wires 5 ft. 6 in. long runing the long way of the panel and 5 ft. 6 in. long running the short way of the panel. These mats run across the middle of the span of the direct bands $\frac{3}{4}$ in. below top of the slab for their full length and



TYPICAL REINFORCING ARRANGEMENT IN FLOOR SLAB

extend equally on each side of the center line of the column. Positive means were taken to maintain these mats in their correct position in the top of the slab. The details of the reinforcement are shown in the accompanying table.

At the edges of the slab all systems of reinforcement were extended into the concrete wall to within 2 in. of the outer face, and for a length of at least 1 ft. were imbedded in the wall.

MESH REINFORCING USED IN THE FLOOR SLAB

Key Letter	When Placed	Width of Fabric	Size of Mesh	Size of Wire	Number of Wires
A	After bars	54 in.	3x16	8 and 10	19
B	After A	54 in.	3x16	6 and 10	19
C	After B	52 in.	4x16	8 and 10	14
D	After C	52 in.	4x16	8 and 10	14
E	After pouring concrete	..	4x16	8 and 10	14
F			4x16	8 and 10	14

All concrete in the structure, from foundation to penthouse, was poured within a period of 64 days, eleven separate pourings being made. Typical floors were completed at the rate of one story per week. Shores were kept in place during the progress of the work for three stories below the pouring. A 1:2:5 mix was used in which the crushed gravel aggregate ranged in size from ½ to 1½ in.

The building was designed by C. H. Snyder, consulting engineer of San Francisco.

Calumet Harbor for Chicago

A project for harbor development in Lake Calumet, in the southern portion of Chicago, has been the subject of a public hearing by the council committee on harbors and bridges. The lake is a shallow body of water connected with Lake Michigan by the long and winding course of the Calumet River, both the river and lake being under the control of the Federal Government. Extensive industrial development around Lake Calumet is a part of the project, but there would be facilities also for rail and water terminals and for laying up ships during the winter. According to a report to the city council, prepared by Arend Van Vlissengen, of a real estate firm, the material dredged to form a basin and channels would be used to fill in to low land along the shores, the completed harbor district having 1,450 acres of land and 690 acres of water, of which latter 220 acres would be comprised in slips opening from a large basin. This project is distinct from that of the lake front harbor proposed by Col. W. V. Judson, U. S. A., at Illiana, on the Illinois-Indiana state line, as described in *Engineering News-Record* of Jan. 20, p. 120, but it is considered that both will be needed eventually for the city's development.

Coaling Station for City Engine Terminal: P. & R. R.R.

Three Grades of Coal—Operator Handles Chutes—One Hoist Service for Coal and Sand—Large Sand Drying Plant

A LOCOMOTIVE COALING STATION which provides for automatic triple separation of coal for hand-fired and stoker-fired engines, has 600 tons storage capacity, serves engines on three tracks and utilizes the same elevator equipment for both coal and sand, is one of the important items in the improvement of the Philadelphia & Reading R.R. engine terminal at Tulip St., Philadelphia. About 35 engines take coal daily at this plant.

Drop bottom and hopper bottom cars dump the coal into a track hopper from which it is fed through a 2½-ton automatic measuring loader to a 2½-ton bucket in the elevator pit. The cars are moved on a falling grade to and from the hopper by a cable on a nigger head operated by the hoist motor. An adjustable drop gate between the hopper and the loader provides for regulating the charges, and the loader prevents the coal from flowing into the pit when the bucket is raised.

Automatic Separation of Grades

At the top of the elevator tower, the lower part of the front of the bucket falls forward and forms an apron over which the coal flows to a chute above the coal bin. In the bottom of this chute is a screen 6 x 12 ft. having perforations 2 x 6 in. Lump coal passing over the screen is delivered to one pocket, the finer coal which falls through the screen is delivered to another for supplying locomotives fitted with mechanical stokers. This separation is for bituminous coal. When anthracite is delivered, a by-pass gate at the head of the chute deflects it by a steeper chute to a third pocket. Each of these pockets is of 200 tons capacity. The by-pass gates for the sand and coal chutes are operated by hand chain-hoist, as the man should be over the bin to see the condition in each pocket. A 22-hp. motor operates the bucket hoist, which runs automatically and is started or stopped by push buttons in the hoist house and at a platform above the bin. The elevating capacity is 80 tons per hour.

Two tracks pass under the structure and a third passes on the outside. One engine on each track can take coal of either of the three classes by means of a hinged spout, the enlarged end of the spout being fitted with an undercut gate and hooded apron giving a nearly vertical discharge in order to prevent spilling coal over the tender. These spouts will not be handled by the firemen of the locomotives, but by a station operator who raises and lowers the spouts and adjusts their gates to regulate the supply. An engine can take a full charge of about 15 tons of coal in 45 seconds. No automatic weighing or recording device is used to show the amount delivered to each engine.

Sand Drying and Supply

An unusual feature is the delivery of sand to the track hopper and elevator bucket which serve the coal pockets. This sand for the locomotive is often delivered in coal cars and is thus somewhat dirty, but the hopper and bucket are cleaned before being used for sand, and all foreign matter is removed subsequently by screening.

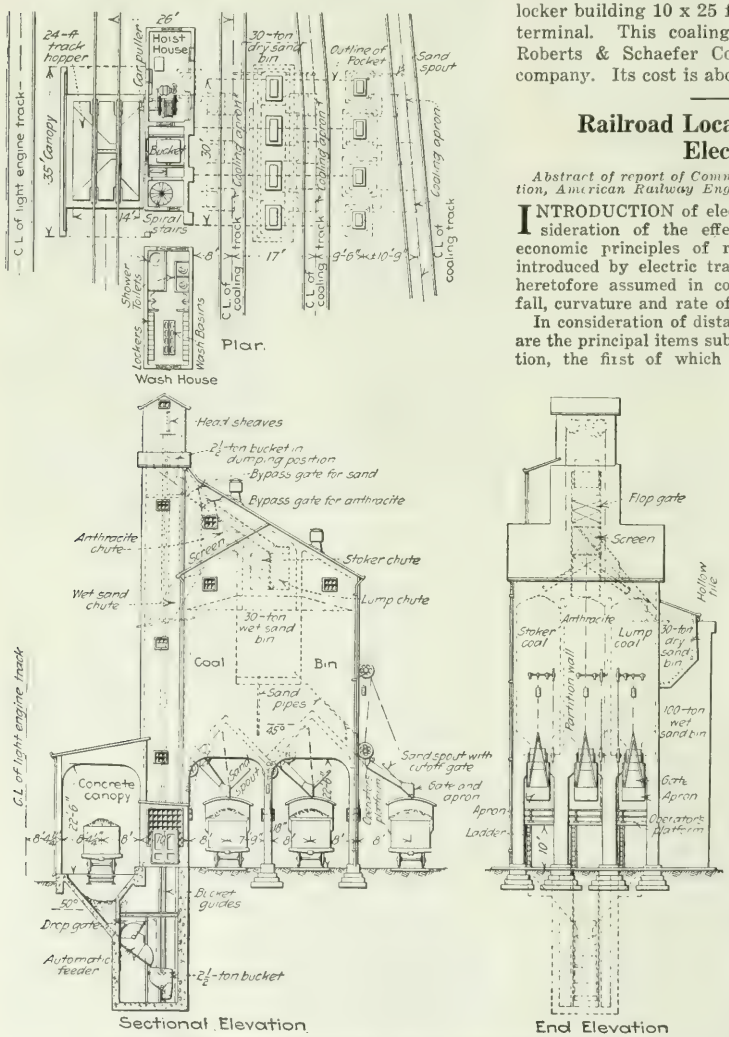
This duplex service of the hoisting plant is an original design by the builders.

From the elevator bucket the sand is delivered to 100-ton storage pocket flowing by gravity from this through adjustable gates to three sand dryers which are inverted pyramids built up of horizontal steam pipes. The wet sand is held by the pipe walls, but as it dries it flows through the openings between the pipes and falls into steel hoppers, from which it passes through screens to hopper drums. When a drum is filled, it is closed and the dry sand is blown by compressed air at 30-lb. pressure through a 4-in. pipe to a 30-ton elevated bin. This bin is lined with hollow tiles for ventilation.

Pipes 4 in. in diameter lead the sand from this bin to each of the three engine tracks, where they end in hinged spouts fitted with cut off gates to control the supply to the engines. The builders estimate the operating and repair expenses based upon handling 110,000 tons per year, as follows:

Coal handling (operating)	3c. per ton
Coal handling (repairs)	½c. per ton
Green sand (operating)	5c. per ton
Drying sand (operating)	2c. per ton
Drying sand (repairs)	1½c. per ton

Two men can operate the plant, one attending to the hoist and bins and the other supplying coal and sand to the engines. The building is of reinforced concrete construction. Adjacent to it is a washhouse, toilet and locker building 10 x 25 ft. for the use of the men at the terminal. This coaling station was designed by the Roberts & Schaefer Co., Chicago, and built by that company. Its cost is about $120,000.



RAILWAY COALING STATION SUPPLIES THREE GRADES OF COAL

Railroad Location as Affected by Electrification

Abstract of report of Committee on Economics of Railway Location, American Railway Engineering Association.

INTRODUCTION of electric locomotives necessitates consideration of the effect of electric operation on the economic principles of railway location. New elements introduced by electric traction will affect economic values heretofore assumed in connection with distance, rise and fall, curvature and rate of grade.

In consideration of distance, train wages, fuel and repairs are the principal items subject to variation under electrification, the first of which is little affected. However, an increased charge is made for operation and maintenance of power stations and transmission and distributing systems. The saving in fuel from electrification may be from 50 to 70 per cent, depending upon the class of service, and engine repairs are reduced possibly 50 per cent. But track maintenance will generally be increased due to destruction effect upon track of comparatively large unsprung weight of motors.

Time and temperature limitations of the electric motor and possibilities for regeneration of power on descending grades will affect previously assumed cost due to rise and fall of grades. The value of regenerative braking under proper conditions is considerable, but it does not become economical except on long, heavy grades.

The effect of a change to electric operation as affected by curvature will be in degree rather than in kind, with the possible exception that the shorter rigid wheel base in some types of electric locomotives will result in reduced resistance and wear of wheels and rails.

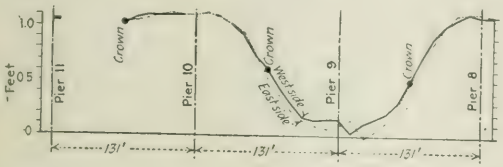
In electric operation the effects of rate of grade and of rise and fall are more closely interrelated than under steam operation. Over lines of moderate grades under steam operation train tonnage ratings can often be determined by average train resistance of the division and the boiler horsepower of the locomotive, rather than by the resistance of maximum grades. But under electric operation the resistance of the maximum grade may become the limiting factor.

Repair of Tempe Concrete Arch Bridge Damaged by Settlement and Floor Expansion

Bridge Over Salt River Endangered by Failure of Cylinder Pier Supposed to Rest on Rock—Load Transferred to New Cylinders Sunk Alongside Pier—Cracking of Floor and Spandrels—Expansion Joints

By Merrill Butler
Bridge Engineer, Arizona Highway Department, Phoenix

Settlement of one pier of the concrete arch bridge across the Salt River at Tempe, Ariz., placed a serious problem before the State Highway Department in the latter part of 1919 and the early part of 1920. The bridge, built in 1911-1913, is a link in the main highway route leading from Phœnix and the Salt River Valley to the eastern and southern portions of the state, and to New Mexico and the East, and is crossed by about 2,500 vehicles per day. It consists of eleven two-rib three-hinged arches of 125 ft. clear span, with open spandrels. The piers were intended to be founded on rock, as stated in a description of the bridge in *Engineering News* of March 28, 1912, p. 578, "on account of the failure of two piers of a large railroad bridge about 500 ft. upstream from the proposed bridge site." Some of the piers were carried to rock in open excavation, but others rest on concrete-filled steel cylinders sunk to rock. It was one of the latter that settled.



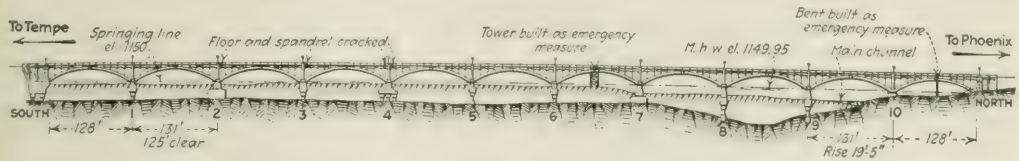


FIG. 1. GENERAL ELEVATION OF TEMPE BRIDGE, AND PROFILE OF ROADWAY IN SPANS ADJACENT TO THE SETTLED PIER NO. 9

Shortly after the floods of Thanksgiving, 1919, the second pier from the north end of the bridge (Pier 9) settled about 4¾ in. Traffic was maintained, except during high water, until Feb. 13, 1920, when a further settlement occurred, about ½ in. A two-ton limit was then placed on the loads permitted to cross the bridge. On March 2 an additional settlement of 1⅛ in. occurred, and the bridge was closed to traffic. The following day there was a sudden drop of nearly 5 in. At this time also it was noticed that the pier had shifted out of line about 0.1 ft., downstream.

A profile of the bridge roadway between piers 8 and 10 is shown by a small sketch in Fig. 1, drawn to an exaggerated vertical scale. The sag was strikingly noticeable in looking along the pavement, as in the view, Fig. 2. Evidently the structure adapted itself to the 1-ft. settlement of pier 9 in fairly flexible manner. No evidence of any crack in the floor was found in the region of settlement, although the hand rail was badly cracked; the longitudinal steel in the floor slab probably prevented any serious break in the concrete.

Emergency measures were taken at once to insure the stability of the structure, and the bridge was thrown open to pedestrian traffic on March 4. Material and equipment for sinking cylinders to underpin the defective pier had been in process of being assembled for some time, but repair work could not be started till late in the month as the timber that had been ordered was delayed in shipment. Once begun the work progressed so rapidly that vehicular traffic could be allowed to cross the bridge again on May 11.

Conditions at the Settled Pier

Prior to the flood of Thanksgiving, 1919, pier 9 was entirely surrounded by sand and gravel, which, being in its undisturbed state, served to carry a considerable portion of the load by way of the base of the pier block (note the pier construction, Fig. 4). The flood swept away all this material and left the pier supported on the two cylinders, which proved inadequate to carry the load. Soundings taken in March, 1920, indicated that except for some thin layers of gravel overlying the bedrock everything had been scoured out. In the light of the difficulties subsequently experienced in sinking the new cylinders it is very probable that the concrete in the bottom of the original cylinders was of inferior grade, or that a foot or so of sand had filtered in after the rock had been cleaned off. The natural consequence would be a crumpling of the steel shells of the cylinders, and this is what actually happened, it is believed. Unbalanced live-load thrust would tend to accelerate such failure.

Other defective conditions in the bridge had also developed, and the plan for the repair work included them. A great number of the spandrel columns were found broken in horizontal shear near the extrados and several spandrel walls near the crown had pulled loose from the arch rings. In the vicinity of piers 2, 3 and 4 the roadway slab and spandrel arches had cracked completely through; in the spans adjacent to these piers none of the spandrel columns were cracked.

There was also trouble at the floor expansion joint. The type of joint used had proved unsatisfactory and large chuck holes had formed alongside each joint, causing serious impact whenever a heavy vehicle passed

FIG. 2 SAG OF ROADWAY OVER SETTLED PIER

over the bridge; in some cases the concrete supporting the wooden strips which bridged the joints was found to be cracked and broken from traffic action. The reconstruction of these joints as well as the repair of the other bridge defects will be mentioned farther on.

Underpinning the Pier

In April the channel of the river, scoured out by the November flood, began filling up again, and by the middle of May a considerable deposit of silt and fine sand had accumulated around pier 9. This condition and the desirability of maintaining traffic on the bridge were the main factors of the problem when the state highway department entered upon the repair work in the spring of 1920.

Falsework under the bridge was considered necessary as a safeguard if traffic was to be carried during reconstruction. The department had no steel sheetpiling available, and market conditions were such that none could be obtained for immediate delivery. It was decided to place new cylinders around the old pier, which would allow the underpinning to be done without disturbing the existing structure; it was feared that there was a chance that the pier might tip over if the old cylinders were left without lateral support. The total dead load at the base of the cylinders of pier 9, not allowing for buoyancy of the water, was about 1,650,000 lb. Salt River is subject to sudden freshets, and all work had to be planned to withstand a sudden rise of the river at any time. Fortunately no rise greater than a foot occurred during the whole undertaking.

As already mentioned, emergency provision for holding the structure against further movement was made early in March, when, after a sudden new drop of pier 9, the total settlement had reached a foot. A repair gang was hurried to the bridge and put in a 36-hour shift. About 500 sand bags were thrown around pier 9, in the hope that the bearing would be increased and further scour prevented. Towers were built at the crown of spans 7-8 and 10-11, with the object of saving the remaining portion of the bridge if the two spans between piers 8 and 10 went out; the depth of water in the river prevented the construction of supports any nearer to pier 9. With respect to the arrangement of the temporary supports it should be remarked that the deck of the bridge is continuous over the piers, and has expansion joints at the crowns of the arches only (except as subsequently reconstructed). Since this emergency work no further settlement of the pier has been observed.

Later in the month, in preparation for the underpinning work on pier 9, falsework piles were driven in spans 8-9 and 9-10. These had to be placed outside the side lines of the bridge because the driver leads reached above the deck. Framed bents were erected on these piles, and their caps wedged against the intrados of the arch ribs by oak wedges (Fig. 3); a man inspected these wedges every second day, to make sure that none worked loose under the action of traffic.

Work on a cofferdam around pier 9 was started immediately upon completion of the falsework. It was made up of Wakefield piles consisting of three 2 x 6's, 2 x 8's or 2 x 10's, 20 ft. long, driven by a small steam hammer hung from a pair of short leads mounted on skids. A jet was used to facilitate the sinking, but despite the jet there was considerable difficulty in getting the piles down, owing to the compact nature of the sand.

The general scheme of underpinning is clearly indicated by the drawing in Fig. 4. The work of sinking the steel cylinders began early in July. A small stiff-leg derrick was rigged to handle a 2½-ft. orangepeel bucket, operated from an engine near pier 10. A 40-hp. gasoline engine and a belt-driven 8-in. centrifugal pump were installed on a barge near the downstream side of the cofferdam; this outfit at all times kept the water level below the bottom of the new concrete block.

All of the six new cylinders went down easily with-

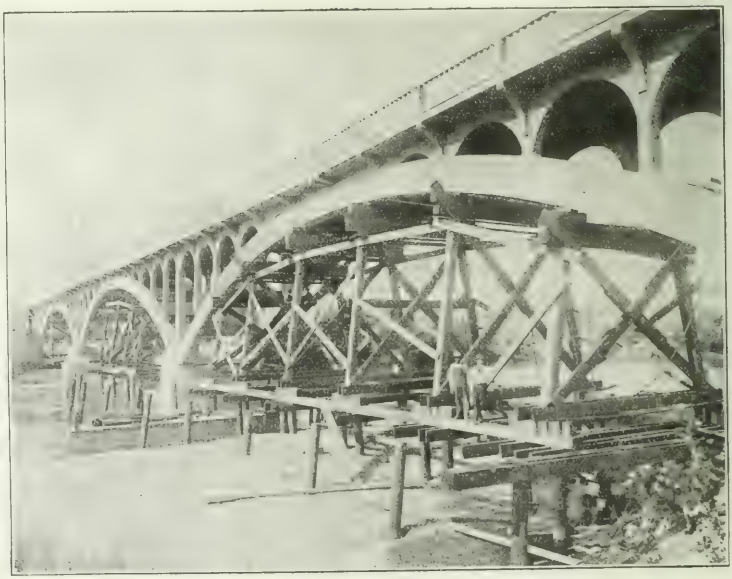


FIG. 3. FALSEWORK ON BOTH SIDES OF PIER 9

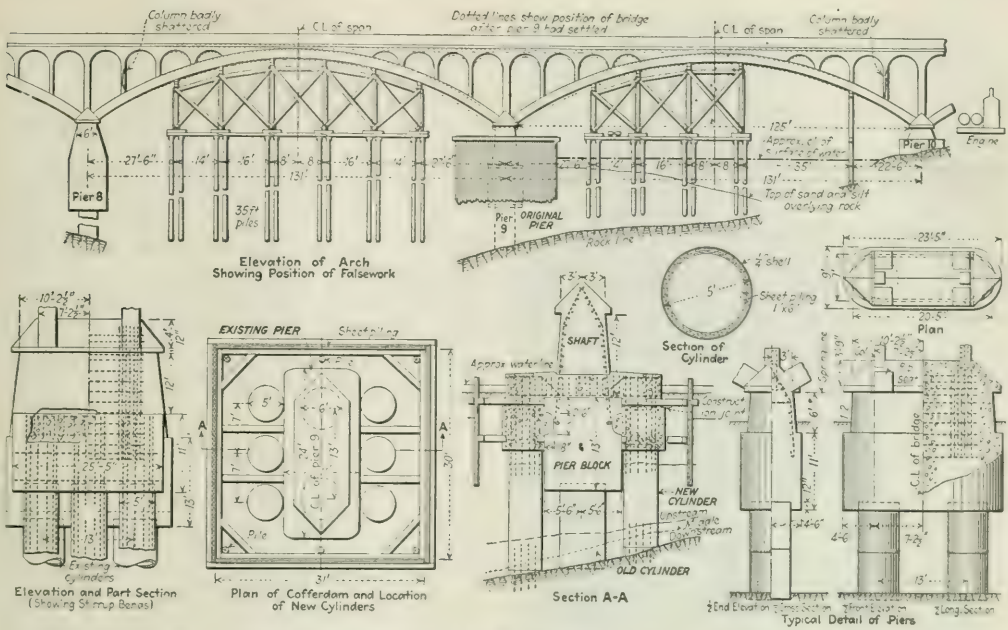


FIG. 4. PIER 9 UNDERPINNED BY NEW CYLINDERS SUNK ALONGSIDE, WITH REINFORCED-CONCRETE BEAM CAP

out loading, until they lodged on logs or branches of trees that had wrapped themselves around the pier during floods. These obstructions caused considerable delay, especially as the fine sand flowed almost with the consistency of water, and it was impossible to pump these cylinders down. Dynamiting was tried, to break up the logs, with little success, and in two cases with rather damaging results, as events proved. Cutting tools of 1¼-in. drill steel were then made up and these proved very satisfactory for getting the timber obstructions out of the way. Cottonwood logs 8 in. in diameter were removed by this means. After this clearing, no difficulty was experienced in getting the cylinders down to rock. Even then, however, the flow of sand was such that it was impossible to reach the rock for cleaning it off and anchoring the cylinders.

To solidify the sand around each cylinder, at least sufficiently to allow the cylinders to be pumped out, grout apparatus was made up and placed on the job. Steam pressure was found to bake the cement until it clogged the 6-in casing; water pressure worked quite satisfactorily. The general scheme of operation was as follows: Grout was poured into the storage chamber after removing the cap, and when the cap had been replaced the water pressure from the pump was turned on. The valve in the 2-in. pipe was kept closed until pressure was on the storage chamber, in order to prevent sand from working into the bottom of the jet pipe. At first considerable inconvenience was experienced from the entry of sand, but by installing the valve and keeping it closed until full pressure from the pump was on the storage chamber the trouble was largely overcome. The bleeder at the bottom of the storage chamber was used to determine when the grout had been forced out.

In some cases the grout set up, but when excavation was continued, a week after grouting, much material of pasty consistency was removed. Evidently where the sand carried a considerable amount of silt the cement had failed to set. The grouting proved to be only partially successful, in no case entirely stopping the flow of sand and water.

Wakefield sheetpiles of three 1 x 6 boards were then driven inside the cylinders by hand, after the sand had been excavated as low as possible with the orange-peel bucket. Once the piles were down to rock, it was possible to pump the cylinders. The sand was then removed, the rock cleaned off, four anchor holes drilled for 1¼-in. square rods set in pairs, and the anchor rods grouted in. The sheetpiles showed little tendency to kick in at the bottom.

When examined, cylinders 1 and 5 proved to be so badly distorted by the blasting tried for removing logs that it was necessary to pull them and sink new cylinders. The seams were broken and the lower sections forced out of round. Blasting had been done with quarter-stick charges of dynamite.

The bottoms of the cylinders were sealed with concrete, and twelve 1-in. square rods were set in place with sufficient lap below the tops of the anchor rods to provide bond. The cylinders were then concreted up to the construction joints just below the cap concrete. The steel shells were cut off at the proper elevation with an oxyacetylene torch. Then the concrete caps were poured, up to the top of the old pier block. After they had set, the existing shaft was cut out in sections and the reinforced beam which transfers the pier load to the new cylinders was poured.

No effort was made to raise the pier or the floor back to the original elevation. The hand rail, however,

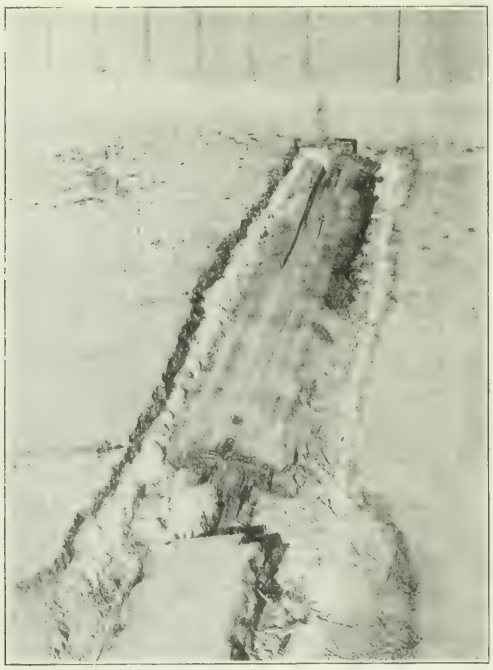


FIG. 5. OLD ROADWAY EXPANSION JOINT

has been rebuilt, to remove the appearance of sag, and it is proposed to take out part of the dip in the floor by filling in with a wood block pavement between crown expansion joints on either side of pier 9.

At piers 2, 3 and 4 the original plans for the floor did not contemplate the use of the longitudinal steel subsequently decided upon and used in the other panels; instead the slab was thickened and longitudinal steel rails were added here. The reinforcing in the center longitudinal beam, however, remained unchanged throughout the construction. These beams were found to be cracked or broken in diagonal tension in four cases, at the three piers in question, and the roadway slab and spandrel arches were cracked substantially as shown on section *MM*, Fig. 4. In two instances these cracks were so wide that a man's little finger could be inserted.

To repair the damage, the old concrete was cut back to the middle of the panel, and a new girder built alongside the old cross-girder, with an expansion joint as shown. Additional stirrups were placed in the longitudinal beams to take care of horizontal shear. During this work all vehicle traffic was excluded from the bridge.

Renewal of Crown Expansion Joints

As originally built, the floor expansion joints over the crowns of the arches consisted of a beveled strip of redwood spanning the 4-in. gap in the concrete, seated in a properly beveled recess in the floor. This strip was stiffened by another strip attached below as a rib, and was covered with asphalt continuous with that over the concrete. These expansion joint had never been repaired, except for additions to the wearing surface, during the seven-year interval since the bridge was built. Large chuck holes had formed at each joint, Fig. 5, and in some cases the concrete supporting what was left of the redwood filler was cracked and broken.

Experience had shown the impossibility of keeping a satisfactory asphalt surface over an expansion joint supported on both sides of the crown opening. There-

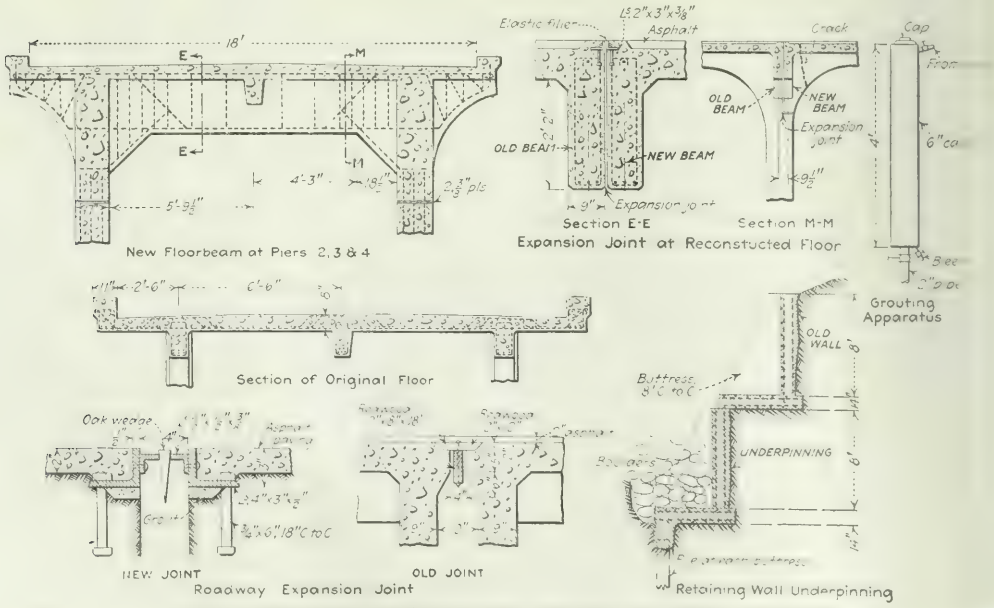


FIG. 6. EXPANSION JOINTS AND FLOOR DETAILS, AND REPAIR SKETCHES

fore the design shown in Fig. 6 was decided upon for the reconstruction. The 1½ x 1½ x ⅜-in. angles are for the purpose of reducing the width of the opening, and are dropped below the general surface of the pavement to prevent their taking much weight from traffic.

One of these new joints has broken out from the effects of stresses to which it was subjected, but has been replaced. Oak wedges have been driven as shown, and these seem to have been of material help, as no other trouble has been experienced at the joints, which have been in service now a little over six months.

Underpinning Retaining Wall

The retaining wall adjoining the east abutment was a reinforced-concrete buttress wall founded on gravel. Floods had scoured out the gravel adjacent to this wall until the edge of the footing was exposed and slightly undercut on a length of about 30 ft. It was considered necessary to underpin the wall for a 50-ft. length.

This work was carried out in sections, the gravel bank being utilized as back form. Under the toe of each buttress there is a pile, for added security. The nature of the construction is clearly shown in Fig. 6.

No attempt has been made to repair the broken spandrel columns, as their condition is not considered to involve any direct danger.

The entire work described was carried on under the direction of Thomas Maddock, state engineer, F. N. Holmquist, assistant state engineer, the writer as bridge engineer, J. H. Zeitler as construction engineer during the foundation work, and J. M. Brown in the same capacity during falsework construction and floor repair. All work was done by state forces, and most of the equipment used was state owned.

Good Scholarship and Engineering Eminence

A close correspondence between good scholarship in college and eminence in engineering is shown in an investigation made under the auspices of the American Association of Collegiate Registrars by Prof. Raymond Walters of Lehigh University, who presents a report in the current issue of *School and Society*. It was found that of 392 distinguished engineers graduated at 75 technical schools, colleges and universities 182, or 46.4 per cent, stood in the highest fifth of their classes scholastically upon graduation, 109, or 27.8 per cent, stood in the second highest fifth, 72, or 18.3 per cent, in the middle fifth, 14, or 3.6 per cent, in the next to lowest fifth, and 15, or 3.8 per cent, in the lowest fifth. Figures for a group of 189 alumni of five Eastern engineering schools were somewhat different in the upper classes, the second highest scholastic fifth having the largest percentage. In all groupings of the eminent engineers there were less than 4 per cent in each of the two lowest scholastic fifths. Of 730 names on the Registrars' Association list of distinguished engineers practically 80 per cent were found to be collegiate graduates, 16 per cent men of secondary school education and practical training, and less than 5 per cent men who started in college but did not finish. The arbitrary basis of eminence in this study of a professional group was taken to be the holding of office, membership in important committees and service as representatives of the four founder engineering societies, civil, mechanical, electrical, and mining and metallurgy, for five years, 1915-1919.

Allocation of Nile Waters Between Egypt and the Sudan

Minority Report by H. T. Cory, American Member of the Nile Project Commission, Gives Principles of Water and Cost Division

INDORSEMENT of the immense project for the full utilization and a larger measure of flood control of the Nile advocated by the Egyptian Ministry of Public Works, but with divided opinion as to the allocation of water and cost between Egypt and the Sudan are the outstanding features of the report of the Nile Project Commission (see review, p. 689 of this issue), created early in 1920, whose report was dated in August of that year but not made public until 1921.

Unusual interest for American engineers attaches to this report because one of its three members was H. T. Cory, of San Francisco, Cal. This interest is heightened by the fact that Mr. Cory felt compelled to make a minority report as regards allocation of water and cost between Egypt and the Sudan, in which report he embodied his conception of the fundamental principles that should govern the allocation of water between two countries having a common interest in the same stream, as well as the basic principle for joint action in developing the water supply and distributing the cost of the work between the two countries.

Briefly, the two majority members of the commission—F. St. John Gebbie, inspector general of irrigation in India and head of all the irrigation service in that country, and Dr. G. C. Simpson, since last September head of the Weather Service of Great Britain and before that chief of the Weather Bureau of India—attempted no definite and comprehensive answer as to the allocation of water and cost, but merely proposed that Egypt and the Sudan should each go on with water storage developments already under way—Egypt with the Gebel Aulia reservoir on the White Nile to be formed by a dam just above the junction of the White with the Blue Nile, and the Sudan with the Sennar or Makwar reservoir, being formed by a dam at Sennar on the Blue Nile some distance above Khartum—each country to pay the entire cost of its reservoir and to have the use of all the water stored by it, with relatively minor exceptions and adjustments based upon local conditions.

As to Mr. Cory's proposal for allocation of cost and water the majority members of the commission say:

"With regard to Mr. Cory's report, we feel that while his findings may be theoretically correct it is impossible, on financial and other points, to apply them in present circumstances."

It should be noted that the complete project contemplates a large amount of additional storage and also the construction of a long channel through the Sudd in order that water proposed to be stored in Lake Albert may not be lost in its passage to the Nile proper through what is now a vast overflowed area. It should also be noted that data for the design of these additional works are still lacking. The majority of the commission apparently bases its failure to attempt to allocate water and cost from the ultimate development to a lack of data and to other difficulties. This lack of engineering data and all the other unenumerated difficulties Mr. Cory appears to think do not stand in the way of an allocation of water and cost on broad general principles and to a certain extent upon experience. Mr. Cory also sets forth

in his report figures designed to show that if the Sudan shared half and half in the development of storage in the Gebel Aulia reservoir on the White Nile, and also half and half in the water thus developed, it could irrigate far more land in the Sudan at much less cost than would be possible with the water stored in the Sennar or Makwar reservoir. This, however, is contingent upon the assumption that because Egypt has the benefit of a large volume of the natural flow of the Blue Nile both in Egypt and the Sudan should share equally in the cost of the first additional reservoirs constructed on the two branches of the Nile, the Sudan being allowed to use all of the water from the Sennar or Blue Nile reservoir and to have half of the water conserved by the Gebel Aulia or White Nile reservoir.

For a complete understanding of the position taken by the majority and minority members of the commission either the complete report on "Nile Control," published early in 1920, is necessary or a somewhat extensive abstract of the report. Lack of space prevents giving further details here and at the same time presenting Mr. Cory's presentation of "General Principles" underlying the allocation of water which constitutes the portion of the report of greatest interest to American engineers, and also to engineers in other parts of the world outside of Egypt. In outlining these general principles Mr. Cory introduces, here and there, what might be termed supporting evidence from the Quran or Koran. This portion of Mr. Cory's report is as follows:

There are several kinds of beneficial use which may be made of a stream's water. The most important are navigation, power development, irrigation, human and animal consumption. Broadly speaking, irrigation differs from the other uses in that relatively large quantities of water must be abstracted from, and only a portion can be returned to, the watercourse.

Regarding the beneficial uses of water, the legislation of the Occident, viewed as a whole, appears to start from the primary principle that every riparian proprietor is entitled to make a beneficial use of the natural flow of a stream running through or along his land, in its accustomed channel, undiminished in quantity and unimpaired in quality except as may be occasioned by the reasonable use of the stream on the part of other like proprietors.

This doctrine, however, has had to be abrogated or curtailed by constitutional or statutory amendments or by the effect of judicial decisions whenever found to be unsuited to the natural conditions of a given governmental unit, or inconsistent with the proper development of those industries or those beneficial uses of water which are deemed of paramount importance.

Whenever the rule remains in its pristine form careful analysis will show that either the governmental unit which has adhered to the old system is supplied with a sufficient or evenly distributed rainfall or that its economic welfare is but slightly dependent upon utilizing the water of its streams.

The Orient, on the other hand, has taken the principle that water is public property. It has adhered to but one rule in this regard, which as enunciated by Muhammad is "People are free partners in three things, water, vegetation which springs spontaneously from the soil, and fire."*

In some portions of the Occident there is not an evenly distributed or sufficient rainfall, and as the development of these portions proceeded the emancipation from the thraldom of the "riparian ownership" principle took place or is taking place. A usual change is to the doctrine of "prior appropriation." This rule of "first in time, first in right" implies that one who appropriates water is entitled to the full amount appropriated to the exclusion of all subsequent takers, the capacity fo the first appropriator's channel fixing a limit beyond which he must not go in taking water but up to which he is *prima facie* entitled to take.

This basis of adjustment works out in practice as long as there is in the stream a surplus of unappropriated water. A contingency often arises, however, where the potential water supply is materially reduced but along the banks there still remain large tracts of arable lands unwatered but irrigable belonging to diffrent proprietors, including the original appropriator, all of whom simultaneously law claim to the unappropriated water supply.

Neither the legislation, the jurisprudence, nor the diplomacy of the Occident has as yet laid down a principle of universal application affording a solution to the problem thus presented.

The original doctrine of "riparian ownership" obviously cannot be resorted to as an initial basis of reasoning.

The rule of "first in time, first in right" fairly recompenses foresight and rewards enterprise. It finds its proper application as long as the potential water supply answers all existing needs. It recognizes vested rights but limits these vested rights, and does not give a "first appropriator" a right of pre-emption upon the "unappropriated" water supply.

The civilization of the Occident has sprung from lands where rain nurtures vegetation and there is ample water for potable and domestic use. The cradle of the Orient is largely a vast desert, redeemed from unproductivity by streams and springs, and therefore, in the very nature of things, the Near East looks upon water as a precious commodity and carefully provides for its distribution.

Thus one naturally turns to the basic legislation of the Orient for a suggestion. The East is a land of parables and the great truths of the Quran are often handed down in the form of parables. When, therefore, the apostles said to Saligh: "*You are* naught but a mortal like ourselves; so bring a sign if *you are* one of the truthful," he said: "This is a she-camel; she shall have her portion of the water and you have your portion of water on an appointed time."†

The word "*shirb*," which is used in the text, according to Maulid Muhammad Ali, the eminent commentator, "signifies either an act of drinking, or a share or portion that falls to one's lot of water, or a watering-place, or a time of drinking, and in law signifies the use of water for the watering of sown fields and of beasts." ‡

And then, again, it is decreed, "And inform them that the water is shared between them; every share of the water shall be attended."§

The tendency of modern Occidental water-right legislation is toward the final results of Oriental experience and a conserving of the natural resources on which depend the permanent prosperity and the equal opportunity of the people in a given governmental unit. The result has been that many recent enactments in semi-humid and arid areas specifically declare that water forms part of the public domain and is in no sense private property.

It is, therefore, the duty of Governments to consider that the use, conservation and development of water must be viewed as a public trust and administered in the interests of the beneficiaries of the trust, and accordingly with due regard to the eventual rights of generations yet unborn.

The principle being accepted, it follows that, in the contingency before cited, the arable lands unwatered but irrigable belonging to different proprietors, including the "original appropriator," enjoy an equitable right to an adequate share of the unappropriated water of a stream.

The proper conservation and development of the water yield from any drainage area will, in general, require the construction of storage or other works which should be located with due regard to the interests of the beneficiaries of the trust aforesaid.

Circumstances may obtain whereby the physical configuration of a governmental unit which comprises within its

*Hadith, complied by Imam Alaa Eddin el Hanafi, Part VI., p. 189, line 1.

†Quran, Sura, The Poets, verses 154-155.

‡The Holy Quran, containing the Arabic text with English translation and commentary, by Maulid Muhammad Ali, Islamic Review Office, Woking, Surrey, England, 1917, cxiii, 1275 pp. p. 136.

§Quran, Sura, The Moon, verse 28.

limits arable land unwatered but irrigable traversed by a stream makes it impossible for the said governmental unit to construct within its own borders such works as may be necessary for the proper conservation and development of the stream flow in question, although it would be physically possible for it to construct such works upon the territory of a neighboring power.

The construction of such works upon the territory of a neighboring power would be a violation of the sovereignty of the neighbor, and they therefore cannot validly be erected except as the result of an agreement.

Should no such agreement exist, and it be desired that certain fundamental principles be enunciated as a basis of agreement, an equitable adjustment can be effected by considering the real nature of the rights of all parties.

Assuming that the consent of the neighboring power has been obtained and that no third power asserts a conflicting interest, it becomes the duty of both high contracting parties to view the stream as an entity, to apply the principle hereinbefore enunciated to the stream as an entity, and to consider that the use, conservation and development of water must be viewed as a public trust and administered in the interests of the beneficiaries of the trust and with due regard to the rights of generations yet unborn.

The two governmental units, viewed thus as joint trustees charged with a common trust, can reconcile the interests of all concerned by acting as a *"bon père de famille,"* that is to say, by solving the problem just as would a parent towards the children whose present and eventual interests were committed to his charge.

Such a one would begin by acquainting himself with the genesis, evolution and crystallization of the law in respect to water rights. When he had thus prepared himself the conviction would be borne in upon him that in the Quranic maxims before cited, as well as the experience of the arid and semi-arid Occident, is found the key to the entire subject. He would therefore refuse to look upon a stream as private property but would view it solely as a constituent element of the public domain. He would also keep prominently before his mind the cardinal principle that the right of drawing water from a stream is not, in the last analysis, an attribute vested in the owner of riparian property, but a servitude due to the property itself as distinct from the present owner thereof or those who may inhabit the land at the moment.

In connection with the last clause it may be well to notice the suggestion sometimes made that the allocation of water should be based upon, or at least take into account, the population of the moment. Such an idea is untenable because, first, the vesting of rights to use irrigation water in *individuals* instead of making them appurtenant to *lands* would quickly bring about chaotic condtions; second, with regard to vested rights in general, the number of people in men's families is not considered in their adjustments; and, third, relative populations change enormously in short periods, due to civil and foreign wars and many other causes, and water diversions cannot practically be changed in synchronism—the very essence of water rights is that lands acquiring them should be assured of continual irrigation in future.

He would then require that he be advised:

(1) Of the full amount of water used throughout the various seasons of the year by each high contracting party during the past few years; and

(2) Of the superficial areas of arable lands unwatered but irrigable of each high contracting party within the watershed of the stream and of their irrigation water requirements.

After having verified the respective figures so submitted he would decree that:

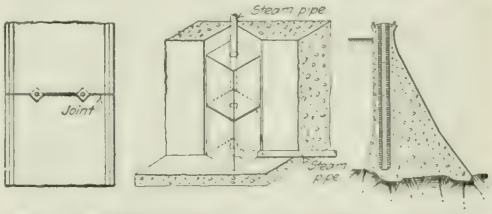
(1) Each high contracting party should be considered as having a vested right in perpetuity to the supply of water when and as beneficially used by it during the past few years.

(2) The unappropriated water possible of use with conservation should be divided among the two high contracting parties so as to in each case permit irrigation of like percentages of the superficial area of arable land unwatered but irrigable and lying within the watershed of the stream.

(3) The cost of all works which may be constructed pursuant to the agreement in question, as well as all maintenance and operation charges in connection therewith, should be shared upon the basis of the quantity of conserved water each shall be entitled to receive, measured at the point of conservation, it being understood, however, that if either high contracting party should not desire or be able to advance its share of the first cost of any conservation work its failure so to do in no sense estops it from eventually participating in the full use of the works aforesaid upon due payment of its proper share of the cost.

New Stop-Water for Joints in Concrete Structures

A STOP-WATER, or means of sealing joints in concrete structures, recently patented by Francis Betts Smith of San Francisco, has the novel feature of providing for renewal of the seal in case it is broken by settlement of the structure or other causes. The seal is made by asphalt in the form of blocks placed in a vertical groove during construction. After the completion of the structure this asphalt is melted by passing steam through



PLAN AND SECTION OF DAM WITH DETAIL OF JOINT

a pipe imbedded in the blocks, thus allowing the hot asphalt to flow into and fill the joint. Should renewal of the seal become desirable at a later time, the asphalt is again melted and if necessary more is added at the top of the column to replace that which, at the time of the second melting, may flow into the joint.

In making the forms for a concrete face which is to be sealed to the one adjoining, a vertical V-shaped projection is made in the form so that a groove of this shape will be left in the finished concrete face. When the second or abutting section of concrete is being poured against this face, asphalt blocks of square cross-section are placed, half in the groove and half projecting into the new concrete, which is poured around them. These blocks have a hollow core and when they are placed an iron pipe is also put in, passing vertically through the core of the blocks. Short lengths of pipe are added as the work progresses.

The pipe is connected so as to form a U with both ends terminating at the top of the structure. In a thin dam or retaining wall, the two lines of pipe are run in in the same column of asphalt. In dams of considerable bottom-width, the pipe is run horizontally along the bottom and returned to the top in another column of asphalt, not necessarily vertical. Where the two columns are separated by a considerable distance and after the asphalt joint has been made tight by the heating process, grout may be pumped from the top of the structure into the joint between the two columns of asphalt, thus developing the beam action in a straight gravity dam or, in the case of an arched dam, forcing the arch to take its share of the load.

Effect of Practical Factors on Earth-Pressure Theory

Many Observed Phenomena Are Due to Cohesion But Designing for Non-Coherent Material Is Conservative Practice

By George Paaswell
Civil Engineer, New York City

IN DECIDING upon the amount of earth presure to use in designing a retaining wall the engineer is perplexed by large discrepancies between the theory on which standard methods are based and various practical facts. The result often is doubt as to the validity of accepted theory, and uncertainty as to how strong a wall he must provide. The present purpose is to show that such doubt is not warranted and that the current methods of dealing with earth pressure are safe and conservative.

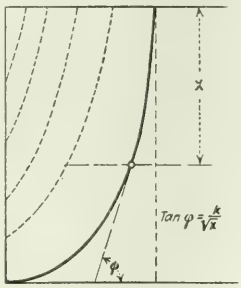
In analyzing earth pressures we instinctively seek an analogy to other structural materials, elastic solids. The analogy is limited, for elastic solids possess continuity, while earth masses are discrete aggregates in which the ordinary stress-strain relations can only be assumed to exist by a highly artificial mechanism; yet it is useful, and probably valid with regard to transmission of high pressures. A verification of this elastic-solid analogy was given by Charles Terzaghi in *Engineering News-Record* of Sept. 30, 1920, p. 632. It leads to interesting qualitative results.

But why do we seek such analogies in place of established theory? The classic theory of earth pressure predicates its formulas upon a granular, non-coherent soil with plane slip surfaces. Such soil, admittedly, occurs but rarely in practice The soils actually encountered comprise (1) recent fills and (2) old fills or original soils cut through, and while the former may often suit the assumptions of the theory the latter do not.

The action of a new fill is exemplified by a load of sand back-dumped from a motor truck. As the body elevates, the material sloughs off with *plane surfaces of slip;* the material then reaches a static condition and no more fill comes away; the driver gives the truck a sudden jerk and the shock sends the rest of the material sliding to the ground. In such material, and generally in any new fill of low height, the plane surface of rupture does exist. But under load, and by the action of time, a fill becomes compacted, and the plane of slip becomes warped. The principal cause of this change is cohesion; it is cohesion that causes the divergence between theory and practice.

Experience data given by H. G. Moulton in a paper entitled "Earth and Rock Pressures" presented before the American Institute of Mining and Metallurgical Engineers a year ago are significant with respect to earth-pressure theory. Mr. Moulton refers to a remark of E. G Haines, some years previously, that earth banks break on the surface a distance back from the edge of the cut equal to one-half the height of the cut, and that rock should show the same behavior if the cut were deep enough. Deep mining in rock makes it possible to test this prediction. Observations on mines, and on deep cuts and tunnel work of the New York subway (for which Mr. Moulton was consulting engineer) supply information on the action of many materials, from rock to moist sand. The general conclusion from the observed facts is that failure of the material is independent of the so-called angle of repose (which for rock would be 90 deg.) and follows generally along the 1:2 break line noted by Mr. Haines.

In moist sand, verification of the conchoidal fracture plane whose extreme points fall within the 1:2 slope is supplied by observation of the limits of street settlement over tunnel work in soil of that character. Verification of the law for gravel banks was obtained by study of placer mining operations. The copper workings in the West illustrate that in deep rock cuts the general law also holds. Thus it may be said to be shown that coherent materials of all types have a similar mode of failure, which is independent of the angle of repose of the material. An explanation of the action of timbered cuts is made on the basis of this uniform law, involving arch action of the soil as described some years ago by J. C. Meem.



FAILURE SURFACES IN COHERENT EARTH

Mr. Moulton has thus brought coherent materials into one general class whose failure surface is, roughly, a quarter ellipse with horizontal offset at the top about one-half of the depth. A similar failure surface may be deduced for an elastic solid, the friction and cohesion elements of soil being replaced by tension, compression and shear, as follows: The maximum tension in a solid is given by any text on mechanics as

$$f = \frac{c}{2}\left[\sqrt{1 + 4\frac{p^2}{c^2}} - 1\right]$$

where f is the maximum tension, p is the unit shear, and c is the unit compression. Since of necessity tension and shear stresses are small in comparison with the compressive stresses, p/c is a small fraction; hence we may expand the radical and drop the terms of higher power than 2, so that,

$$f = \frac{c}{2}\left(1 + 2\frac{p^2}{c^2} - 1\right) = \frac{p^2}{c}$$

Again, the angle that the plane of maximum tension at any point makes with the horizontal is $\phi = \tan^{-1}(2p/c)$, or, in view of the relation just developed, $\phi = \tan^{-1} 2\sqrt{f/c}$. The unit compression c which occurs in this equation is the weight of the unit column of earth above the point in question, or wx, if x is the depth below the surface and w is the unit weight of the earth. Substituting this value, $\tan \phi = 2\sqrt{f/wx}$.

Using this equation, curves of maximum tension may be drawn. The curves of maximum tension, however are the curves of possible failure for a material weak in tension. Considering the ratio f/w a constant for the purpose of this calculation—a rough approximation, but of some service—the equation just developed may be used as a differential equation; its integration shows that the surfaces form a family of parabolas, as sketched herewith. They correspond closely to the fracture surfaces of Mr. Moulton.

From a practical standpoint there is no justification in attempting to force the above mathematics any further; the premises will not permit it. But since observed facts as well as this theoretical estimate of the effect of cohesion prove that the slip surface is

curved, while the classic theory takes it as a plane, we are in the anomalous position of founding a mechanics of soil pressure on a type of failure that does not generally occur.

Cohesion varies for different coils and for different parts of the same soil, and also varies with time, degree of moisture, compactness, etc. Moreover, it is changed or destroyed by vibrations, large discontinuities in the soil, or other factors. Thus it cannot be made a definite factor in engineering design.

It is easily demonstrable, and experiments show, that the granular, noncoherent soil theories give the *maximum* lateral earth thrusts, i.e., that the thrust of any coherent soil is less than that calculated by the classic formulas for non-coherent soil. Neglect of cohesion is therefore an error on the side of safety. Moreover, since cohesion has been shown to be an indefinite factor, the engineer must of necessity ignore it, and the use of the granular sliding-wedge theory is consistent and conservative engineering practice.

Undoubtedly there are times when cohesion is a factor that engineering ingenuity may utilize. An excellent example of this is the method used in placing the embankment for the Hell Gate arch approaches, where compactness was secured by ramming while placing the fill, and its permanency was assured by tying the retaining walls together. Here the elasticity analogy might perhaps have been used in determining the lateral pressures; the actual method was to assume that the plane of slip had been made steeper by the compacting.

However, exceptions only emphasize the fact that for ordinary conditions the worst must be anticipated. That the ordinary pressures against retaining walls are nowhere near those for which the engineer has made provision should prove no cause for worry. It is for the extraordinary contingency that designs are made, not for every-day conditions.

One is therefore brought back to the justifiable conclusion that the theory to be used in general for all calculations of lateral pressure computation is a simplified granular sliding-wedge theory with the element of cohesion ignored, as in the classic Coulomb-Rankine methods.

Possible advance in the general theory may be realized by way of the theory of probabilities, as in some recent analyses of substances of unknown detail character, molecular or otherwise. Using the ingenious devices of statistical mechanics, fruitful results have been obtained in the study of gases, for instance (see Jeans' "The Dynamical Theory of Gases"). The method may prove similarly useful in study of soil pressures where the individual grain movements are uncertain.

City Engineer's Salary $1 for Each Inhabitant

Cranford, N. J., a town of 6,000 inhabitants, has appointed a town engineer at a salary of $6,000 per annum. The town is a suburb of New York and numbers among its residents a great many engineers. These engineers, supported by progressive citizens, urged upon the people the importance of employing a thoroughly competent engineer to plan and supervise the construction work in the town and to safeguard the investment which it now has. The township committee apparently appreciated the force of the argument for it authorized the raising of the salary of the engineer from $3,000 to the amount named. D. C. N. Collins has been appointed to the position.

1920 Motor Vehicle Statistics In the United States

By Andrew P. Anderson
Highway Engineer, U. S. Bureau of Public Roads, Washington, D. C.

The figures given herewith are official statistics compiled by the U. S. Bureau of Public Roads. Slight differences will be noted in some cases between these records and those of the American Automobile Association; published in "Engineering News-Record," Feb. 24, p. 330.—Editor.

A TOTAL of 9,211,295 motor cars, including commercial vehicles, were registered in 1920 in the 48 states and the District of Columbia. There were also registered a total of 238,146 motor cycles. The registration and license fees, including those for chauffeurs, operators, and dealers, amounted to a total of $102,034,106.

As compared with 1919, the data for 1920 represent an increase of 22 per cent, or 1,645,849 motor cars. This increase alone lacks only about 4 per cent of being equal to the total registrations of the United States for the calendar year 1914. The number of motor cars registered in 1920 in the State of New York (670,290) exceeded the total cars registered in the United States in 1910. Furthermore, the revenues derived from the registrations in the State of New York in 1920 ($8,511,597) were about equal to the entire registration revenues of the United States for the year 1913. The revenues derived from all registrations and licenses during the year 1920 exceed those of 1919 by 58 per cent or a total of $37,336,850.68; this increase is practically equal to the total registration revenues of the United States for the calendar year 1917.

Use of Revenues

The increase in the motor car registrations and revenues in the United States during the past 14 years presents many interesting comparisons, especially in respect to the use made of the revenues. In 1906 the total registrations were approximately 48,000 cars, paying a gross revenue of about $193,000, or about the same as that collected by Arizona during 1920. In 1906 the gross registration revenues were equivalent to less than three-tenths of 1 per cent of the total rural road and bridge expenditures for that year, while the registration revenues for 1920 are equal to about one-fourth of the total rural road and bridge expenditures for 1919. Furthermore, while in 1906 practically none of the motor-vehicle revenue was applied to road maintenance or construction, in 1920, 96 per cent, or a total of $97,997,160, was used for this purpose. Of the total amount applied to road work, 79 per cent, or $77,531,582, was expended under the control or supervision of the several State highway departments. The remaining 4 per cent not applied to road work was expended very largely for number plates and in the carrying out the provisions of the motor-vehicle registration laws in the several states.

On Jan. 1, 1921, every state but Minnesota had made provision for some definite form of annual registration. In Minnesota a three-year registration period ended on Dec. 31, 1920. The registration figures for Minnesota, therefore, are the total number of cars registered during the period of three years. How

TABLE I. MOTOR VEHICLE REGISTRATIONS AND REVENUES, 1920

State	Automobiles	Motor Trucks and Commercial Vehicles	Motorcycles	Total Gross Motor-Vehicle Registration and License Revenues	— Motor-Vehicle Revenues — Available for By or Under State Highway Department	Road Work Under Direction of Local Authorities	Average Gross Revenue Return per Motor Car Registration	Population per Motor Car	Motor Cars per Mile of Public Rural Road
Alabama	61,941	12,696	1,035	$835,178	$668,142		$11 23	31	1 3
Arizona	29,868	4,733	542	192,369	189,869		5.55	10	2.9
Arkansas	59,082	(1)		591,465	550,000		10 01	30	1 2
California	534,814	34,078	20,047	5,554,265	2,777,133	2,777,133	9.76	6	9 3
Colorado	121,506	7,749	3,420	819,873	375,699	375,699	6 34	7	3 2
Connecticut	95,123	24,011	6,543	1,852,591	1,852,591		15 55	12	8 5
Delaware	18,300	(1)	674	329,980	329,980		18 03	12	5 0
District of Columbia	29,131(10)	5,030(11)	2,648	266,285			7 78	13	
Florida	63,466	10,448	1,275	554,695	554,695		7 63	13	4 1
Georgia	134,000	12,000	1,382	1,919,339	1,851,541		13 14	20	1 8
Idaho	50,861	(1)	764	882,035	220,509	661,526	17 34	8	2 0
Illinois	504,250	64,674	10,569	5,915,700	5,915,700(2)		10 40	11	5 9
Indiana	300,226	32,841	8,823	2,029,694	1,902,363		6 09	9	4 5
Iowa	407,578	29,800	4,000	7,507,202	7,244,450(3)		17 16	5	4 2
Kansas	294,159	(1)	3,605	1,419,346		1,327,308	4 83	6	2 6
Kentucky	99,437	13,246	1,543	815,549	815,549		7.24	21	1 9
Louisiana	66,000	7,000	512	390,000		350,000	5 34	25	3 0
Maine	55,395	7,512	1,566	818,756	818,756(2)		13 02	12	2 7
Maryland	87,625(4)	15,216(5)	5,222	2,124,925	1,537,540	384,385	20 53	14	6 2
Massachusetts	223,112	51,386	15,143	3,860,232	3,506,000		14.07	14	14 7
Michigan	366,946	45,771	8,011	5,754,901	2,745,715	2,737,138	13 94	9	5 6
Minnesota	324,166(6)	(1)	7,546	143,795	143,795		0 44	7	3 5
Mississippi	63,721	4,765	194	800,000(13)	750,000		11 68	26	1 5
Missouri	297,008	(1)	3,954	2,111,697	2,111,697		7 11	11	3 1
Montana	59,450	1,200	675	416,245	280,557	93,519	6 86	9	1 5
Nebraska	200,000	19,000	2,100	2,800,000(13)	2,100,000	700,000	12 78	6	2 7
Nevada	10,464	(1)	125	103,318	103,318(2)		9 87	7	0 9
New Hampshire	30,240(7)	4,440	2,542	654,702	580,342		18 69	13	2 5
New Jersey	204,125	23,612	11,041	3,503,937	3,441,771		15 39	14	15 3
New Mexico	22,100	(1)	219	200,000	180,000		9 05	16	0 6
New York	521,417	148,873	29,453	8,511,597	6,383,698	2,127,899	10 16	15	8 3
North Carolina	127,405	13,455	1,418	1,785,000	1,785,000		10 26	18	2 7
North Dakota	90,840	(1)	898	691,500	274,258	274,258	7 61	7	1 3
Ohio	538,090(8)	83,300	23,300	6,400,000(13)	3,100,000	3,100,000	10 30	9	7 2
Oklahoma	204,300	8,580	1,360	2,500,000(13)	2,294,405(3)		11 74	10	2 0
Oregon	103,790	(1)	3,434	2,085,168	1,469,145	489,715	20 09	7	2 8
Pennsylvania	521,835	48,329	23,981	8,090,873	8,090,873		14 01	15	6 2
Rhode Island	40,914	9,563	2,260	531,462	468,162		10 51	12	23 3
South Carolina	93,843	(1)	908	527,868	92,529	329,765	5 63	18	2 2
South Dakota	112,589	7,806	777	784,000(13)		700,000	5 51	5	1.2
Tennessee	90,214	11,638	1,151	1,215,776	571,817	571,817	11 94	23	2 2
Texas	427,693	(1)	4,290	3,510,356	1,468,475	1,715,416	8 21	11	3 3
Utah	37,060	5,556	1,114	350,933	325,000(2)		8 23	11	4 8
Vermont	28,709	2,916	946	555,422	515,737		14 40	11	2 2
Virginia	101,800	13,670	2,233	1,822,736	1,730,931		15 70	20	2 1
Washington	144,131(9)	29,789	4,915	2,828,896	1,800,000(2)	1,000,000	16.15	8	4.1
West Virginia	69,862	10,802	1,659	1,280,193	1,096,662		15 87	18	2.5
Wisconsin	277,093	16,205	8,002	3,127,073	2,250,000	750,000	10 67	9	3 8
Wyoming	23,926	(1)	327	267,179	267,179(2)		11 16	8	1 6
Total and average	8,369,605	841,690	238,146	102,034,106	77,531,583	20,465,578	11.08	11	3.8

(1) Included under automobiles.
(2) To pay interest and provide sinking fund for state highway bond issue; remainder for state highway work.
(3) Distributed to counties but expended under supervision of state highway department; 2½ per cent of grand total, to state highway department for expenses.
(4) Does not include 13,500 non-resident registrations.
(5) Includes 4,022 buses and vehicles used for hire.
(6) Registrations cover a period of three years ending December 31, 1920. Number of cars given are for total period; revenues are for calendar year only.
(7) Does not include 2,359 non-resident and neutral zone cars.
(8) Does not include 2,683 state, county and city cars.
(9) Does not include 1,287 exempt cars.
(10) Does not include 14,797 non-resident cars.
(11) Does not include 1,790 non-resident trucks.
(12) Data cover period of 18 months, ending Dec. 31, 1920.
(13) Approximate

many of these cars have been removed from the State or have been scrapped there is no way of determining. A few states as yet make no distinction between original registrations and reregistrations or transfers. Consequently, in these states the number of registrations is in excess of the actual number of cars. In most states, however, the registration figures represent fairly accurately the actual number of cars.

For a number of years the general tendency toward devoting an ever-increasing portion of the net motor-vehicle revenues to road work under the control and direct supervision of the State highway departments has been noticeable. Prior to 1912 only a very small portion of the motor-vehicle registrations was devoted to state highways. In 1920, however, 76 per cent of the total motor-vehicle revenues, or $77,531,582 was applied to road work under the direct supervision of the State highway departments, and $20,465,578 additional was applied to road work by counties or other local supervision, but with little or no direct supervision from the State highway departments.

In most states the motor-vehicle revenues are devoted to maintenance and repair of the State roads or other improved highways. These states thus seem to have solved fairly well the difficult problem of securing funds for the maintenance of the more important roads under the ever-increasing traffic requirements. As both the traffic and the revenues increase with the number of cars, there seems to exist a possibility of so adjusting the registration rates as to keep pace with the ever-growing maintenance charges.

A number of states having in general but a small mileage of improved roads have recently adopted the plan of capitalizing the motor-vehicle revenues and devoting these funds to road construction. These states are, Illinois, Maine, Minnesota, Missouri, Nevada,

Utah and Wyoming. In these states bonds have been voted or issued for road construction, and the principal and in some cases also the interest is to be paid entirely from the motor-vehicle revenues. There seems to be no doubt that these revenues may be made sufficient for this purpose. The question as yet to be solved by these states is from what other source can sufficient maintenance revenues be secured so as to prevent the deterioration of the roads constructed from the bond issues.

TABLE II. MOTOR-VEHICLE REGISTRATIONS BY STATES, 1914 AND 1920

	1914	1920
Alabama	8,672	74,637
Arizona	5,040	34,601
Arkansas	5,642	59,082
California	123,504	568,892
Colorado	17,756	129,255
Connecticut	27,786	119,134
Delaware	3,050	18,300
District of Columbia	4,833	34,161
Florida	[1] 3,368	73,914
Georgia	20,915	146,000
Idaho	3,346	50,861
Illinois	131,140	568,924
Indiana	66,500	333,067
Iowa	106,087	437,378
Kansas	49,374	294,159
Kentucky	11,766	112,683
Louisiana	[2] 12,000	73,000
Maine	15,700	62,907
Maryland	20,213	102,841
Massachusetts	77,246	274,498
Michigan	76,389	412,717
Minnesota	67,862	324,166
Mississippi [2]	5,694	68,486
Missouri	54,468	297,008
Montana	10,200	60,650
Nebraska	16,385	219,000
Nevada	1,487	10,464
New Hampshire	9,571	34,680
New Jersey	62,961	227,737
New Mexico	3,090	22,100
New York	168,223	670,290
North Carolina	14,677	140,860
North Dakota	17,347	90,840
Ohio	122,504	621,390
Oklahoma	13,500	212,880
Oregon	16,447	103,790
Pennsylvania	112,854	570,164
Rhode Island	12,331	50,477
South Carolina [1]	14,000	93,843
South Dakota	20,929	120,395
Tennessee	[1] 19,769	101,852
Texas [1]	40,000	427,693
Utah	2,253	42,616
Vermont	8,475	31,625
Virginia	13,984	115,470
Washington	30,253	173,920
West Virginia	6,159	80,664
Wisconsin	53,161	293,298
Wyoming	2,428	23,926
Total	1,711,339	9,211,295

[1] State registrations only.
[2] Estimated.

At the beginning of 1921, there were still 7 states in which motor trucks were registered at the same rate as passenger cars. The past five or six years, however, have shown a very decided tendency toward increasing the fees required for heavy motor trucks over and above those required for passenger cars. This increase is usually based on the weight of the truck, its carrying capacity, its horsepower, or a combination of these factors. The most general practice seems to be toward definitely limiting the maximum total loaded weight of the vehicle and basing the registration fee on the carrying capacity of the truck. Some few states have adopted a scale of fees which in actual practice serves to make the operation of very heavy trucks unprofitable. A number of states have also provided legislation to limit the maximum wheel load per inch of tire.

TABLE III. TOTAL REGISTRATION OF MOTOR-VEHICLES IN UNITED STATES, 1914–1920

Year	Registration
1914	1,711,389
1915	2,455,664
1916	3,512,996
1917	4,983,340
1918	6,146,617
1919	7,565,446
1920	9,211,295

It is unfortunate that the terms motor truck and commercial vehicle are as yet rather indefinitely defined in the laws of a number of the states. In a few states no distinction is made between passenger cars and freight-carrying vehicles, while in one state only trucks used for hire are classed as commercial vehicles.

Gasoline Tax

Colorado, New Mexico, and Oregon, in addition to the registration fees, also levy a state tax on gasoline or other products used for the propulsion of motor vehicles. In Alabama, Delaware, Idaho, Iowa, Michigan, New Hampshire, New York, North Dakota, Oklahoma, Oregon, South Carolina, Pennsylvania, Tennessee, and Vermont, the registration fees are in lieu of all personal property taxes. In other states, however, motor cars are taxed as personal property in addition to the required registration fees. In comparing the registration rates in the several states this fact should be borne in mind.

The registration of automobiles, motor trucks, commercial vehicles, chauffeurs and operators, dealers, and manufacturers, as well as the total gross revenues and the amount available for state road work, either by the State highway departments or under their supervision and that available for local road work for the year 1920 are given in Table I. The number of registrations in this table does not necessarily indicate the exact number of motor vehicles in use or existence in the several states except in so far as the laws of the several states require and enforce an annual registration under these classifications. All of the states, with the exception of Minnesota, now require an annual registration. Some states, however, do not segregate registrations from reregistration, consequently the registration figures in these states exceed the actual number of cars by the number of transfers which have been made during the year.

It is unfortunate that, during 1920, only 36 states required motor trucks and commercial vehicles to be registered in separate classes. Consequently the data in the third column of Table I do not give a very definite index as to the total number of trucks in existence except in those states requiring separate registration. Even where separate registration is required the classification as to what constitutes a motor truck is far from uniform. A vehicle may be classed as a truck or commercial vehicle in one state where in another it is included among passenger or motor cars for registration purposes

Table II gives a compilation of the total registrations and total revenues for the years 1914 and 1920 inclusive. For further information in regard to registrations and revenues previous to 1913, the reader is referred to Public Roads Bulletin No. 48, Repair and Maintenance of Highways, pages 68 to 71 inclusive, and also to the files of *Public Roads* for the years 1919 and 1920.

Sanitary Rating of the Indiana Public Water Supplies

Abstract of Paper Presented to Indiana Sanitary and Water Supply Association by John C. Diggs, sanitary engineer, State Board of Health.

FROM a recent compilation of data on 211 water-works plants furnishing water to 1,600,000 people in Indiana the State Board of Health has made up a classification of supplies from the sanitary standpoint (see tables). In only 35 plants is the water treated.

Factors used in making the classification are as follows: (1) The source of supply with reference to geologic formations from which the water is drawn and possible contamination by domestic sewage and industrial wastes. (2) The purity of the supply as gaged by chemical and bacterial examinations. (3) The equipment of the water purification plant treating the supply. (4) The character of the personnel responsible for the operation of the water plant.

TABLE I. ALLOCATION OF INDIANA WATER SUPPLIES BY SOURCE AND TREATMENT

Classes	I	II	III	IV	V	Total
Ground water natural	98	35	26	2	1	162
Ground water treated	0	0	3	3	0	6
Surface water untreated	0	0	0	3	11	14
Surface water treated	4	0	12	13	0	29
Total	102	35	41	21	12	211

With the utilization of these factors five classes of public water supplies were made.

Class I supplies comprise those plants which obtain their water from wells adequately protected not only with reference to general water-bearing formations but to local conditions as well. Such supplies must stand the test of a sanitary survey and of chemical and bacterial examinations. A second group of waters placed in Class I are those from adequately equipped water purification plants, under suitable laboratory control and in charge of technically qualified operators who are also conscientiously disposed to exert themselves to produce safe water.

Class II supplies are ground waters usually of good quality but which have some unfortunately situated suction line, reservoir or well by which contamination might gain access to the city system.

Class III supplies include waters from improperly protected ground water sources, springs, shallow wells, etc., and from purification plants not properly equipped or operated by inefficiently trained men and not under adequate laboratory control.

Class IV supplies include waters obtained from surface sources, impounding reservoirs or ground waters exposed to contamination at times and from water purification plants not properly operated or not controlled by laboratories. These waters are normally of poor quality and are often grossly polluted.

TABLE II. TYPHOID IN INDIANA TOWNS OF VARIOUS CLASSES

Class	No. of Plants	Population 1920 Census. Total	Population 1920 Census. Served with Water	Average Typhoid Deaths per Year. Total	Average Typhoid Deaths per Year. Rate per 100,000
Rating of All Cities					
I	102	728,178	528,614	118.0	16.1
II	35	394,941	350,210	65.1	16.3
III	41	364,196	303,923	70.1	19.3
IV	21	112,045	102,200	41.5	37.0
V	12	24,173	10,700	8.5	35.4
Total	211	1,623,533	1,295,647	303.2	18.7
Supplies for Cities of Over 5,000 Population					
I	13	568,373	422,250	70.4	12.4
II	16	353,288	314,650	53.1	15.0
III	14	309,522	266,500	54.6	17.7
IV	6	76,439	75,000	27.0	35.5
V	0	.....	.....	00.0	...
Total	49	1,307,622	1,078,400	205.1	15.6
Ratings of Towns Having Purification Plants					
I	4	472,059	340,500	59.6	12.6
III	15	288,348	245,700	54.1	18.4
IV	16	102,218	100,400	36.0	35.3
Total	35	862,625	686,600	149.7	17.3

Class V supplies are unquestionably bad through the constant contamination by sanitary sewage or other wastes.

Typhoid rates in Table II are from data for 1915 to 1919 for cities having populations of 5,000 or more, and for years 1916 to 1917 for smaller cities and towns.

Though but 35 of the supplies have purification plants they furnish water to more than 50 per cent of the citizens served by public water systems and it is probable that efforts to improve their operation would be most profitable of results. In many cases changes in operation or the addition of personnel qualified to carry on laboratory control work efficiently would result in a vast improvement in the quality of the supply.

For a proper supervision of the public water supplies of the state a routine system of inspection and sampling as follows should be carried out: Class I, inspect annually and make laboratory examination at least semi-annually; Class II, make survey annually and analysis quarterly; Class III, make survey quarterly and analysis weekly; Class IV, make surveys quarterly and analysis weekly or semi-weekly; Class V, surveys are useless except as a means of urging the installation of an improved system.

Final Values of Four Properties Reported by I. C. C.

Commission Now Reports Additional Land Costs as Required by Kansas City Southern Decision—Single Total Sums Given

VALUATIONS of the properties of four railroad companies were issued by the Interstate Commerce Commission as tentative final reports, April 5, 1921, termed "supplemental tentative valuations" including statements of the additional cost of acquiring lands over and above the "present values" reported in the previous tentative valuations, as required by the decision of the U. S. Supreme Court, March 8, 1920, in the Kansas City Southern case. The reports now filed also give single sums as final value of properties. It is stated that these sums take into consideration additional costs of acquiring carrier lands, appreciation, depreciation, going concern value, working capital, materials and supplies, and "all other matters which appear to have a bearing on the values reported."

The four reports are on the properties of the Kansas City Southern Ry. System, the Atlanta, Birmingham & Atlantic R.R. Co., the San Pedro, Los Angeles & Salt Lake R.R. Co., and the Winston-Salem Southbound Ry. Co. In the case of the Kansas City Southern, the additional cost of acquiring land, over and above the original "present value," is equal to 95 per cent of the sum previously given as "present value," thus almost doubling the total cost of acquisition. This additional cost of acquisition of land, including severance and condemnation damages, as stated in the present report on the Kansas City Southern properties, amounts of 8.83 per cent of the sum given as final value of the entire system.

In the original tentative valuations the Bureau of Valuation of the Interstate Commerce Commission reported only what was termed "present value of land," largely based on prices, as of the date of valuation, of adjacent lands. In the present supplemental reports what is termed "excess cost" is included as the price railroads would have to pay in addition to the cost of similar adjacent lands due to severance damages, condemnation proceedings and other items in the cost of acquiring land not included in the value of adjacent areas.

The single sum given as final value of the Kansas City Southern is 29.5 per cent more than the figure pre-

viously reported as cost of reproduction less depreciation. The additional cost of acquiring lands and the final value of properties owned by the four companies are reported as follows:

Kansas City Southern, $4,371,970 and $49,485,907; Atlanta, Birmingham & Altantic $1,831,665 and $26,548,250; San Pedro, Los Angeles & Salt Lake $2,504,529 and $45,871,093; Winston-Salem Southbound $468,022 and $5,850,000. Cost of reproduction less depreciation and "present cost" of lands of the Kansas City Southern were previously reported as $38,316,799 and $4,609,377.

Reports as of June 30, 1914, indicate the capitalization of the companies approximately as follows: Kansas City Southern, about $99,000,000; Atlanta, Birmingham & Atlantic, about $54,000,000; San Pedro, Los Angeles & Salt Lake, about $81,000,000; Winston-Salem Southbound, about $5,125,000.

The decision of the Supreme Court, in the mandamus action of the Kansas City Southern System to compel the Interstate Commerce Commission to report on additional costs of acquiring railway lands, was printed in full in *Engineering News-Record* March 18, 1920, p. 563, editorial comment appearing on page 553 of the same issue. The decision stated that the Court was not required to decide "a controversy growing out of duty performed under the statute" but "one solely involving an alleged refusal to discharge duties which the statute exacts." The decision ordered the Interstate Commerce Commission to proceed to carry out the requirements of the Valuation Act to find the so-called "excess" cost of acquiring lands.

In issuing the present "supplemental" reports, the Bureau of Valuation of the Interstate Commerce Commission outlines the method pursued in developing excess cost of land. To meet the requirement of the Act and to report the present cost of condemnation and damages or of purchase in excess of present value it was attempted to show what the expense to a carrier would be of acquiring its common-carrier lands upon the date of valuation, on the assumption that it did not possess those lands, but was obliged to obtain them through purchase or condemnation at the value of similar lands in the vicinity, on that date. It is held that the figure reported could be only an estimate, since the "excess" amount actually paid would depend so much upon individual circumstances and conditions. But so far as possible prices were determined with reference to actual transactions and actual sale by a method developed as an average. While a single instance is not held to be reliable, it may be possible to find many instances putting them together in the form of an average factor and dividing the land into types. By subtracting the present value from the total amount paid the land owner, the excess cost in each case is found, establishing a ratio between such excess and present value. The result is known as the multiple of that individual case and all multiples of a given kind are combined into a weighted average, this average being treated as the multiple of that type.

It is also recognized that there are certain expenses connected with the acquisition of lands besides the money paid to owner, and these are taken into consideration. But the cost represented by interest charges previous to the time of opening for operation of the road is not included since the reports state that "this has been compensated for by basing the estimate on present value of land."

Federal Highway Policies Stated by President Harding

The following excerpt from President Harding's first message to Congress, delivered April 12, states his policies with regard to highway financing, construction and maintenance.

TRANSPORTATION over the highways is little less important [than railway transportation], but the problems relate to construction and development, and deserve your most earnest attention, because we are laying a foundation for a long time to come, and the creation is very difficult to visualize in its great possibilities.

The highways are not only feeders to the railroads and afford relief from local burdens, they are actually lines of motor traffic in interstate commerce. They are the smaller arteries of the larger portion of our commerce, and the motor car has become an indispensable instrument in our political, social and industrial life.

There is begun a new era in highway construction, the outlay for which runs far into hundreds of millions of dollars. Bond issues by road districts, counties and states mount to enormous figures and the country is facing such an outlay that it is vital that every effort shall be directed against wasted effort and unjustifiable expenditure.

The federal government can place no inhibition on the expenditure in the several states, but since Congress has embarked upon a policy of assisting the states in highway improvement, wisely, I believe, it can assert a wholly becoming influence in shaping policy.

With the principle of federal participation acceptably established, probably never to be abandoned, it is important to exert federal influence in developing comprehensive plans looking to the promotion of commerce, and apply our expenditures in the surest way to guarantee a public return for money expended.

Large federal outlay demands a federal voice in the program of expenditure. Congress cannot justify a mere gift from the federal purse to the several states, to be prorated among counties for road betterment. Such a course will invite abuses which it were better to guard against in the beginning.

The laws governing federal-aid should be amended and strengthened. The federal agency of administration should be elevated to the importance and vested with authority comparable to the work before it. And Congress ought to prescribe conditions to federal appropriations which will necessitate a consistent program of uniformity which will justify the federal outlay.

I know of nothing more shocking than the millions of public funds wasted in improved highways, wasted because there is no policy of maintenance. The neglect is not universal, but it is very near it. There is nothing the Congress can do more effectively to end this shocking waste than condition all federal-aid on provisions for maintenance. Highways, no matter how generous the outlay for construction, cannot be maintained without patrol and constant repairs. Such conditions insisted upon in the grant of federal-aid will safeguard the public which pays and guard the federal government against political abuses, which tend to defeat the very purposes for which we authorize federal expenditure.

(See editorial comment on above, p. 664.)

ENGINEERING LITERATURE

Building Construction Handbook

REVIEWED BY ROBERT W. BOYD
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HANDBOOK OF BUILDING CONSTRUCTION: Data for Architects, Designing and Constructing Engineers, and Contractors, Vol. I and II—Compiled by a staff of Forty-six Specialists: Editors-in-Chief, George A. Hool, S. B., Consulting Engineer, Madison, Wisconsin, Professor of Structural Engineering, The University of Wisconsin, and Nathan C. Johnson, M.M.E., Consulting Engineer, New York City. New York and London: McGraw-Hill Book Co., Inc. Flexible cover; 6 x 9 in.; pp. 1,474 in the two volumes; illustrated. $10 for both volumes (not sold separately).

The two editors-in-chief with their forty-six collaborators have compiled a work which embraces practically every phase of building construction. Under the general caption Design and Construction are presented sections dealing with Elements of Structural Theory, Designing and Detailing of Structural Members and Connections; Structural Data, General Designing Data, Construction Methods, Construction Equipment, and Building Materials. Under Estimating and Contracting are sections on Estimating Steel Buildings, Estimating Concrete Buildings, Architectural Practice, Contracts, and Specifications. The general heading Mechanical and Electrical Equipment covers Heating, Ventilation and Power, Water Supply, Sewage Disposal, Waterless Toilet Conveniences, Plumbing and Drainage, Electrical Equipment, Electric Lighting and Illumination, Gas Lighting, Gas Fitting, Elevators, Refrigeration, Communicating Systems, Lightning Protection and Vacuum Cleaning Equipment.

Like every other book, the value of a handbook depends upon the material which it contains and the way that material is presented. In compiling a handbook the problem is not only to crowd into it every essential element of each subject treated, but also to subordinate or omit all material that is obvious or unimportant so that the salient features presented will stand out in such a way as to be readily found by the user.

In the present work the editors have gathered together in the two volumes a large mass of very valuable material. From a consideration of the ground covered and the material presented this book is probably far ahead of any similar book that has yet appeared. There are few subjects connected with buildings and building construction which are not treated and the architect, the engineer and the builder should find the book of great value for general reference.

There is, however, much matter that could be omitted without impairing the book in any essential particular. For example, it is doubtful if the four pages devoted to cast-iron lintels serve any very useful purpose in this day of structural steel. Again, while the article on school planning contains much detailed information of great value, a large amount of the text has to do with matters only remotely connected with actual school building. In many instances space is devoted to matters so obvious as to require no mention whatever. For example, we are told that "water in excavations or in footings or trenches must be removed by pumping," that "drop hammers are so called because they consist of a weight hoisted to some distance and allowed to fall" and that "hoists . . . are devices of the highest importance to all building operations."

Some of the omissions are hard to understand. Why such a thing as a table of the properties of cast-iron column sections should not be included is not clear. One looks in vain for information relative to the yield of various concrete mixtures, and the quantities of the several materials entering into one yard of concrete.

On the whole, however, the editors are to be congratulated upon the vast store of very excellent data made readily available. The section devoted to Building Materials is particularly noteworthy. The articles on timber, building stones, glass and glazing and stucco are exceptionally good. The inclusion of articles on such subjects as swimming pools, chimneys, domes, architectural design, public buildings and acoustics of buildings will be welcomed by many who heretofore have found it difficult readily to find reference to these subjects. The book gains in value by including the standard specifications for cement, steel for buildings, reinforcement bars, and concrete building stone.

In the arrangement of the material presented the book is open to some severe criticism. It is apparent that in planning the book the editors prepared what they considered a logical scheme and then followed that scheme notwithstanding where it led them. The scheme itself is logical enough, but following it rigorously results in many places in the separation of various parts of the same subject which should be treated together when the point of view of the reader is considered. For example, excavation and pile driving are discussed in general under the heading "Construction Methods" but the reader must jump to another section under "Construction Equipment" to find out what a steam shovel or a pile driver looks like. Again, anyone wanting to refresh his memory on the analysis of stresses in roof trusses is referred to the article on the "General Method of Computing Stresses in Trusses" by Prof. Hool, or to the succeeding article by Mr. Rogers on "Stresses in Roof Trusses." Both articles contain almost the same matter and should be combined.

There seems to be no good reason why "Steel Beams and Girders" should be separated from "Plate and Box Girders" by "Reinforced-Concrete Beams and Slabs" and "Wooden Girders." The book would gain in value if all the material bearing on the same general subject were brought together in the same section. In general the arrangement of the matter in the book leaves much to be desired.

The index, which in a work of this kind should receive the most careful attention, is not entirely satisfactory. Some important matters, for example the *Engineering News* formula for safe loads on piles, found on p. 357, have been overlooked. Many of the references are not sufficiently descriptive.

Taken as a whole, the merits of the book outweigh its defects and the editors and their associates deserve credit for adding to engineering literature a valuable reference work on building construction.

The Nile Project and Problems

REPORT OF THE NILE PROJECT COMMISSION — [Cairo, Egypt: Adviser, Ministry of Public Works.] Heavy Paper, Cloth Back; 8 x 13 in.; pp. 126; 3 diagrams in text and one on folding plate.

CRITICISM OF THE NILE PROJECTS: Submitted by the Commission of Egyptian Engineers to the Nile Projects Commission. For copies apply to Abdalla Pasha Wahbi, Munira, Cairo. Paper; 8 x 11 in.; pp. 36.

Comprehensive projects for the conservation and utilization of the waters of the Nile have been the subject of much study and controversy for years. On Jan. 10, 1920, the Council of Ministers of the Egyptian Government approved the appointment of a commission to report on the Nile control projects proposed by the Egyptian Ministry of Public Works. The commission consisted of F. St. John Gebbie, M.Inst.C.E., president; Dr. G. C. Simpson, F.R.S., and H. T. Cory, M.Am.Soc.-C.E. Mr. Gebbie is inspector general of irrigation in India and head of all the irrigation service in that country. Dr. Simpson was chief of the Weather Bureau of India at the time of his appointment and since September, 1920, has been at the head of the Weather Service of Great Britain. Mr. Cory is a well-known American engineer of San Francisco who has served as consulting engineer for the United States Reclamation Service.

For a complete understanding of the reports now before us one should have available the report on "Nile Control" by Sir Murdoch MacDonald, adviser, Ministry of Public Works, Egypt, noted briefly in these columns on July 15, 1920, p. 132. In his prefatory notes to the report just mentioned Mr. MacDonald states that the object of all the projects has been "to expand the agriculture of Egypt to its utmost limit by the further utilization of the waters of the Nile, while at the same time developing the Sudan to such an extent as may be possible without injury to Egypt." The portion of the foregoing quotation that relates to the Sudan and its development "without injury to Egypt" should be borne in mind in considering that portion of the Nile Projects Commission report relating to the allocation of water and cost between Egypt and the Sudan. The reason for this will be better understood when it is explained that the three members of the commission were unanimous in approving the engineering features of the Nile project, as proposed by the Egyptian Ministry of Public Works, but were divided as to allocation of water and of cost between Egypt and the Sudan. The two British members of the committee submit a majority report advising that Egypt and the Sudan each go ahead with the construction of reservoirs now under way on the White Nile and the Blue Nile, respectively, each country to have the use of all the water stored in the reservoir built by it. All questions regarding the division of water and cost resulting from the large scheme for future development are left unanswered by the majority of the commission except for some general proposals and minor details.

In strong contrast, Mr. Cory considered it to be the duty of the commission to carry out the clearly apparent intent of sections 2 and 3 of the terms of reference (the first term of reference being to report upon "physical data on which the projects are based") which read as follows:

2. To report upon the propriety of the manner in which, as a result of these projects, the increased supply of available water provided by them will be allocated *at each stage of development* [italics ours—EDITOR] between Egypt and the Sudan.

3. To advise as to the apportionment of the cost of the proposed works under this inquiry as between Egypt and the Sudan.

Acting accordingly, Mr. Cory submits an analysis and argument of some twenty printed pages on the second and third terms of reference, together with a definite plan for the division of the waters developed and the cost of the necessary construction works. Some further particulars regarding Mr. Cory's plan, the whole report and the Nile project in general are given on p. 679 of this issue.

Coming now to the report as a whole, it may be stated that of its 126 pages, 10 are devoted to routine matters and 76 to the controversy over charges brought by Sir William Willcocks against the accuracy of certain Nile gage readings. The commission unanimously concluded that these charges were utterly unwarranted. It seems unfortunate that so much of the time and space in its report were given up to them. This is all the more unfortunate in view of the fact that the majority of the commission passes over the vital questions of allocating water and its cost with only three pages of discussion.

Summarizing the Niles Project Commission Report is (1) a whole-hearted and unanimous endorsement of the engineering features of the Nile project, as worked out by the Egyptian Ministry of Public Works, with (2) a majority report made by the British members of the commission that seems to back up the opinion of the Egyptian Government of Public Works as to how the water and its cost should be allocated between the two governments, and (3) a minority report on the same subject by Mr. Cory, the American member, presenting a well-reasoned plan complying with the second and third terms of reference and outlining what he considers to be a just scheme of dividing the water and the cost of its development, taking into account the fundamental world-wide principles that should govern in such a case and also bearing in mind that Egypt and the Sudan should be regarded as wards of Great Britain.

In the criticism of the Nile project by the committee of Egyptian engineers whose report is listed at the head of this review, it is first alleged that for nearly twenty years "the English officials of the Public Works Ministry" of Egypt "continued to work in secret" on the Nile project. A series of criticisms of the Nile project is then presented, in which some of the basic data are questioned and strenuous objections are made to some parts of the project. A considerable part of this report is reprinted in the Niles Projects Commission Report and discussed by Mr. Cory in his minority report.

New Relief Map of the United States

A handsome new relief map of the United States, lithographed in shades of brown and blue in ten printings, has been published by the U. S. Geological Survey (Washington, D. C.; 75c.). The scale is 50 miles to the inch or 1:3,168,000 and the map measures 40 x 70 in. Besides showing relative elevations of land, and also the continental and secondary shelves and the ocean floor (depths of 600, 6,000 and 12,000 ft. or more) the map shows the larger lakes and streams, the principal cities and the state boundaries. The map is the work of John Renshawe who, according to a statement by the Geological Survey, has "made maps, and studied maps and thought maps" ever since he began work for the Survey 41 years ago.

Special Problems of Flood Control

REVIEWED BY ROBERT E. HORTON

of Horton, Barker & Wheeler, Engineers, Albany, N. Y.

HYDRAULICS OF THE MIAMI FLOOD CONTROL PROJECT—By Sherman M. Woodward, M. Am. Soc. C. E.; M. Am. Soc. M. E.; Consulting Engineer of the Miami Conservancy District; Professor of Mechanics and Hydraulics, State University of Iowa. Technical Reports, Part VII, The Miami Conservancy District. Dayton, Ohio: The District. Paper; 6 x 9 in.; pp. 343; illustrated. $1.

After a description of the great flood of March, 1913, sufficient to form a foundation for what follows, this book takes up hydraulic problems of a special or unusual character which were involved in the design of the Miami flood control works.

Most of the matter treated in the book is outside the ordinary line of categorical discussions in textbooks of hydraulics. Much of the text relates to the determination of requisite capacities of the retarding basins, and the modes of operation of these basins under hypothetical storm conditions. As a foundation for these studies many other problems required solution—such as the determination of the outflow through the discharge conduits of the retarding basins at various water levels, and with conduits flowing full. The effect of the reservoirs operating in conjunction with various floods is considered, but especially a flood resembling that of 1913, but of 20 per cent greater volume.

In addition to the treatment of the operation of reservoirs in such a flood there are studies showing the effect of short, sharp storms of more local character on the individual reservoirs and on the system as a whole. Engineers are generally quite familiar with methods of determining the regulating effect of a single reservoir in conjunction with a given actual or assumed flood graph. In this work it became necessary not only to determine the effect on each retarding basin or reservoir separately but also the effect where all or several of the retarding basins are operating in conjunction. This problem, while somewhat intricate, is treated in a general manner. As a basis for these studies only the discharge in the 1913 flood at Dayton was actually known. Methods of estimating the discharges from the various tributary areas, as under simultaneous flood conditions, are described.

It is not to be expected that all of the special methods developed or used and described in this work will be generally accepted as final. As explained in the text, some of the methods were necessarily arrived at early in the studies, before complete information was at hand, in order to form a basis for a general plan and to outline the reservoir system as a whole. But almost every special topic is treated in such a manner as to throw new light upon it, and there is much in the book that is unquestionably sound and rational and will form a permanent basis for future work along the same line. For example, it is clearly recognized that only floods of definite magnitude can by any possibility occur on a given drainage basin, and the formulas or methods of calculation, indicating that floods of infinite magnitude may ultimately be expected, even if at infinite intervals, cannot form an acceptable basis of economical design.

The discussion of the question as to the probable flood magnitude on a tributary, when the flood graph for the main stream is given, seems, however, somewhat unsatisfactory. It is indicated, although somewhat vaguely, that there are two quite distinct cases: One where the storm is local, thus producing a maximum flood on the tributary, and the flood peak discharge rate per unit of area decreasing in general as the tributary area increases; the other, the case of a general storm, such as that which produced the great flood of 1913, wherein the discharge rates per unit of area, other things being equal, for areas of different sizes may be much the same.

The effects of channel improvement with retarding basins as a means of flood regulation receive attention, and some unusual features of stream channel hydraulics are treated, including the head losses due to channel curvature and varying form of cross-section. Obstruction by bridge piers receives general treatment only, without mathematical discussion.

Finally, the important problem of balancing the flood protection system is taken up in an illuminating manner, with ample illustrations, and the economics of retarding basins as affected by the relation of spillway height and form to the utilization of lands within the basins is given consideration.

The book is written in a lucid and painstaking manner, and contains no more mathematical discussion than is essential to the comprehensive treatment of the problems involved. It is a work on certain advanced features of hydraulics in relation to the hydrology of floods which will be useful not only to those engaged in similar projects but to others interested in various aspects of river channel improvement. It contains a number of tables, including one of four pages, giving essential facts regarding existing flood control reservoirs, and is accompanied by an excellent index.

A New and Better Work on Public Health

PUBLIC HEALTH AND HYGIENE: In Contributions by Eminent Authorities—Edited by William Hallock Park, M. D., Professor of Bacteriology and Hygiene, University and Bellevue Hospital Medical College, and Director of the Bureau of Laboratories of the Department of Health, New York City. New York and Philadelphia: Lea & Febiger. Cloth; 6 x 9 in.; pp. 884; illustrated with 123 engravings. $10.

Twenty-three men and one woman believing "that there was need for a volume in which the most important phases of hygiene in relation to public health" should "be presented in a practical way by specialists actually devoting themselves to the subjects (here) treated by them" have united in the production of this volume, under the able leadership of Dr. Park. Although the book is represented as being for "public health officials, physicians and medical students" the larger part of its contents would be equally informing and helpful to the increasing number of engineers who, while not public health officials, find it worth their while to keep informed of the advances in public health.

Dr. Park opens the volume with chapters on microorganisms and disease, antimicrobal substances (Dr. Charles Krumwiede, joint author), prevention of infectious diseases, and disinfectants. Further on Dr. Park has chapters on bacterial and other contaminations and infections of milk, meat and other foods. Among other authors and topics are: Dr. George A. Soper, epidemiology; air, health and ventilation, Prof. C.-E. A. Winslow; housing, Lawrence Veillier; the soil and also plumbing, Dr. A. R. Guerard; water supplies and sewage, James T. B. Bowles; sanitation of swimming pools, Dr. W. A. Manheimer; vital statistics, Drs. W. H. Guilfoy and S. W. Wynne.

The book is singularly free from the lapses common to attempts to cover the whole field of public health when made by one man or a few men who cannot possibly have personal knowledge of the subjects treated.

Factory Administration Revised

REVIEWED BY R. R. POTTER
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FACTORY ADMINISTRATION AND COST ACCOUNTS: A Reference Book of the Principles and Practice of Industrial Administration and Costing for Present Day Requirements—By Edward T. Elbourne of Messrs. Brindley & Elbourne, Consulting Engineers on Factory Organization and Costing Systems. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 817; illustrated. $15.00.

Mr. Elbourne has so thoroughly rearranged the subject matter in this new edition of his book that it is difficult to draw a close comparison in detail with the earlier edition, which was reviewed in *Engineering News*, Dec. 24, 1914. Three chief reasons are given by the author for so thorough a revision: (1) Costing, or factory cost accounting, had come to be a recognized necessity if competition must be met; (2) efficiency of production, as a result of widespread experience in munitions manufacture, had acquired a new significance; and (3) the relationship of labor, management and capital had undergone a notable alteration. The work still retains its character, however, as primarily a reference book of factory accounting and clerical details.

As it now stands, the book is divided into seven sections: I. General Administration, II. Production control, III. Labor Administration, IV. Material Control, V. Works Accounting—Administrative Records, VI. Cost Accounts, and VII. Specimen Forms. The nature of the rearrangement wil be evident from a comparison with the review of the earlier edition. The general effect is an improved co-ordination and classification of the information presented. The new subject matter is well distributed among the several sections, the net result being an increase of 173 pages. Notable new features include a general diagram of staff organization and functions, a glossary of technical and business terms which may increase the possible usefulness of this book to American readers, and a system of marginal notes throughout the text whereby the reader is referred to other pages bearing on related subjects.

In the preface, the author lays emphasis upon "the fact that the book deals essentially with principles." It would be more definite to say that the book discusses the application to administrative details of principles which, for the most part, remain themselves unstated.

Design and Construction of Masonry

MASONRY STRUCTURES—By Frederick P. Spalding, Professor of Civil Engineering, University of Missouri. New York: John Wiley & Sons, Inc., London: Chapman & Hall, Ltd. Cloth; 6 x 9 in., pp. 494; illustrated. $3.50.

As a college text for students just being introduced to structural engineering this book will probably serve. It treats of all of the materials and constructions that possibly could be classed under the head of masonry and discusses them in a quite correct manner. It is not, however, specially valuable beyond the classroom, because, after the fashion of all books on masonry, it groups together a great number of things which have no particular relation to one another and has therefore to treat each one, on account of the lack of space, in a manner much less complete than the particular subject is treated in books devoted especially to it. Subjects covered, for instance, are materials, in which the treatment is adequate and concrete and reinforced-concrete for which obviously a better reference can be found in the numerous special treatises on those subjects; retaining walls, masonry dams, slab and girder bridges, masonry arches, culverts and conduits, and foundations are the remaining headings, and the wide extent of those subjects indicates how broad the field of such a book really must be.

Work of the War Industries Board

AMERICAN INDUSTRY IN THE WAR: Report of the War Industries Board—By Bernard M. Baruch, Chairman. Washington, D. C.: The Board. Paper; 6 x 9 in.; pp. 421.

Mr. Baruch's report on the activities of the War Industries Board is an essential part of a sane preparedness program. In case of a future emergency we shall want to have, in brief form, just the information here given. The volume presents not merely the historical development of the War Industries Board, but also describes in sufficient detail the activities of its various divisions, so that an excellent idea of what it did can be obtained. Each particular type of work, such as the study of resources, priorities, conservation, price fixing, etc., is first treated in general; then follow brief outlines of the accomplishments of the various commodity sections, which controlled individual products and industries. Appendices give the chief circulars, orders, priority lists, etc., that put into effect the decisions of the board.

Of chief interest is a summary chapter in which Mr. Baruch tries to crystallize the conclusions to be drawn from the work of the board.

One of the most interesting chapters is that on conservation, telling how the waste in industry was cut down during the war.

Factors in Business Success

AMERICAN BUSINESS METHODS: For Increasing Production and Reducing Costs in Factory, Store and Office—By Floyd W. Parsons, E.M.; Mem.A.I.M.E., M.M.S.A., Academy of Political Science; Founder and Former Editor of *Coal Age*, and Author of Everybody's Business in the *Saturday Evening Post*. New York and London: G. P. Putnam's Sons. Cloth; 6 x 9 in.; pp. 373. $2.50.

Made up largely of articles published in the department entitled "Everybody's Business," in the *Saturday Evening Post*, this book is chiefly inspirational in character. Covering a very wide range of subjects, including labor management, light and ventilation, labor-saving machinery, advertising and selling, and foreign trade, it cannot go into intimate details. It will stimulate the thinking of those who have heretofore given little attention to some of the most fundamental factors in the successful running of industries and business. The book bristles with practical suggestions regarding improvements that make for greater efficiency in the many fields on which it touches.

PUBLICATIONS RECEIVED

ACCEPTANCES TRADE AND BANKING—By [illegible] Manager of Credits [illegible] Vice President, The Bankers [illegible] New York: [illegible] Paper; [illegible] pp. [illegible]

CALIFORNIA BOARD OF STATE HARBOR COMMISSIONERS [illegible] Paper; [illegible] pp. [illegible]

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING [illegible] Cloth; [illegible] pp. [illegible]

THE CLEVELAND TRUCK-FREIGHT PLAN—Cleveland [illegible] Paper; [illegible] pp. [illegible]

COOPER-HEWITT EXPERIENCE WITH MOTOR TRUCKS—A Study of 581 Reports from Farmers Who Own

Motor Trucks—By H. R. Tolley, Agricultural Engineer, and L. M. Church, Assistant in Farm Accounting. Washington, D. C.: U. S. Dept. of Agriculture. Paper; 6 x 9 in.; pp. 34; illustrated. 10c. from Superintendent of Documents.

THE DYNAMICS OF THE AIRPLANE—By Kenneth P. Williams, Ph.D., Associate Professor of Mathematics, Indiana University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 138; illustrated. $2.50 postpaid.

ELECTRIC-ARC WELDING OF STEEL—I: Properties of the Arc-Fused Metal—By Henry S. Rawdon, Physicist; Edward C. Groesbeck, Physical Chemist; Louis Jordan, Associate Chemist, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 63; illustrated. 15c. from Superintendent of Documents.

ENGINEERING COUNCIL: A Brief History—By J. Parke Channing, Philip N. Moore, Alfred D. Flinn, Members, Am. Soc. C. E., A.S.M.E., A.I.E.E., etc. New York: The Council, 29 W. 39th St. Paper; 6 x 9 in.; pp. 27.

THE ENGINEERING FOUNDATION OF UNITED ENGINEERING SOCIETY: Report for Year Ended Feb. 10, 1921. New York: The Foundation, Engineering Societies Building. Paper; 7 x 10 in.; pp. 32.

FACTORS GOVERNING THE SELECTION AND PROTECTION OF SOURCES OF WATER SUPPLY—By J. K. Hoskins, Associate Sanitary Engineer, U. S. Public Health Service. Washington, D. C.: The Service. Paper; 6 x 9 in.; pp. 20. 5c. from Superintendent of Documents.

FIFTEEN YEARS FILTRATION PRACTICE IN INDIANAPOLIS—By H. E. Jordan. (From Proceedings of the Thirteenth Annual Convention of the Indiana Sanitary and Water Supply Association.) Indianapolis, Ind.: Indianapolis Water Co. Paper; 6 x 9 in.; pp. 68.

A unique and valuable summary of the various details of water-filter operation at Indianapolis. An abstract of the paper appeared in *Engineering News-Record*, Feb. 3, 1921, p. 218.

FINANCIAL STATISTICS OF CITIES HAVING A POPULATION OF OVER 30,000: Report, 1919. Washington, D. C.: Bureau of Census. Paper; 9 x 12 in.; pp. 355; illustrated.

THE FUNDAMENTAL PRINCIPLES OF WATER POWER ENGINEERING: Describing Types, Applications and Operation of Water Turbines and Developing the Fundamental Formulæ of Water Power Engineering—By Frank F. Fergusson, C.E., Assoc. M.Inst.C.E., Assoc.Mem.Am.Soc.C.E. New York and London: Isaac Pitman & Sons. Cloth; 4 x 6 in.; pp. 116; illustrated. $1.

An admirable little treatise from the English viewpoint. In a few pages the author ranges over the design of the power plant. The book has little to do with the hydraulics of a development prior to the time the water enters the turbines. That the author does not think very well of or know very much about American practice may be inferred from the fact that in the short list of "Periodicals Making a Special Feature of Papers on Water Power, Etc.," there is no reference whatsoever to any American periodical or engineering society.

HYDRO-ELECTRIC DEVELOPMENT IN ONTARIO: A History of Water-Power Administration Under the Hydro-Electric Power Commission of Ontario—By E. B. Biggar, Author of "Canadian Railway Problem," former Editor of *Canadian Engineer*, etc. Toronto, Can.: The Biggar Press, Ltd. Cloth; 5 x 8 in.; pp. 202; illustrated.

An inspired eulogy of the Hydro-Electric Power Commission of Ontario. The controversy in Canada regarding the merits or defects of "Hydro" is violent. No one apparently is unprejudiced or non-partisan in the discussion. Such a book as this one serves little purpose, therefore, in settling the question whether "Hydro" is or is not an economic success.

MASSACHUSETTS STATE DEPARTMENT OF HEALTH: Report. Boston, Mass.: The Department. Cloth; 6 x 9 in.; pp. 220.

MINERAL PRODUCTION OF CANADA: Preliminary Report, 1920—Prepared by John McLeish, B.A., Chief of the Division of Mineral Resources and Statistics. Ottawa, Can.: Dept. of Mines. Paper; 7 x 10 in.; pp. 24.

MISSISSIPPI RIVER COMMISSION: (Extracts from the Annual Report of the Chief of Engineers to the Secretary of War.) Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 1307; illustrated.

MODERN ROAD BUILDING AND MAINTENANCE: Principles and Practice; Prepared for the Use of Engineers, Contractors, Road Officials, Students and All Who Are Interested in the Rational and Economic Solution of the Many Problems Connected with Our Public Roads and the Traffic They Are Required to Carry—By Andrew P. Anderson, Highway Engineer, Bureau of Public Roads, U. S. Dept. of Agriculture. Chicago and New York: Hercules Powder Co. Paper; 6 x 9 in.; pp. 146; illustrated.

About 120 pages on road planning, materials, construction, maintenance and 25 pages on the use of explosives in road work.

MOTOR TRACTION AND ROAD RAILWAYS: Including the Stronach-Dutton-System — By Sir F. D. Couchman, K.B.E., M.Inst.C.E., and Major-General Sir H. F. E. Freeland, K.C.I.E., C.B., M.V.O., D.S.O., R.E.; with an Introductory Note by F. G. Royal-Dawson, M.Inst.C.E., Chief Engineer with the Railway Board. Simla, India: Railway Board. Paper; 8 x 13 in.; pp. 41; illustrated. 1 Rupee.

THE MYSORE ENGINEERS' ASSOCIATION, BANGALORE: Proceedings, 1920. Bangalore, India: The Association. Paper; 5 x 8 in.; pp. 193; illustrated.

NEW HAMPSHIRE STATE HIGHWAY DEPARTMENT: Report Relative to Highway Improvement. Concord, N. H.: The Department. Cloth; 6 x 9 in.; pp. 243; illustrated.

NEW YORK DEPARTMENT OF LABOR: Special Bulletin Issued Under the Direction of the Industrial Commission, Including N. Y. Court Decisions on Labor Law and Industrial Disputes, January, 1915-21. Albany, N. Y.: Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 200.

NEW YORK STATE INCOME TAX PROCEDURE, 1921: Including Corporation Franchise Tax—By Robert H. Montgomery, C.P.A. of Lybrand, Ross Brothers and Montgomery; Attorney-at-Law; Former President, American Association of Public Accountants; Professor of Accounting, Columbia University. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 682. $5.

PENNSYLVANIA MINING STATUTES ANNOTATED—By J. W. Thompson. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 1221; $1 from Superintendent of Documents.

THE PEOPLE'S BUSINESS IN THE FIFTH CITY: Facts About the Affairs and Activities of the City of Cleveland—W. S. FitzGerald, Mayor; a Plain Statement of the Manner in Which the People's Business Was Managed and Their Money Spent During 1920—Compiled and Edited by M. F. Bourjaily, Commissioner, Bureau of Information and Research. Cleveland, Ohio: The Bureau. Paper; 8 x 11 in.; pp. 48; illustrated.

Instead of printing 500 copies of a 2,000-page volume of little interest or value to anyone, as formerly, 100,000 copies of a 48-page readable pamphlet outlining various city activities were printed and distributed from house to house. The new plan is commendable but can hardly be accepted as a substitute for department reports, which, properly written, are well worth while.

THE POWER SITUATION DURING THE WAR — By Col. Charles Keller, Corps of Engineers; with Appendixes Containing Reports on Conditions in the Several Power Districts. Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 300; illustrated.

PROGRESS REPORT OF THE NATIONAL SCREW THREAD COMMISSION. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 109; illustrated. Free on Application.

Contains standards for screw threads, established by the Commission according to law.

THE PRICE OF LUMBER: A Study of the Fundamental Conditions in the Lumber Industry—By Robert B. Goodman, Secretary of the Goodman Lumber Co. and Chairman of the Committee on Economics of the National Lumber Manufacturers' Association; An Address Delivered at Yale University, January, 1921, under the Auspices of the School of Forestry on the 20th Engineers' Memorial Foundation. Chicago, Ill.: The National Lumber Manufacturers' Association. Paper; 5 x 8 in.; pp. 29; illustrated.

The lecture is supplemented by a Bibliography of 2 pages and statistics and diagrams showing the yearly index numbers of (1) wholesale prices for all commodities and (2) of lumber building material for the years 1850, 1855 and then yearly to 1920, together with the percentages of (2) to (1).

RED-LEAD AND HOW TO USE IT IN PAINT—By Alvah Horton Sabin, M.S., D.Sc., Author of "Technology of Paint and Varnish," "White-Lead," etc.; Member of the American Chemical Society, the Society of Chemical Industry, etc. Third Edition, Rewritten and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 7 in.; pp. 139; illustrated. $2 postpaid.

REGULATION OF EXPLOSIVES IN THE UNITED STATES: With Especial Reference to the Administration of the Explosives Act of October, 1917, by the Bureau of Mines—By Charles E. Munroe. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 45. 10c. from Superintendent of Documents.

SHADES AND SHADOWS—By David C. Lange, M.S., Instructor in Architecture in the Washington State College. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 135; illustrated. $2.50 postpaid; 15/ net.

A text for architectural students. The book first takes up the elements of descriptive geometry. It then goes on with the subject from the architectural viewpoint.

STANDARD METHODS FOR THE EXAMINATION OF WATER AND SEWAGE: Fourth Edition Revised by Committees of the American Public Health Association, American Chemical Society, and Referees of the Association of Official Agricultural Chemists. Boston, Mass.: American Public Health Association. Paper; 7 x 10 in.; pp. 115; illustrated. Paper, 60c.; Cloth, $1.25.

Embodies changes (in bacterial methods only) recommended by the Committee in its 1919 report and adopted by the Laboratory section. Some of the more important changes are: Authorization of new brands of peptone; phenol red method of hydrogen-ion concentration; and preforation of endo medium.

STATE WATER COMMISSION OF CALIFORNIA: Report, 1919-20. San Francisco, Cal.: The Commission. Paper; 6 x 9 in.; pp. 176; illustrated.

STATISTICS OF COMMON CARRIERS: Preliminary Abstract, 1919. Washington, D. C.: Bureau of Statistics. Paper; 9 x 12 in.; pp. 172.

STRUCTURAL DEFECTS INFLUENCING THE SPREAD OF FIRE: Suggestions for Their Elimination and Protection—Prepared by the Committee on Manufacturing Risks and Special Hazards. Boston, Mass.: National Fire Protection Association. Paper; 6 x 9 in.; pp. 18; illustrated. 10c.

TRAIN RESISTANCES: For Various Gauges, Rail Sections, Track Conditions and Types of Rolling Stock—By F. G. Royal-Dawson, M.Inst.C.E., Chief Engineer with the Railway Board. Simla, India: The Board. Paper; 8 x 13 in.; pp. 31. 4 As.

THE USE OF CONCRETE PIPE IN IRRIGATION—By F. W. Stanley, Senior Irrigation Engineer, with Introductory Paragraphs by Samuel Portier, Chief of Irrigation Division, U. S. Department of Agriculture. Washington, D. C.: The Dept. Paper; 6 x 9 in.; pp. 54; illustrated. 20c. from Superintendent of Documents.

Includes various accessories, such as settling basins and screens, air vents, relief stands, measuring devices and distributing hydrants. Gives cost figures. Contains tables of pipe capacities and weir discharges.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

When Would the New Am. Soc. C. E. Constitution Begin to Function?

Sir—Several questions have been raised regarding the working of the machinery of the proposed new constitution of the American Society of Civil Engineers providing it is adopted in its present or amended form, and the answers to some of these questions are contained in the accompanying copy of letter from Parker and Aaron, Attorneys for the Society and also for the Committee on Referred Amendments: P. H. NORCROSS,

Atlanta, Ga., Committee on Referred Amendments.
April 11.

Dear Mr. Norcross: We beg to acknowledge receipt of your letter asking our opinion as to the effective date of the new revised constitution in event that it shall be approved by the vote of the members. The time at which the new constitution can take effect is limited and prescribed by the terms of the present constitution, which prescribes that amendments shall be voted upon by letter ballot in the form as amended by the business meeting during the annual convention, or if not so amended they shall be voted upon by letter ballot as submitted, the vote to be counted at the first regular meeting in October. The present constitution further provides that amendments so adopted shall take effect thirty days after their adoption.

The revised constitution therefore, if approved, will necessarily take effect and be in force thirty after the first regular meeting in October next and will be in foce from that time until thereafter amended.

About this there can be no doubt. The real question would seem to arise as to what effect the adoption of this new constitution will have upon the proceedings at the annual meeting held on the third Wednesday in January. The nominations for officers to be elected at that meeting will not be made under the provisions of the new constitution. On the other hand, the nominating committee provided for under the present constitution will have completed its duties and submitted its candidates prior to the taking effect of the revised constitution. There will be in December, 1921, no legal provision requiring the submission of the names thus selected by the nominating committee to the corporate members prior to the annual meeting, but nominations by declaration in accordance with the provisions of the revised constitution will be in order. It may be assumed that the Board of Direction will authorize or require the Secretary to send out the nominations as made by the nominating committee to the corporate members in the manner prescribed by the present constitution, but there will be no compulsion on the Board to do so. If it be deemed necessary to insert a transitory article in the revised draft providing that in December, 1921, the Secretary shall send out the names prepared by the nominating committee in the manner provided in the present constitution, such a transitory clause may be added to the proposed draft. We think, however, that the constitution could properly be met by the action of the Board of Direction requiring this matter of submission of these names as a matter of information to the electorate. In all other respects the revised consitution will inevitably take effect as of thiry days from date of adoption

Of course the adoption of the revised constitution will not affect the tenure of office of any of the present Board of Direction, including among them the present five past presidents who will continue to serve until they cease to be the five latest past president or resign their office as directors. This circumstance is due to that provision of the New York statute that prevents an amendment legislating directors out of their office.

(Signed) PARKER & AARON.

Disparities in Highway Bids

Sir—I notice, among your editorials of the March 31 issue, an article entitled "Disparities in Highway Bids." As I read it, the author seriously questions the prices being paid for Pennsylvania highways as compared to other states, and wishes facts on the subject.

As an engineer of long practice and experience in highway construction, I could give you a careful analysis of the whys and wherefores of this "seeming disparity," but prefer to give you the comparison as set forth by one of the most reputable highway contractors of New York, who has contracted not only in New York and Pennsylvania, but elsewhere. His statement is as follows:

As compared to New York, the stone requirement required in Pennsylvania is is more than double in weight [illegible] in cost of nearly $2,000 per mile of [illegible] 18 ft. wide). The excavation is unclassified, making the item a pure gamble. Pennsylvania in general is very mountainous, with steep grades and long hauls. Contractors are not paid for sod removal by direct item, and this also introduces another risk. Last, but not least, the very rigid and strict inspection in Pennsylvania places the work upon an entirely different basis, and the price per mile, therefore, cannot be compared with other states with so widely different conditions.

On a fair basis of comparison, more money can be made with quoted prices in other states than with present prices in Pennsylvania. If those who are making statements about the prices being paid for Pennsylvania work, without any knowledge of the true conditions, can perform in the field the wonders they set forth on paper, they can pick their job and set their own salary as a "Highway Construction Doctor."

Another contractor of national reputation, who has built highways in many of the Eastern States, calls attention to the following:

Acceptable sources of stone and sand supply, particularly for reinforced concrete pavement, are not so numerous in Pennsylvania as in the state of New York, thereby making the average freight rate on concrete aggregates higher; also the average price for crushed stone, as charged by the producing quarries in Pennsylvania, is higher than that in New York. Another point on which it is difficult to fix an exact money difference, is that of interpretation of the requirements on materials. This frequently changes the entire aspect of a contract. In Pennsylvania the interpretation is considerably more rigid than that of New York or Ohio.

In closing this note I would simply add that frequently, in Pennsylvania highway contracts, the grading costs are between 20 and 30 per cent of the entire contract, whereas in other states it is as low as 5 per cent. In addition to this, many of the points so well put by William B. King, of the Bar of Court of Claims, Washington, D. C., in his article in *Engineering News-Record*, Feb. 3, 1921, p. 227, entitled "Minimizing the Risk," find application in Pennsylvania, and until these risks are eliminated, the conservative, responsible contractor must bid accordingly.

At this point, however, it is only fair and just to the Pennsylvania State Highway Department, to say that Pennsylvania is getting the highest class and most durable type of road construction of any state in the Union, and when all other factors have been given due consideration, this one stands out pre-eminently. Low first costs satisfy for the moment, but they are soon forgotten, while fair, ultimate economic costs are facts which live with the roads.

Harrisburg, Pa., April 11 CHAS. F. PUFF, JR.,
Secretary and General Manager
Associated Pennsylvania Highway Contractors.

Corner Breakage of Concrete Road Slabs

Sir—In *Engineering News-Record*, Feb. 3, 1921, p. 210, Clifford Older calls attention to the breaking down of the corners of concrete slabs. In Mr. Older's opinion it is necessary to reinforce slabs at the corners, or else make them sufficiently thick to withstand the loads imposed.

The information regarding the saturation of subgrade is most interesting and coincides with the experience of the writer. Throughout California, on practically every highway built in the State, on ground which is effected by moisture, there has been a great deal of breaking of corner slabs. Such reinforcement as has been tried, has not materially corrected this evil and I believe it cannot be corrected by reinforcement, unless a very thorough job is done.

A point which seems to have been overlooked by practically all designers of concrete slabs is the fact shown by Mr. Older, though not brought out in sufficient detail, that the cause of the breaking of the corners is that the supported area under a corner is a triangular segment of concrete having an area equal to one-half that of any other bearing section of pavement.

A number of years ago the writer devised a joint support for concrete pavements. A strip of base 4 in. thick and 18 in. wide was first constructed, with its surface even with the surface of the subgrade, and the concrete pavement was then constructed with a joint over the center of this supporting strip. The result was that whereas earlier pavements had broken or cracked at the joints, this breakage did not occur on subsequent concrete pavements. There are numerous streets and alleys in Los Angeles built in this way and they are all giving first-class service, with no signs of failure at the joints. I believe it would be entirely feasible to construct two parallel supporting

strips along the edges of the highway, so that the outer edge of the pavement proper should have an adequate foundation to support the load imposed upon it. Inasmuch as points of cracking in concrete pavements cannot be readily predicted, it seems inadvisable to place supports across a highway, but it may be that this also would be advisable under certain conditions. The fact that even the heaviest highways crack at the corners, indicates that something besides reinforcement is necessary and I believe the solution lies in the well-worn principle of requiring equal areas to be provided for equal pressures, a condition which does not usually exist in highway design.

San Francisco, Cal., Feb. 28. C. S. POPE.

[A copy of the preceding letter was sent to Mr. Older. His reply follows—EDITOR.]

Sir—Mr. Pope's observations of the breaking down of corners of pavement slabs and his suggested remedy are of much interest.

Engineering News-Record, March 24, 1921, p. 504, contains a brief description of the plan proposed by the Illinois Department of Public Works and Buildings to strengthen the corners of pavement slabs. Briefly, the ¾-in. bar, called for along the edge of the pavement, should be means of its shear value cause an equal deflection and thereby equal stresses in the corners formed by transverse cracks or joints. The bar is proportioned to transfer one-half of a four-ton load (the maximum wheel load permitted under the Illinois law) across the crack or joint, thus reducing the transverse bending stress in each corner to one-half of the amount that would otherwise occur.

At the cracks this bar will be subjected to shearing, bending and direct tensile stresses and the concrete to bearing and tensile stresses.

In the bar, the total shearing stress may safely be assumed as equal to one-half the maximum wheel load. At the crack each wheel load causing a deflection of the corners will undoubtedly bend the bar through a slight angle. A four-ton wheel load on a 7-in. slab, deflects the corners from two to three hundredths of an inch. The bar therefore must bend, with the passage of each wheel load, through an angle equal to that formed by lines tangent to the deflection curves of the slabs at the crack. The ultimate effect of this bending remains to be determined.

At the cracks the bar will be subjected to a more or less concentrated direct tensile stress due to the contraction of the slabs. The bars are to be coated with paint and asphalt to reduce the bond and thus facilitate slipping adjacent to the crack. It is hoped that the slip will extend for a sufficient length of the bar to prevent rupture due to direct tension.

The concrete adjacent to the crack and under and over the bar on opposite sides will be called upon to sustain a total bearing stress equal to one-half of the wheel load. This stress will be greatest immediately adjacent to the crack. A slight failure of the concrete adjacent to the crack in bearing would cause a readjustment of the bearing stresses, the tendency being to reduce the maximum. The ultimate result remains to be determined. Tensile stresses will occur in the concrete immediately above and below the bar on opposite sides of the crack. A consideration of the probable area of concrete effective to resist this tension would indicate there should be no serious danger of the bar "stripping out" adjacent to the crack.

It would of course be possible to reduce the bearing and tensile stresses in the concrete due to the presence of the bar at the joint by using additional bars.

The possibility of rupture due to the concentration of contraction at certain joints might be reduced by using frequent transverse dividing planes in the slab.

It is obvious that the adoption of some means whereby both corners may be made to act together in supporting the traffic loads is much to be desired.

It is appreciated that the method proposed may not be the ultimate solution. CLIFFORD OLDER,

Springfield, Ill., April 5. Chief Highway Engineer.

Useful Dodges in Surveying

Sir—Under the caption "Useful Dodges in Surveying" in your issue of April 14, p. 653, you publish letters of Mr. Whitmore and Mr. Roberts, who discussed a previous letter of Mr. Thackwell. In the annual reports of the Philadelphia Water Department of 1883 and 1884 you will find a description, with practical details, of a method fully as simple and economical, according to which about 450 sq. miles of territory in eastern Pennsylvania were surveyed in the interest of new water supply for Philadelphia. It was quite similar to the method described by Mr. Whitmore. The surveys were plotted on the ground to a scale of 400 ft. to the inch, and subsequently traced upon large maps which are still at the Philadelphia department. These maps were accepted by the U. S. Geological Survey, and published by it in their usual scale of 1 mile to the inch, as a part of their survey of the state.

After a general triangulation had been made over the territory, with a fixed point established on about every square mile, the topographical survey was made by several parties, each one consisting of a topographer, leveler and rodman. The instruments were a transit, a so-called field table with alidade and a level rod. The field table (a baby plane table or *croquis*) modeled after Swiss practice, was about 15 in. square and rested on a very light tripod. The work on it began by the plotting of one of the established triangulation points upon the table, after orientation. The alidade, almost as simple as a triangular scale, with vertical sight hairs at each end, was used to sight in all desired points, including the rod held by the rodman, and to mark straight lines leading to them. The distances to the rod locations were obtained by stadia readings with the transit. The elevations were obtained from angles read on the vertical arc of the transit. These were computed and plotted, as were all the topography, roads, buildings, forest borders, main fence lines, etc., and all the contour lines were sketched in with full view of the field before the field table was moved to another point. The scale of the plot was 400 ft. to the inch. The contour lines were subsequently adjusted to 5 or 10-ft. intervals, before the sheets were transferred to the large maps now at the office.

Four different pencils were used: A black one, I believe, for the roads and buildings, a brown one for the contours, a green one for the forests and a blue one for the water courses. Kenneth Allen, now sanitary engineer of the Board of Estimate and Appointment in New York, led one of the parties.

The areas thus surveyed and plotted on the field sheets were turned in weekly, and each party covered from 2 to 3½ sq. miles of territory. This survey, therefore, was similar to the Lucas County survey, described by Mr. Whitmore. The cost of our entire field work, including the plotting as described, was, I believe, less than 5 cents per acre, and was the first survey of the kind. The details were mostly worked out by us in the office during the winter of 1883 and 1884. Some improvements were subsequently made in the field.

In view of the limited appropriation for the survey, originally not intended to be as extensive as we make it, it had become necessary to evolve a sufficiently accurate method that could be employed at a very small cost. Col. Wm. Ludlow, U. S. A., was then chief engineer of the Water Department. RUDOLPH HERING,

New York City, April 18. Consulting Engineer.

Fusing Temperatures of Concrete Measured

Determinations of the fusing point of concrete have been made at the Bureau of Standards on small specimens. They give the fusing temperature as about 1,200 deg. C., which is approximately 2,200 deg. F. The temperature probably varies with the kind of sand and cement used. Fusion of concrete has been observed in one or two very hot fires in reinforced-concrete manufacturing buildings, and was also noticed as occurring frequently in the fire tests of columns recently completed at the Underwriters' Laboratories.

HINTS FOR THE CONTRACTOR

Tail-Gate Measuring Box Minimizes Handling of Road Materials

IN repairing California pavements, where a series of concrete patches are to be put in, and where the work is extensive enough to warrant using a concrete mixer, a device is used by means of which materials are delivered, batch by batch, direct from motor truck to the mixer hopper. Advantages claimed for this device are that (1) it avoids the necessity for piling material along the right-of-way ahead of the mixer; (2) it reduces the material-handling crew by four men; and (3) it delivers cleaner material to the mixer.

TAIL-GATE MEASURING BOX DISCHARGING AGGREGATE INTO MIXER SKIP

The device consists of a measuring box made of 2-in. plank which is hung under the tail-gate of a tilting-body truck by ½ x 2-in. iron straps. The iron straps have their upper ends turned over in hook form and these hooks are slipped over the rod across the top of the tail-gate. Only one box is required on the job, as it is removed from an empty truck and put on the loaded truck that takes its place. The box is divided by a vertical partition into two compartments, one for sand and one for rock. The trucks to be used with it are likewise provided with a longitudinal partition which divides the truck body into sand and rock compartments in the capacity ratio of one to two. In the tail-gate, on each side of this partition, is a small shear gate, and one compartment of the measuring box is always under each of these small gates. When the truck is full the box can be filled without tilting the truck body; as the materials are used up, the truck body is tilted to the angle necessary to continue to deliver the materials by gravity.

The measuring box holds 4 cu.ft. of rock and 2 cu.ft. of sand, which, with one sack of cement just makes a batch for the mixer ordinarily used on patching work. The bottom of the box slopes away from the truck toward the side which is hinged so that, by tripping a latch at the bottom, the contents of both compartments are quickly discharged. With the mixer hopper on the ground ready for a charge, the truck moves back until the measuring box is over it, and the contents of the box are discharged directly into it. Just enough cement is brought with each load so no cement storage is necessary along the road.

Mixer on Paving Jobs Drags Pipes that Support Reinforcing

A convenient means of supporting reinforcing bars in concrete pavement, adopted by the California Highway Commission, is shown in the accompanying illustration. The bars are laid on pipes which are attached by means of chains to the concrete mixer and are dragged forward before the concrete sets, each time the mixer moves to new position.

The method first used, that of pulling the bars up into place by means of hooks after pouring the slab, was slow and costly, and the final position of the bars in the concrete was uncertain. The present method uses two pieces of 2-in. galvanized iron pipe, 4 to 8 ft. in length, according to the length of roadway poured at each position of the mixer. One of the pipes is placed at each one-third point on the roadway width. The ends of the pipes are flattened and punched so that they can be conveniently attached to the mixer by chains.

PIPE SUPPORTS FOR BARS ATTACHED TO MIXER

NEWS OF THE WEEK

New York, April 21, 1921

State Officials Confer on Highway Policies

Delegation Drafts Bill Confining Federal-Aid to Two Classes of Roads and Calls on President

(Washington Correspondence)

State highway officials met in Washington last week and drafted a bill providing new conditions under which federal aid is to be extended to the states for the construction of public roads. The bill was submitted to the Secretary of Agriculture for his approval. As changes in the text are likely to be made, the proposed bill was not made public. It is understood, however, that it provides for road classification, for complusory maintenance on the part of the states and for the contribution by the states, as states, of the co-operative funds. The bill is understood to confine federal aid to a small percentage of the total road mileage of the state with the federal aid confined to Class 1 and Class 2 roads, with the states contributing a larger percentage of the cost in the case of Class 2 roads.

It was admitted by state highway officials that the bill, as drafted, is the most stringent in its provisions that ever had been contemplated by the states, but that the highway department representatives of all the states are practically pledged to a bill of the type drafted. The measure was described as "a golden mean between inadvisable extremes." It was made very clear that the highway officials are to take no stand as to the type of agency which will administer the federal-aid fund for the government. It was stated authoritatively that it had been decided to take no part whatever in the controversy as to whether road matters should be administered by the U. S. Bureau of Public Roads or by a new independent agency.

The State highway officials were received by President Harding on April 14. They assured the President that they are highly appreciative of the attention given the highway problem in his recent message to Congress. They told him that they are thoroughly in accord with everything he said. (See p. 687 of this issue.)

Senator Townsend of Michigan, chairman of the Committee on Post Offices and Post Roads of the Senate, has announced that hearings will soon be begun on his bill. It is understood that Senator Townsend has given up the idea of building roads with federal money alone. The state highway commissioners have not decided whether they will appear at the Townsend hearing or whether they will confine their attention entirely to the bill which will be introduced on their behalf in the House of Representatives. It was stated by state highway officials that they have not approved any one of the various road bills which have been introduced at the extra session.

There is considerable difference of opinion among highway officials as to just what the President intended to convey when he said in his message that "the federal agency of administration should be elevated to the importance and vested with authority comparable to the work before it." Some think that this means that the Secretary of Agriculture should be given broader powers, some are of the opinion that the President had in mind the creation of a Department of Public Works, to which the Bureau of Roads would be transferred, while some admitted that it looks like an endorsement of a federal highway commission.

W. C. Markham, legislative representative of the American Association of State Highway Officials declined early this week to divulge any detailed information as to the provision of the federal-aid bill which the state highway officials have drafted. The draft is in the hands of the solicitors of the department of Agriculture. It will go to the Secretary of Agriculture and later in the week to the President. It is possible that some of the suggestions of the Secretary of Agriculture will be embodied in the draft of the bill. The draft of the bill will not be made public until the President has had an opportunity to study it.

Hoover Resigns as President of Engineering Council

At the meeting of the executive board of American Engineering Council in Philadelphia, April 16, noted elsewhere in these columns, Herbert Hoover tendered his resignation as president of American Engineering Council. He did this because he considered that the activities of the council and of the Federated American Engineering Societies in national affairs would be likely to place him in an embarrassing position on account of his Cabinet post. He indicated that his interest in the work of the council and of the federation had in no degree diminished. In fact, he reiterated that he believed the formation of the Federated American Engineering Societies was the starting point of one of the most valuable voluntary services that could be rendered the nation.

His successor as president of the council was not elected at the meeting, but the selection of a successor was referred to the consideration of the council's committee on procedure.

Urge Governor To Oppose Corporation Engineering

Col. Wilgus Heads Group of Engineers in Petition for Hearing on License Bill

Headed by Col. William J. Wilgus, consulting engineer, New York City, 49 engineers have addressed to Governor Miller, of New York, a communication asking for a hearing on the bill to amend the existing professional engineers' license law which has already passed the State Assembly and the Senate and is before the Governor for final action. The petition calls upon the Governor to veto the bill known as Senate Bill 147,716, which would permit the practice of engineering by corporations. The engineering profession, in the event of the Governor's veto, will then, it is stated, have before it an unprejudged, clean-cut issue on which to go to its membership with a view to offering suitable amendments at the next session of the Legislature.

The petition opposes the definition of professional engineering contained in Senate Bill 147,716 and finds seven other grounds for objection to the measure which, it is asserted, would: Nullify the intent of the law; divide allegiance; cause the loss of professional responsibility; violate the code of ethics; place New York engineers on a plane lower than in other states; lower the dignity of the profession; be detrimental to the public interest.

In conclusion the petitioning engineers make the following request: "May we ask that you kindly give us a hearing at such time as you may fix so that, first-handed, you may see who we are, and so that we may orally supplement what we have here said with such additional data or arguments as may be required for the clarification of a matter that means so much to our profession and to the public."

Copies of the petition have been sent to the headquarters and to the local sections of the national societies of civil, mechanical, electrical, mining and chemical engineering.

Indiana Engineers Oppose License Law Changes

A resolution opposing any changes in the existing New York State license law for engineers was approved April 13 at a meeting of the Indianapolis Chapter of the American Association of Engineers. The Indianapolis engineers operate under a law which recognizes the practice of engineering by corporations. It is claimed that in proposed amendments to the New York law the reciprocity section is so worded as to discriminate against Indiana engineers.

Federation's Board Plans Engineering Assembly

Philadelphia Meeting Considers Questions of Public Affairs—Committee to Report on New York Licensing

The executive board of American Engineering Council held its regular bi-monthly meeting in Philadelphia, April 16. Aside from the resignation of Herbert Hoover as president of the council, noted elsewhere in these columns, the outstanding feature was the decision to hold an "Engineering Assembly" in Washington in January, 1922. The remaining time of the sessions was devoted to the consideration of reports of committees and the reference to these committees of new matters brought to the consideration of the board.

The Engineering Assembly is to be a two-day session for the discussion of engineering problems. A committee was appointed to make arrangements for holding it.

Considerable time was given to a discussion of the employment bureau, resulting in a decision to appoint a committee of three to study the whole problem and report back to the board. The Duluth Engineering Society, the Boston Society of Civil Engineers, and the Milwaukee Engineering Society were admitted to membership. The next meeting was fixed for June 3, and, according to previous decision, will be held in St. Louis. W. W. Varney, who has been serving as acting treasurer, was elected treasurer.

The secretary reported that the work of the committee on elimination of waste in industry had proceeded according to schedule, that brief summary reports would be available for newspapers in June, and for longer magazine articles in July and August.

Public Affairs

The committee on public affairs deemed it inadvisable for the council to engage in activities with reference to the general reorganization of the government. It believes that the council will be stronger if it confines its efforts to presenting to Congress and the public the merits of the proposal to establish a Department of Public Works. Plans are maturing for presentation of the latter subject to the congressional committee which is studying the reorganization of the national government. The council's representative on the Board for Jurisdictional Awards in the Building Industry, Rudolph P. Miller, reported on the work of that body. The executive board approved the continuance of the council's participation in the work and reappointed Mr. Miller as the council's representative.

Proposals that the council consider the New York water-power situation, better recognition of the officers of the Public Health Service, national legislation regarding standards, the quantity survey method, and a new bill for appropriations for completing the topographic map of the United States were referred to the appropriate committees for consideration and report.

A statement was made regarding the controversy in New York State with reference to the exclusion of corporations and unrestricted partnerships from the practice of engineering, and the matter was referred to the council's original committee on licensing.

The meetings were held at the Philadelphia Engineers' Club and the members of the executive board were the club's guests at luncheon.

Philadelphia Engineers Give Dinner to Hoover

Herbert Hoover was the guest of honor at a dinner in Philadelphia, April 16, given by the engineers of that district, under the auspices of the Philadelphia Engineers' Club and its affiliated societies. Over 600 were present. The function was a brilliant affair and afforded opportunity for Mr. Hoover to discuss the need for governmental reorganization and to indicate the functions that he believed should be exercised by the Department of Commerce. He also made a strong plea for support of the Federated American Engineering Societies and urged the Philadelphia Engineers' Club to become a member.

Advantage was taken of the occasion to present to Mr. Hoover an illuminated certificate of honorary membership, to which he was elected Nov. 11, 1919, in "fullest appreciation of the eminence attained by him in the field of engineering and of his great service to humanity." Guilliaem Aertsen, president of the Engineers' Club, presented the certificate.

John C. Trautwine, Jr., spoke on "The Engineers of Philadelphia," Dean Dexter S. Kimball of Cornell University, on the "Federated American Engineering Societies," and George Wharton Pepper, of the Philadelphia bar, on "Hoover as a Citizen." Joseph A. Steinmetz, past-president of the Engineers' Club, was toastmaster.

Mr. Hoover's address will be printed in next week's issue.

Reppert Appointed City Engineer of Pittsburgh

Charles M. Reppert has been appointed chief engineer of the Bureau of Engineering of Pittsburgh, Pa., and will assume the duties at once. Mr. Reppert is a graduate of the College of Civil Engineering, Cornell University, class of 1904, and has been engaged practically all of his professional life in Pittsburgh. He was in the service of the city for a number of years, latterly in charge of sewers. At the outbreak of the war he became attached to the cantonment division of the army and was in charge of sewerage and water supply during the construction of Camp Meade, in Maryland. He then became assistant chief engineer of the housing division of the United States Emergency Fleet Corporation. Since [illegible] he has been connected with [illegible] Inc. of Pittsburgh.

Highway Departments Queried as to Policy

Committee Representing Automobile and Farm Interests Seeks Information About Federal-Aid Work

State highway departments last week were asked to supply information involving present and future policies of federal-aid work and prospective measures for the construction and maintenance of a system of interstate highways. The request took the form of a questionnaire letter issued by a committee representing the National Grange, United States Chamber of Commerce, American Automobile Association, National Automobile Chamber of Commerce, and the Federal Highway Council, this committee having been formed in 1919 at the request of Senator Charles E. Townsend to collect information which might be useful in amending the present federal-aid road act. The letter, which is addressed to the heads of all state highway departments and signed by Thomas C. Atkeson, Washington representative of the National Grange, asks the following questions:

1. Are you confining the expenditure of federal-aid funds to a selected system of inter-county state roads? If so, what is the mileage of the state system and its percentage of the total road mileage in your state?

2. Do you consider it wise to expend federal-aid funds on the grading and drainage of roads over clay or alluvial soils in the humid sections of the United States without providing at the same time for an adequate hard surface of gravel or better, so that the roads will be suitable for travel at all seasons of the year?

3. Are the funds used in meeting federal aid in your state contributed by the state, or by the counties, or both; and is any money taken from the motor vehicle fees?

4. Are the roads on which federal funds are spent in your state maintained by the counties, or by the state, or by the counties under state supervision?

5. In case additional federal aid is granted by Congress: (a) Would your department favor confining the federal funds to a limited system of inter-county state roads, selected by state and federal authorities?

(b) Do you think that your state would be willing to provide the funds and to assume absolute responsibility and control over the maintenance of all federal-aid roads in your state without calling upon the counties for financial assistance?

(c) Do you believe that a percentage of the federal-aid allotment to each state should be set aside for the maintenance of previously constructed federal-aid projects in the various states to be met with state funds in the same proportion as allotted for construction purposes?

(d) If so, how would you suggest [illegible]

that money be provided for the adequate maintenance of federal-aid roads?

(d) Do you think that the legislature of your state would provide state funds to meet federal-aid without calling upon the counties for financial assistance in the construction of all federal-aid projects?

6. In the event that additional federal aid is granted for a limited period of years along the lines indicated by the above questions, do you think that the people of your state would favor a federal system of inter-state roads laid out by federal highway authority in co-operation with state highway departments as to location, construction, and maintenance, all expenses connected therewith to be borne by the federal government, the work to proceed in each state as nearly as possible at the same time?

City Manager Plan Proposed for Cleveland

The committee of fifteen, at Cleveland, Ohio, created some three years ago to consider the city manager plan for that city, has approved an outline for charter amendments and proposes to carry on a city-manager plan campaign during the next two months. The outline provides for a city council of from 15 to 25 members, elected from several rather large districts, the councilman from each district to be nominated by petition and elected to give proportional representation. The council would be vested with all legislative and executive power, but would exercise the latter through a city manager appointed by it. The manager in turn would appoint all heads of departments, with the possible exception of the director of law and director of finance, who might be appointed by the city council.

Colorado Revises Engineers' License Law

A revised license law for the practice of professional engineering and land surveying has been enacted by the Colorado legislature. It conforms closely with the uniform license law drafted by Engineering Council. The original Colorado law, which was one of the pioneers, lacked a reciprocity clause. A new feature is a clause empowering the board of examiners to use surplus funds to pay traveling expenses of a representative to the council of state boards of engineer examiners.

The clause relating to corporations engaging in the practice of engineering follows that of Engineering Council; it provides that persons in the corporation in charge of the designing or supervision which constitutes such practice be registered.

The Colorado Society of Engineers, which sponsored the first law took a leading part in the revision but the bill was recommended by the Colorado Engineering Council and its eight member organizations, which includes sections of the four founder societies, the engineering group of the Denver Civic and Commercial Association, Colorado Society of Engineers, Colorado Scientific Club and Teknik Club. The State Board of Examiners also endorsed the revised bill.

Governor Appoints Members to New York Port Authority

Governor Miller of New York on April 16 named the three New York members of the Port of New York Authority and the nominations were immediately confirmed by the Senate; they are Eugenius H. Outerbridge, former member of the New York, New Jersey Port and Harbor Development Commission, ex-Governor Alfred E. Smith of New York State, and Lewis H. Pounds, ex-Borough President of Brooklyn, who is a real estate dealer.

Both New York and New Jersey had already adopted the bill authorizing the compact between the two states for the development of the Port of New York and the creation of the Port Authority. Previous to last week the second bill providing the means of appointment of members to the Port Authority had become law in New Jersey and had been passed by the Senate in New York. Last week it was passed by the Assembly and signed by the Governor.

The second bill itself, in New Jersey, named as the members of the Port Authority the three New Jersey members of the New York, New Jersey Port and Harbor Development Commission. They are Frank R. Ford, DeWitt van Buskirk, and J. Spencer Smith.

The government of the City of New York, at this writing, still has pending an application before the Supreme Court of the State of New York for an injunction to restrain the commissioners from signing the port compact with New Jersey. It is expected that an early decision on this application will be made.

County in New Jersey to Have Own Road Material Plant

Plans and specifications for a complete road-materials storage plant, providing adequate storage facilities for bituminous materials used in road construction and for surface treating, for Bergen County, N. J., have been drawn by Dow & Smith, consulting engineers, New York City. The plans call for the erection of four 50,000-gal. storage tanks, two 4,000-gal. heating tanks and a concrete and hollow tile cement storage warehouse 25 ft. by 40 ft. The plant is to be located at Hackensack, N. J., and will be situated on the Erie R.R., county authorities having constructed a siding on the property.

The capacity of the new plant is based upon the demonstrated requirements of the county, the annual consumption of bituminous materials of all kinds alone in new construction and surface treatment being in the neighborhood of 1,500,000 gal.

Further Study of Milwaukee Water Filtration Problem

Acting upon the report of a committee of the local section of the American Chemical Society to the effect that the construction of a water filtration plant for Milwaukee should be postponed until further experimental work is done upon problems of precipitation, filtration and chlorination, or even until the sewage-works now under construction is in operation and has shown its effect upon the water-supply, Mayor Hoan has appointed Harrison P. Eddy, of Metcalf & Eddy, consulting engineers, Boston, Mass., to report upon the whole situation. The report of the committee of chemists, as noted in our issue of April 7, p. 604, disagreed with the conclusion of J. W. Ellms, consulting engineer of Cleveland, Ohio, that the immediate construction of a filtration plant is advisable. Mr. Eddy has been consulting engineer for the Milwaukee Sewerage Commission.

Garbage and Refuse Disposal Plant for Baltimore

Garbage disposal at a central reduction plant, with a maximum daily capacity of 300 tons and at an estimated cost of $1,000,000 for construction; rubbish disposal in four incinerators, each having two 15-ton units located at different parts of the city, at an estimated construction cost of $180,000; and disposal of ashes by filling are the chief recommendations of a report made to W. F. Broening, Mayor of Baltimore, by the Department of Public Improvement, H. G. Perring, chief engineer. The report, which is dated April 9, also recommends that until the garbage reduction plant can be built the garbage be buried on the city farm at Graveyard Point. Another recommendation is that the night soil of the city be disposed of by dumping at the Black River sewage-works. The report recommends very strongly that everything pertaining to the collection and disposal of garbage, rubbish, ashes, and other city wastes be done by the city. A careful investigation of the possible use of trucks and trailers in garbage and waste collection and a study of the whole collection system are advised in the report. It is proposed that after collection, the garbage be removed quickly to relay stations and thence to the proposed central reduction plant by truck and trailer, or by trolley, railroad, scow or other means.

Ocean Beach Improvement Planned at San Francisco

Plans are being completed for the extension of the esplanade along the ocean beach near the Cliff House at San Francisco, the improvement of the bluffs of Sutro Heights and the paving of the upper end of the highway around the bluffs. The work is to cost $200,000 and is to be started soon, according to reports from the city engineer's office.

U. S. Roads Bureau Discusses Arkansas Situation

Federal-Aid Projects Free From Abuses, Says McDonald—Local Laws at Fault

Federal-aid road projects in Arkansas, according to a statement issued this week by Thomas H. McDonald, chief of the U. S. Bureau of Public Roads, after an investigation of the situation, are notably free from the serious conditions which are said to surround other highway construction work in the state. The conditions complained of (see *Engineering News-Record*, April 7, p. 611) are found to be mainly in the road districts created by special local laws which specialists of the Bureau of Public roads have unsuccessfully endeavored to have changed. The statement says, in part:

"The state law, known as the Alexander law, though not perfect, provides sufficient safeguard to protect the public interest and to prevent confiscatory taxation. It provides that assessments shall not exceed 30 per cent of the assessed valuation of the property. Of 96 projects which have advanced to the point where the Government is apprised of the details of the laws creating the districts in which they are located, 43 are in road districts created under the Alexander law, and 52 are in road districts created by special laws. One project, which has been completed, was initiated by a county and was not in a road district.

Creation of Road Districts

"Under the Alexander law, the right of appeal from the assessments levied is protected. To establish a district the county court must have a petition signed by a majority in land value, acreage, or number of land owners in the territory affected. The proposal must be advertised for 3 weeks, and any property owner has the right to protest at any time within 30 days. In certain special districts, on the contrary, it is alleged that the limit on assessments is raised to a practically confiscatory level, that unjust discriminations are made in the law and that, on account of special provisions, assessments are not always in proportion to benefits. The districts are created by acts of the legislature and not upon petition of the land owners, and opportunity for appeal is usually denied. The time allowed for appeal against the assessments is usually reduced to 2 or 3 weeks.

"Though a number of Federal-aid projects are in such districts, the Department of Agriculture has not been advised of any injustice in connection with federal-aid projects. In every case the legal procedure required has been followed to the letter.

"The principal difficulties which the Government has encountered in its work in Arkansas have arisen from causes altogether aside from the acts creating the districts. They are due mainly to the peculiar conception of the Federal-Aid Road Act held by officials of the state highway department, which has led them to act as though the only function of the Secretary of Agriculture was to approve any project which the state department might submit. It has been necessary on a number of occasions to deny the correctness of this interpretation.

"Further trouble has been caused by the ill-advised promises of federal assistance made by persons connected with or associated with the state department. These promises have been made without definite knowledge as to whether there would be money enough to fulfill them, or whether the details of the projects submitted would be satisfactory to the Federal Government.

"The Department of Agriculture, through its specialists in the Bureau of Public Roads, has made several efforts to assist the state in the correction of the laws and the conditions which are now complained of, but has met with no great success on account of local resistance. The only hope of improvement is in a realization of the seriousness of the situation by the people of the state."

Resolution Offered for Federal-Aid Road Investigation

Senator William H. King, of Utah, on April 12, submitted to the Senate a resolution calling for the appointment of a special committee of the Senate to make an inquiry into the subject of federal-aid to the states in the construction of post roads, including the allotment and expenditure of appropriations under the Federal-Aid Act, methods and expenses of administration, supervision and overhead charges not actually expended in road construction, and work accomplished by such expenditures. The resolution also indicates that the inquiry, if made, will endeavor to determine whether or not wasteful and extravagant practices have been followed, and whether or not a propaganda has been carried on to induce larger and further appropriations by Congress.

The resolution also refers to charges of waste and extravagance in the expenditure of federal moneys on road work and to what is termed interference with the authority and powers of the officials of several states having charge of road construction.

Competition for Sewerage Plan for Chauny, France

American sanitary engineers are invited by the American Committee, La Renaissance des Cites, with headquarters at 248 Boylston St., Boston, Mass., to enter "an inter-allied competition" for a sewerage plan for Chauny, France. It is hoped that the competition will "develop ideas which will be useful in many manufacturing towns of medium size" in France. There will be two prizes, one of 10,000 and one of 5,000 francs. Plans must be submitted by June 10, 1921. Sketches and other information needed by contestants may be obtained from the French headquarters of La Renaissance des Cites, 23 rue Louis-le-grand, Paris, France, for 65 francs ($4.55 at present exchange rates) of which 50 francs will be returned when the documents are sent back. Information may also be obtained from the American Committee, named above.

Among the engineers connected with the committee are Frederick H. Fay, Edwin Farnham Greene, Charles T. Main, and Edwin S. Webster, of Boston, Mass.; Profs. George F. Swain and George C. Whipple, of Harvard University, Cambridge, Mass.; George W. Fuller and E. F. Goodrich, of New York City; Harland Bartholomew, of St. Louis, Mo.; and Charles Saville, of Dallas, Tex.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27-30.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

The Engineers Club of Indianapolis, Ind., is being addressed, at its regular weekly meeting April 27 by P. J. Walsh on "Modern Building Methods." Mr. Walsh is the Hoggson Brothers' superintendent in charge of construction on the new sixteen story bank-and-office building for the National City Bank of Indianapolis which has been designed and is being constructed by Hoggson Brothers, New York and Chicago bank building specialists.

The Illinois Section, Am. Soc. C. E., April 12, was addressed by A. S. Baldwin on the proposed new constitution. Few dissenting arguments were advanced and unanimous approval was finally given with a recommendation that the Houston convention accept for transmittal to letter ballot without amendment. In answering a criticism similar to that made in *Engineering News-Record* of April 7, p. 579, to the effect that nomination ought to be made exclusively by the districts Mr. Baldwin stated that council had ad-

vised the committee that the whole election proceeding according to New York State constitution must be left open to all members. Mr. Baldwin expressed the feeling that the sections would function as primary caucuses in the selection of presidential nominees. Although it was the general opinion that this would nearly always throw the nominations to the large centers no one had a better method to offer. A startling statement was made to the effect that the secretary elected by the board could not legally be a member thereof. In consequence all actions in which he has cast a deciding vote could be upset.

Personal Notes

R. E. Caldwell, of Caldwell & Richards, civil engineers, Salt Lake City, Utah, has been appointed state engineer of Utah by Governor Charles R. Mabey.

Prof. Ira O. Baker, acting head of the civil engineering department, University of Illinois, after 47 years' teaching service, will resign at the end of the school year.

Benjamin B. Shapiro, formerly chief engineer for Holabird & Roche, architects, has opened a consulting office for the practice of civil and structural engineering especially in relation to the design of modern steel and concrete construction. Previous to his 5½-year engagement with Holabird & Roche he was 3½ years with The Worden-Allen Co., steel fabricators, Milwaukee.

H. B. Hommon of the U. S. Public Health Service, has recently been appointed to head the sanitation work in United States National Parks with headquarters at San Francisco where he is expected to arrive May 10.

Charles Gilman Hyde, professor of sanitary engineering, University of California, has been named as consultant in connection with the sanitation work in United States National Parks, at the San Francisco headquarters.

J. E. Worley has been appointed chief engineer of the Kansas Public Utilities Commission with headquarters in Topeka, Kan. He has been employed by the New York Commission of freight supplies, the New York Public Service Commission, the U. S. Government in the construction of League Army and Navy Yard, the Valuation Department of the Central R.R. of New Jersey.

F. T. Crowe, reclamation engineer, who assisted in the construction of the Arrowrock dam in Idaho and built several dams on the Flathead project in Montana, has been selected to take charge of the Tieton dam, near Yakima, Wash.

William C. Pickersgill, for nine years connected with the engineering staff on the design and construction of the Catskill aqueduct and for three years designing engineer for the City of Providence, R. I., Water Supply Board, has entered private engineering practice and is prepared to furnish reports and designs for water-works, sewerage systems, refuse disposal, ventilating system, industrial plant layouts, pier and waterfront work, steel frame and reinforced-concrete buildings.

A. J. Rhodes has been appointed city engineer of Manhattan, Kan.

John Chambers, city engineer of Louisville, Ky., has been appointed chief engineer and superintendent of the Louisville Water Co.

F. R. Hewett has resigned as county construction engineer of Adams County, Wash., to accept a position with the Washington State Highway Department.

G. C. Sturman has been appointed county construction engineer, Adams County, Wash., to succeed F. R. Hewett, resigned.

John H. Babbitt, formerly assistant on the engineering corps of the Akron division, Pennsylvania R.R., is now assistant engineer on the engineering corps of the New Castle division, Baltimore & Ohio R.R.

C. T. Jackson has been appointed district engineer, southern district, Chicago, Milwaukee & St. Paul Ry., succeeding D. C. Fenstermaker who has been granted leave of absence.

H. J. Sams, recently county engineer of Napa County, Cal., is now field engineer with the Portland Cement Association with headquarters at San Francisco, Cal.

Charles R. Selkirk, formerly president of the Prospect Constructive Co., Philadelphia, Pa., contracting architects and engineers, has opened offices in Washington, D. C., to engage in the practice of engineering and architecture.

Herbert L. Sherman, formerly president of the New England Bureau of Tests, and, during the World War, in charge of inspection for the Construction Division of the army, has associated with H. J. Skinner and Gustavus J. Esselen, Jr., under the firm name of Skinner, Sherman & Esselen, Inc., chemists and engineers, with offices in Boston, Mass. Mr. Sherman is an expert in cement and the testing of structural materials.

Thurman W. Dix, since 1914 assistant professor of civil engineering at the University of Vermont and during that time, for three years, city engineer of Burlington and, for two years, testing engineer for the State of Vermont, has been appointed state highway commissioner of Vermont.

Dr. Selskar M. Gunn, associate director of the International Health Board of the Rockefeller Foundation, and formerly secretary of the American Public Health Association, has been appointed by the government of Czecho-Slovakia as technical adviser to the ministry of public health and physical education.

G. H. Chalmers of Sudbury, Ont., has been appointed resident engineer on the construction of extensions to the water-works system at St. Thomas, Ont.

Edward M. Fuller, civil and mining engineer, formerly superintendent of mines for the Mutual Coal Co., Rains, Utah, has entered private practice in general engineering in Price, Utah.

Col. Jay J. Morrow, Corps of Engineers, engineer commissioner of the District of Columbia during the administration of Presidents McKinley and Roosevelt, and chief engineer (with rank of brigadier-general) of the First Army, A. E. F., in France during the war, has been appointed governor of the Panama Canal Zone to fill the vacancy caused by the retirement of Brig.-Gen. Chester Harding.

William C. Tuttle has been appointed superintendent of highways and water-works of Attleboro, Mass.

Obituary

Thomas H. Walker, chief inspector of the engineering department, Kansas City water-works department, died in Kansas City, March 20. He was born in Lockport, N. Y., in 1857. He was one of the oldest employees of the Kansas City water department and supervised the construction of many of the trunk and distributing water mains of the city.

William G. Wilkins, consulting engineer and head of the firm of W. G. Wilkins Co., died April 12, in Northside, Pa. He was born in Pittsburgh, 1854, and was graduated from Renssalaer Polytechnic Institute in 1879. Soon after graduation he entered the employ of the Mississippi River Commission. From 1880 to 1887 he was assistant engineer of construction with the Pennsylvania R.R. In 1887 he opened an office in Pittsburgh as civil engineer and architect and in 1890 the firm of Wilkins & Davidson was organized. In 1900 the firm was dissolved and has since continued under the firm name of W. G. Wilkins Co. Mr. Wilkins has designed and built many industrial plants in Pennsylvania and adjoining states among which are the plants of the H. C. Frick Coke Co., the Cascade Coal & Coke Co., the Whipple Colliery Co., and the Chartiers Coal & Coke Co.

Business Side of Construction

Facts and Events that Affect Cost and Volume

To Resume Work on $2,500,000 Rimrock Dam

Work on the $2,500,000 Rimrock impounding dam near the head-waters of the Tieton River, has been resumed by the U. S. Reclamation Service, with headquarters in Yakima. The construction of the dam, intended to create a large storage basin for the irrigation of the Yakima Valley lands, was begun five years, but was interrupted in 1917, when the United States entered the war. More than $750,000 of the appropriation of $2,500,000 will be expended during the present year, and before the end of May 700 men will be employed on the work. F. T. Crowe, supervising engineer of the project, is located at Yakima.

The Rimrock dam will create a deep artificial lake 7 miles long and mile wide in certain stretches by flooding land adjacent to the river. The reservoir, intended for storage purposes, will impound 185,000 acre-ft. The dam will be of earth and rock fill type of construction, 900 ft. long and 200 ft. high, and will contain about 1,785,000 cu.yd. of material. The completion of the reservoir will permit of reclamation of about 75,000 acres of arid land in the Yakima Valley, where 360,000 acres have already been reclaimed. When war stopped the work, about $400,000 had been expended.

Hetch Hetchy Tunnel Contract Is Relinquished

D. D. DeLucca, a subcontractor on the Hetch Hetchy tunnel which is being built for the City of San Francisco, has relinquished his contract and his part of the work is being carried on by the Construction Co. of North America, the main contractors on the 18 miles of tunnel now under way. DeLucca held the subcontract for the 9 miles of tunnel at the upper end. The 9 miles on the lower end is under subcontract to A. C. Dennis, who is making good progress and is reported to be doing the work considerably below the contract price.

International Chamber to Hear Building Problem Discussed

The Associated General Contractors of America has appointed a general committee headed by N. S. Hopkinson, New York City, to prepare a discussion of American building problems at the convention of the International Chamber of Commerce at London the latter part of June. The committee is composed of sixteen members of the A. G. C., and from among them will be chosen the representatives who will go to the London convention.

Boston Chamber Report Assigns Causes to Building Inaction

The special committee of the Boston Chamber of Commerce, appointed Dec. 23, 1920, to investigate the building situation, has made its report. Causes for building inaction are ascribed chiefly to high cost of building materials, inefficiency of labor, and labor waste due to union working rules and conditions. In the public hearings which the committee held from Jan. 31 to Feb. 11 it examined many representatives of all elements in the building industry.

The committee found that present wage rates represent a percentage of increase over the wage rates prevailing in 1911 of from 66⅔ to 237 per cent, varying with the particular trade. The smallest percentage of increase was found in the mason and bricklaying trade, and the largest in common labor. The average hourly rate of wages in fifteen occupations of the building trade was found to be 96.8c. in 1920 as compared with 50c. in 1914, an increase of 93.2 per cent during the six-year period.

As to the inefficiency of labor, the committee reported it to be a more or less natural condition springing from circumstances existing during the war in which there was a sudden demand for all classes of labor in excess of the supply.

Contracts for First Quarter of 1920 and 1921 Compared

March 1921 Exceeds March 1920, Excluding Industrial Work—Street and Road Contracts High

An analysis of contracts let, as reported in *Engineering News-Record*, for the first quarter of 1920 and 1921, shows the following salient facts: (1) That the total value of all contracts let in 1921 is approximately 50 per cent of contracts let in 1920; (2) that, excluding contracts let in industrial work, 1921 values are 65 per cent of 1920 values; (3) that, during 1920, there was a general decline from the first of the year in the value of building done; (4) that there has been a remarkable increase in the value of contracts let in 1921; and (5) that, excluding industrial work, the total value of contracts let for March, 1921, exceed those let during March, 1920.

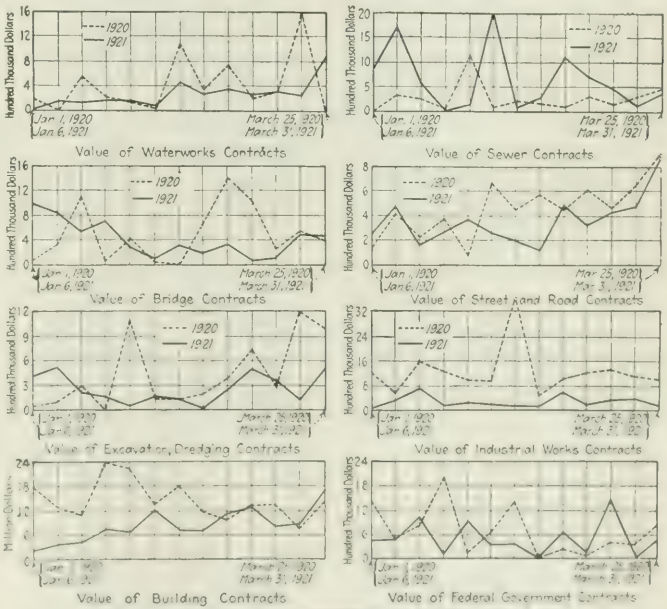

FIG. 1 WEEKLY COMPARISONS OF CONTRACTS LET

The total value of all contracts let for the first quarter of 1920 for all classes of building was $473,365,525 as compared with a total value of $229,599,769 for the first quarter of 1921. However, the greatest amount of the discrepancy between these two figures is attributable to the practical cessation of industrial building. The total value of those contracts alone were in excess of $168,000,000 during 1920, whereas in

1921 their total value is only about $36,000,000.

In all classes of construction the total value of contracts let in March 1921 are found to be 75 per cent of the value of contracts let in March, 1920. However, disregarding the value of industrial contracts, the comparative money value of all contracts for the two months are: 1920, $100,078,251; 1921, $97,252,481. This does not take into account the current cost of construction as compared with cost a year ago, a discrepancy which amounts to at least 10 per cent in favor of 1921. Assuming that building costs are 10 per cent lower now than a year ago, this increases the March, 1921, figure to approximately $107,000,000 — $7,000,000 more than March of last year. None of these figures take residential construction into account, as *Engineering News-Record* reports upon housing projects only in excess of $25,000.

The value of contracts let for the first three months of 1920 were: (1) January, $175,163,766; (2) February, $149,261,676; and (3) March, $148,940,083. For the first quarter of 1921, the figures are: (1) January, $54,408,367; February, $62,906,791; and March, $112,284,611. Thus it is seen there was a considerable decline in the value of contracts let in March, 1920, over those of January, 1920, whereas the March, 1921, contract value is a little more than 100 per cent in excess of the January, 1921, contract value. It is believed that the contracts let for the coming spring months will exceed those of March, 1921, inasmuch as a steady increase in the number of street and road and miscellaneous building projects put uner contract is noted. This belief is substantiated by the fact that for the first week of April the number of projects advertised was 22 per cent larger than the average for March of this year and the number of projects put under contract during the first week of April exceeded the March weekly average by 13 per cent.

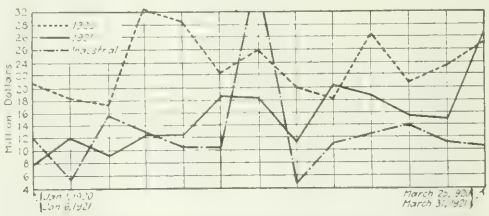

FIG. 2. COMPOSITE CURVES EXCLUDE INDUSTRIAL WORK—THIRD CURVE IS 1920 INDUSTRIAL WORK

In order to give a general idea of the trend in various classes of construction, comparing the first quarters of 1920 and 1921, the accompanying charts have been made, based upon contracts let as reported in the Construction News of *Engineering News-Record*.

Though the week-to-week reports make the curves appear erratic, a study will indicate that there is more steadiness in all classes of construction for the first quarter of 1921 than obtained for the corresponding period of last year. As the curves indicate, only in industrial work does the curve of 1920 keep continuously above that of 1921.

The composite curves in Fig. 2 are a comparison of all contracts let during 1920 and 1921, excluding industrial-building contracts. The curve for industrial building for 1920 is also included with the composite curves. It is generally accepted that at least immediate future building will concern itself primarily with needed construction. In view of that fact, the value of industrial contracts is omitted from the composite curves.

Reject Bids for New York Barge Canal Equipment

All bids received by the War Department April 7, for New York State Barge Canal equipment, except that for one tugboat, were rejected by the chief of inland and coastwise waterways service. In accordance with the recent act of Congress directing the discontinuance of operation by the Government of the fleet of barges on the New York State Barge Canal, the War Department offered 75 per cent of the entire fleet for sale by sealed bid. Nine bids were received, but the only one accepted was that of the Niagara Ferry Co., Grand Island, N. Y., of $7,177 for the tug "Lenahan."

The equipment offered for sale is valued at $2,000,000, and consists of 15 self-propelled barges, 38 steel cargo barges, 16 concrete cargo barges, 3 wooden barges, 3 small tugs, and 10 wooden coal barges. With the exception of 3 wooden cargo barges and 3 small tugs, all of the equipment was constructed for the Government within the last few years and designed for the canal service.

German Steel Trust Dead

(*Berlin Correspondence*)

The *Stahlwerksverband*, which is the official title of the German steel trust, has just delivered its report covering the time between July, 1919, and June, 1920, at which latter date the business activities of the corporation ceased. The beginning of the dissolution of the trust dates from the early stages of the war when it commenced to totter on account of the steadily growing tendency of its members to free themselves from all restrictions with regard to production and distribution. It is believed the trust would have fallen to pieces earlier but for the fact that during the war the government brought influence to bear upon the steel works for the sake of the continuation of the trust.

The Situation as Regards Building Labor

Boston and Denver, two cities in which the dispute over building wages has been felt the keenest, have undertaken construction on an open shop basis during the last few days.

As a result of the failure of the arbitration plan offered as a means of settlement of the strike of the building trades in Boston, the announcement has been made by the building trades employees association, that work will be resumed on an open shop basis. After unsuccessful attempts had been made by the Boston Chamber of Commerce and other organizations and individuals to end the strike declared in January as a protest against wage reductions, the state board of conciliation and arbitration took the matter in hand. The united building trades council, acting as a body, agreed to conciliate as did the building trades employers association until it was known that not all of the unions affiliated with the central union favored conciliation. On that basis, the employers refused to conciliate. The several attempts that have so far been made by the state board of conciliation to harmonize the disputants have failed.

Five trade unions in Denver refused to accept the reduced wage scales recently authorized by the state industrial commission, and are no longer recognized by the master builders association of Denver.

The situation in Rochester, N. Y., is practically the same, the members of six building trades recently meeting the proposition of reduced wages with a flat refusal. Conferences are being continued in the hope that some amicable adjustment may be made before May 1. Bricklayers and stonemasons in Chicago have rejected a proposed 20 per cent wage cut. The unions of Davenport, Iowa, are looking to Chicago, awaiting the outcome of the referendum there before a decision is taken in the matter of the approximate 20 per cent decrease recommended by the state builders exchange.

Pine Output 70 Per Cent Normal

For the week ended Friday, April 1, 1921, 134 mills reporting to the Southern Pine Association showed an aggregate production of 70 per cent of normal. For that same week, orders exceeded the production for the week by 8 per cent, shipments by 5.3 per cent. These figures indicate that shipments are now only 25.8 per cent, and orders 23.8 per cent, below normal production.

The Dillingham Bill Reintroduced

Senator Dillingham, shortly after the extra session of Congress convened April 11, reintroduced his immigration bill that failed of passage at the last session. The bill proposes to restrict immigration to 3 per cent of any ethnic group now in the United States.

Detroit Voters Authorize Municipal Cement and Brick Plants

A charter amendment providing for the acquisition of a municipal cement plant and municipal gravel pits urged by the commission of public works was approved by the voters of Detroit at the recent election. This step was urged in view of the extensive building program anticipated by the city and in order that construction materials might be obtained from independent sources in the event that inflated prices continued to prevail. The amendment also gives the commissioner the power, with the approval of the common council, to establish and operate plants for the manufacture of common brick, vitrified crocks and creosote blocks.

The commissioner has estimated that a city-owned cement plant and gravel pit would result in a saving of at least $500,000 in one year, in view of the large amount of municipal street railway, sewer and paving work to be done, added to the routine needs of the department. This estimate does not include what might be saved by supplying cement by the city to the Belle Isle Bridge and public buildings, contemplated and under way.

Bids have not yet been asked for the acquisition of a municipal cement plant. City officials are awaiting the outcome of the third advertisement for bids on cement, previous bids having been rejected as too high. Bids will again be opened for furnishing 175,000 bbl. of cement before further steps are taken to erect or otherwise acquire a municipal plant.

Permanent New York Branch Construction Congress Formed

The New York Council of the National Congress of the Building and Construction Industry was recently formed by representatives of all elements in the building industry. A committee of 40 was appointed to take charge of the details of organization. A preliminary meeting, at which time plans were laid for the formation of the New York branch, was held late in January, as reported in *Engineering News-Record*, Feb. 3, p. 239.

A. G. C. and Construction Industries Confer on Immigration

At a recent meeting in Washington, representatives of the Associated General Contractors of America, and the National Federation of Construction Industries decided to oppose restrictive immigration measures of an emergency nature and to support legislation of a permanent, constructive character. It is understood that Senator Sterling intends reintroducing his immigration bill, with revisions, and it is this measure which the immigration committees of the two bodies are studying particularly.

Contractors Service to Be Supplied By Surety Company

In order to supply complete information to contractors for all New York State departments, the American Surety Co., New York City, has opened a state surety bond bureau at 148 State St., Albany. The bureau will furnish without cost to its clients accurate contract news from every department as soon as the information is made available to the public. The work will be comprehensive, covering not only construction work, but also supplies of every kind. Some of the services of the bureau will be: Publication of daily bulletins containing notices of all state calls for bids on purchases, sales and construction work; the furnishing of bidding blanks and specifications to all contractors interested; telegraphic notice of bid openings and awards; filing of bid papers; reporting of bid openings, with prices.

Westinghouse Plans to Build California Plant

As a result of a visit to the Pacific Coast during the latter part of 1920 of two of the officials of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., a 12-acre tract of ground has been purchased at Emeryville, Cal., by the company upon which it plans to erect buildings that will give increased advantage and space to the San Francisco service shop and warehouse. This building will be followed by the erection of additional buildings to provide facilities for assembling electrical machinery for use on the Pacific Coast. The plant will probably be used ultimately for building and testing electrical machinery and will prevent delays in shipment and in many ways contribute to better service for Pacific Coast cities. Plans for the first group of buildings comprising an approximate floor space of 120,000 sq.ft. are now being prepared by the company's architect at East Pittsburgh.

Guy Breaks, Derrick Falls, Killing Workman and Wrecking Steel

When a guy rope that anchored the dead-man of a 7-ton steel derrick used in erecting the steel trusses for a theater in Irvington, New Jersey, parted April 13, the derrick fell, killing one workman, injuring three others and wrecking the steel. The derrick was being taken down, the six 86-ft. roof trusses having just been set in place. It was in the approximate center of the building and fell to the rear, the end of the dead-man cutting a hole in the masonry wall and the steel boom striking the top of the wall bending over it. The guy that broke was said to be a new one. Some of the steel members can be salvaged. Aside from slight damage done by the boom and dead-man the masonry wall was not injured.

Past Week Is Record for Year in Value of Contracts Let

The value of contracts let, as reported in *Engineering News-Record* during the past week total $30,874,237, the highest weekly figure of the year. The record is attributable to the large number of street-and-road contracts let and to the steady increase in miscellaneous building. Pennsylvania let highway contracts aggregating in excess of $3,000,000, and Ohio, contracts valued at $847,496. Most of the other street-and-road contracts are small, as is indicated by the fact that 142 projects total in value $13,807,195. Miscellaneous building contracts represent an aggregate value of $13,441,493, the largest projects being two $2,500,000 hotels, one in Windsor, Ont., and the other in Cleveland.

Atlas Co. Issues Statement on Cement Prices

According to a statement recently issued by the Atlas Portland Cement Co., New York City, its cost of manufacturing cement was 30 cents a barrel higher for 1920 than on Sept. 1, 1918, the date on which the government fixed the price of cement at $1.75 per barrel. The recent report made by the United States Geological Survey showed that the average selling price of the Lehigh Valley district for the year 1920 was $1.91 per barrel. The statement of the Atlas Co. is that its average was below this figure. The Atlas Co. therefore points to the fact that though the difference in the cost of manufacture was 30 cents a barrel the increase in the price fixed by the government was only 16 cents per barrel.

The increased cost of manufacture of 30 cents per barrel for 1920 over the four-month period ending with Jan. 1, 1919, the Atlas Co. finds accountable to a 46 per cent increase in labor cost, 20 per cent increase in coal and 23 per cent increase in materials and supplies.

Though these figures indicate a greater increase in mill cost than in selling price, the increased output during 1920 more than offset the differences reflected in the yearly income, continues the Atlas statement. The Lehigh Valley district is used in the comparison because of the much larger output of the Atlas Co. in that district. The Atlas statement gives a figure substantially under 10 per cent as its income for all plants in 1920 on its capital investment.

Record Number Freight Cars Idle

Previous records for the number of surplus or idle freight cars on the railroads of the United States were broken during the week ended April 8, according to reports just compiled by the car service division of the American Railway Association. The number of cars for which there was no freight averaged 507,427, or approximately 21 per cent of the total freight cars owned by the railroads of the United States.

This is an increase of over 11,000 cars as compared with the previous week, and an increase of 210,000 cars since the first of the year. Of the total number of idle cars 261,294 were coal cars, an increase of about 6,000 cars in a week, while there were 176,916 surplus box cars, an increase in a week of 5,000. At the time of the business depression in 1919, following the armistice, the number of surplus freight cars reached 451,739 for one week of March.

Building in New York Cities

According to the labor market bulletin issued by the bureau of statistics and information of the New York State Industrial Commission, building permits issued in the first- and second-class cities of the state took a sudden upward turn in February, the estimated value of authorized building work for that month being $24,817,935. This is an increase 3 per cent over the February, 1920, total.

Slight Decrease in Wholesale Prices Noted in March

According to a bulletin recently issued by the U. S. Bureau of Labor Statistics the weighted index number of wholesale prices compiled by the bureau stood at 162 for March, as compared with 167 for February and 177 for January. Full information on specific commodities is contained in Bulletin 1079, Department of Labor.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 7, the next, on May 5.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.33	$4.25	$3.75	$3.23	$3.51	$4.65	$4.45	$5.00	$5.00
Structural rivets, 100 lb.	4.85	.....	7.05	4.88	5.30	6.90	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb.	3.23	3.75	3.85	3.13	3.53½	4.22½	2.35	4.50	4.25
Steel pipe, black, 2½ to 6 in. lap, discount	49%	50.60–5%	40@45%	58½%	51.9–5%	38@40%	44@47	40%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	59.22	66.20	64.10	67.80	70.00	87.65	73.00	80.00
Concreting Material:									
Cement without bags, bbl.	3.10 (del.)	3.00	2.85	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd.	2.50	2.80	1.75	2.75	2.00	2.50	2.50	1.50	1.50
Sand, cu.yd.	1.25	1.50	1.75	2.75	1.00	1.10	1.65	1.50	1.50
Crushed stone, ¾ in., cu.yd.	2.15	2.50	3.20	2.75	2.25	3.50	2.50	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	48.00	38.00	45.00	55.00	38.00	47.00	27.00	28@30	120.00
Lime, finished, hydrated, ton	21.00	18.00	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl.	3.30	1.60	2.50	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.00	25.00	12.00	18.00	14.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	0.14	0.21	.12	.06	.10	.12½	.13	19
Hollow partition tile 4x12x12, block	....	.15	.19½	.096	.104	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.65	.68	.88	.71	.75	.93	.88	.79	.95
Common labor, union, hour	.75@.80	.35	.60@1.00	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non union, hour	.....	.25	.40@.60	.50	.50	.37½@.50	.50@.55	.50	.30@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, 16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu. yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir, instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

	Mill Pittsburgh	Delivered New York
Bars	$2.10	$3.23
Plates	2.20	3.33
Structural shapes	2.20	3.33
Wire nails	3.25	4.00
Tin plates	6.25	7.50

The decrease in U. S. Steel Corporation mill prices, noted on p. 660 of the Apr. 14 issue of *Engineering News-Record*, has had little effect on warehouse prices owing to the fact that the warehouses had already reduced prices to agree with a $2 base at Pittsburgh. It is still possible to buy certain products under the Steel Corporation prices. For example, plain reinforcing steel can be bought for $3.23 delivered in New York, as against the Corporation price of $3.38. The extra for twisted reinforcing steel is 12½c. per 100 lb. Present prices of light rails per 100 lb., delivered in New York are: 8-lb., $3.59; 12-lb., $3.54½; 16@20-lb., $3.50; 25@45-lb., $3.45½. Following is a comparison of the new mill prices with prices delivered in New York:

The only change in the New York market is a further decrease in the price of linseed oil. The oil dropped also in Atlanta, Chicago and Denver. While brick quotations in New York are practically the same as last week, being $15 as against last week's $15 to $16 at wholesale, the market is "softer." Common brick dropped $2 in Denver. Tile is down 1c. per block in Denver; and can now be bought in Montreal for 19c. per block, as against a former price of 28c. Hard wall plaster is $21.75 per ton in Montreal, an advance of 75c. Montreal reports that few price reductions are expected and that labor is plentiful.

Atlanta announces reductions on steel and cast-iron pipe as the result of a manufacturers' decrease. Lower prices on shapes, rivets and reinforcing bars are expected by May 1.

As regards the Chicago wage dispute, on Apr. 16 70 per cent of the unions had refused to accept the proposed cut from $1.25 to $1 per hour on skilled labor, and from $1 to 75c. on common. The Employing Contractors' Association delivered an ultimatum to the effect that $1 will be the maximum wage after May 1. Serious resistance by labor is not anticipated.

Minneapolis reports that the unions will decide by May 1 whether to accept or reject the reduced scales. A number of the St. Paul unions have rejected proposed cuts, and have taken steps to enter the construction field, by farming out their own building organizations.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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A Valuable Structural Record

WHATEVER be the opinion regarding the New York State Barge Canal as an economic factor there can be no doubt of its high standing as a work of engineering. With few exceptions its structures have been models of detail design which may well be set up as standards for future shipping canal work. The state engineer, Frank M. Williams, is to be congratulated, therefore, for issuing as a part of his 1920 report a "book of plans," which includes, in large scale, drawings of the principal structures on the canal. Too infrequently are the structural records of big projects preserved in such convenient form.

Vicious Garbage Legislation

AT FREQUENT intervals an attempt is made to prohibit the disposal of the sewage or garbage of a city outside its own limits. Two vicious pieces of such legislation, which would virtually prohibit the disposal of the garbage produced in any one of the five counties comprising New York City outside of that county was rushed through the New York Legislature in its recent closing hours. To make the action worse, in order to remove the bill from a possible veto by the Mayor of New York, the bill masqueraded as an amendment to the general health laws of the state, although limited to cities with a population of a million or more. One bill prohibits the transportation of garbage from one county to another for disposal and a second prohibits the construction of a garbage disposal plant in any county without permission from the aldermen from that county. Followed to its logical end, since it splits the city into subdivisions, such legislation would limit garbage or sewage disposal to the wards in which it is produced, then to the blocks, the houses and, in the case of multi-family houses, to each apartment. When governor of New Jersey Woodrow Wilson vetoed a similar but more honest bill governing sewage works. It is to be hoped that this dishonest and otherwise vicious bill well be vetoed by the governor.

Flowability and the Minute Mix

WHETHER the word used be consistency, flowability, or workability, the condition of concrete described by the term is of great importance. Those who are studying it are trying to express by test and observation the approach to perfection of mixture that concrete attains. For the finished material this can be measured by strength, but that determination comes too late to affect the makeup of the sample or of the batches it represents. Measures of workability, on the other hand, are applicable while the concrete itself may be changed to cure any revealed defects. This workability is manifestly a function of material and mixing, though more emphasis has heretofore been put on the former than the latter. Some tests made by Prof. W. K. Hatt and recently reported to the American Concrete Institute show how large a part the mixing plays. It was found, for instance, that workability, as measured on the Bureau of Standards flow table, increases with the time of mixing, provided the quantity of water is kept constant, the change being particularly marked between 30 sec. and 1 min., and not changing much thereafter. In other words, it is possible to obtain the same workability by mixing 1 min. with a given amount of water that is obtained by mixing ½ min. with 25 per cent more water. Contractors sometimes resort to the ½-min. mix to save time and then supersaturate the batch to make it flow readily. Tests before this have shown that short-time mixing reduces strength but not before has there been quantitative observation of the relation between workability and time of mixing. This makes doubly necessary an insistence on a longer mix.

Hysteria on Immigration

THE reintroduction in Congress of the Dillingham bill which would restrict immigration to 3 per cent annually of the number of the respective races now in this country brings forth further reflections upon our hysterical handling of great national questions. It is less than a year since a strong group advocated wholesale importation of Chinese coolies. Today the voices of the members of that group are stilled by the demand for work from some millions of unemployed. There exists now little or no sentiment for letting down the immigration bars. On the other hand, there is rampant, as never before, demand for rigorous restriction of immigration. Many who now demand restriction sincerely believe that the influx of undesirable foreigners will have a serious influence upon our national life. Most of them, however, if they run "true to form" are exclusionists at present for temporary economic reasons. Labor in this country is plentiful, they say, why then admit any more? A year hence, if labor should be scarce, these same gentlemen will probably be clamoring for the admission of Chinese coolies. All of which is, for those who see it, an argument for a careful study of the racial, political and economic effects of immigration and a founding thereon of a policy that can be pursued year in and year out and that will, in the long run, be for the best interests of America.

Racial Versus Economic Reasons

OBVIOUSLY there has been a material change in the immigration situation the last generation—a change too well known to need elaboration here. In brief, the nations of Southern Europe have not the characteristics of those which contributed the bulk of immigrants 30 years ago. That fact has made the racial consideration of possibly dominant importance. No one desired formerly to restrict America as a haven for those who were politically and religiously oppressed. Such oppression

has well nigh passed, but even if it had not we would be forced to consider whether we should continue to offer a haven at the possible expense of serious deterioration of American national life. A picture is easily drawn of the detrimental influence of these Southern and Western European races, but while there have been many sociological studies we doubt whether the facts have been fully marshalled and fairly analyzed. If upon a fair study the decision should be adverse to large immigration no American would continue to advocate a policy that was plainly detrimental. However, if the conclusions on racial grounds should not be overwhelming in their finality the economic argument would have considerable weight. How much common labor must we have annually? is the form in which the economic question is usually stated. That, too, has never had an adequate answer. Now each one answers it in accordance with his own limited experience. For ourselves we believe that an answer based upon close study would be rather shocking to those who are fearful lest our industries will be seriously crippled by a shutting off of the European common-labor supply. We have great faith in the ability of American inventors to supply labor-saving machinery; and with that faith we believe that we can get along with a considerably smaller proportion of common labor than we have today.

A Near-by Trade Opportunity

AN INTIMATE story of the lack of sanitary conveniences, public utilities and other facilities enjoyed by the average American citizen is told in the notes from Barranquilla, Colombia, on p. 732. Mr. Bunker's apologies in the last paragraph are hardly called for, since if all of the things he mentions were at a standard equal to that in the States there would be less reason for engineers to be interested. River improvement, dock facilities, paving, sewers, an improved water supply, all cry for the work of the engineer. Already some engineers are on the ground, laying plans and awaiting only financial support. The opportunities are great. Although Colombia has potentialities for agricultural development equivalent in area to the heart of the Middle West plows are unknown. Already there are signs of the awakening. Barranquilla recently has experienced a growth similar to that of our Western cities—10 per cent in two years. This, however, is to be expected, for the rich back country, most of whose products must pass through this port, is beginning to make strides. Colombia also contains one of the rich oil fields of the world and the development of these fields will bring added commerce. Railroads are projected, while some motor automobile enthusiasts are proposing motor-truck highways as competitors of the railroads. When it is appreciated that Colombia is our near neighbor—only 4½ days from New Orleans—it need not be argued that we are the logical country to further its development. If American capital will seize the opportunity there will be much work there for the American engineer.

Deceptive Highway Propaganda

DISCLOSURES of unsoundness in the financing of highway projects in Arkansas throw a number of interesting sidelights on the methods which good roads "boosters" in that state and elsewhere seize upon to win public opinion to the support of large bond issues. The average taxpayer does not understand the federal-aid law. By the use of such catch-phases as "a fifty-fifty basis" for state and nation, many people are tricked into voting for bond issues in the belief that every dollar raised locally will be matched by the federal government. The fact that certain federal funds are distributed to the states is distorted into a representation that is misleading and that is resulting in the assumption of obligations in excess of what would be approved if the truth were known. The fact that the federal funds are limited has sometimes been concealed when state and local bond issues are to be voted on, as was the case in Arkansas. Alabama is another case in point. In the propaganda for a recent bond issue of $25,000,000, a circular issued by the Alabama Highway Improvement Association carried these statements: "This is a 50-50 proposition. Uncle Sam puts up $1 and requires the state to match it. If Alabama fails or refuses to put up, the money goes to other states." The plain inference here is that $25,000,000 of federal funds would be forthcoming in the event of an affirmative state vote. As a matter of fact, the total federal apportionment to Alabama from the time federal-aid began in 1916 up to the present, is only $5,776,000. Many people who supported the bond issue did so in ignorance of these facts. This type of chicanery, even though it be successful for a time in providing funds for highway construction, will, in the long run, do the cause of good roads irreparable damage.

Engineers in City Government

WITH engineers for two of its five city commissioners or councilmen and six other engineers in important city offices, Memphis, Tenn., is certainly entitled to rank as "a city that is recognizing its engineers" (p. 734).

Few cities can show even one engineer on their commission or council; not many, even among the larger ones, place engineers in administrative positions not distinctively engineering in character; and by no means all cities have engineers in charge of work that can be efficiently done by engineers only. Commission-plan cities, in particular, would profit by having at least one and better yet two engineers among their small membership. The reason for this is that in the plain commission, as contrasted with the commission-manager, cities, the commission exercises administrative as well as legislative functions, each commission heading an executive department.

Since the larger part of city expenditures (outside of education, which is rarely under a city commission) is for engineering works and services, it is good business as well as good sense and good engineering, to have engineer-commissioners in charge of departments that control engineering work. This is recognized at Memphis, where one of the engineer-commissioners is commissioner of streets and bridges and the other of fire and police. In most commission-plan cities (again as contrasted with those of the commissioner-manager form of government) the laymen commissioners are not long in office before they qualify, in their own minds and often in the public mind, as "experts" and relegate the city engineer and other technically trained men to the rear. The result is often a general muddle, with a loss of confidence and even of self respect on the part of the members of the engineering staffs.

A word of caution is needed. Engineer-members of city commissions should not fall into the pits they are sure to dig for themselves if they attempt to be

engineers of the departments they head instead of legislative and administrative heads. If they do this they will follow the erroneous paths of the laymen commissioners.

Why Chicago Does Not Filter Its Water

WITH the ring of towns on Lake Michigan around Chicago which filter their water supply getting more complete every year and the larger cities on all of the Great Lakes filtering or seriously considering it the question why Chicago does not filter its water supply is a logical one. Various answers have been proposed. One is that the removal of the sewage by the drainage canal is so complete as to make further expenditure for a clean, potable water unnecessary. Another is that Chicagoans must wait for a settlement of the controversy over the amount of water which may be diverted from Lake Michigan via the drainage canal before they can agitate the filtration question without jeopardizing their chances of a favorable consideration of their claims. Then there are suspicions that advocates of long tunnels to intakes far out in the lake are powerful enough to be able to hush up any talk about filtration.

Whatever weight these proposed explanations may have the really critical factor is that of waste. Until Chicago can at least halve its present daily consumption of 265 gal. per capita, requiring the operation at peak loads of practically all of its fifty-two pumping engines, with their 1,170 m.g.d. capacity, filtration is economically out of reach. This is the greatest obstacle confronting the official who would propose filters. Immediately he must take up the cudgel for waste prevention. Twenty years ago John Ericson, now consulting engineer to the city, started a campaign of waste reduction which has been kept up intermittently ever since. The water department knows all about this waste. A permanent engineering corps has been in charge of water waste since 1907 and a complete record is available showing use, abuse and an intelligent estimate of future requirements in every square mile of the city. Mr. Ericson's successor as city engineer, P. S. Combs, worked out a comprehensive water-works program, based on the necessity of consumption under limited metering, which would cost $60,000,000 by 1950. (See *Engineering News-Record* April 21, 1920, p. 855). The present incumbent, Alexander Murdock, has been in office too short a time to outline a policy. If he concludes to reduce waste rather than buy more equipment and extensions he will have many influences to combat. If he could hold out equivalent contracts for filter installations he might have a powerful lever with which to sway aldermanic support toward vigorous effective waste prevention. Ten million dollars will meter Chicago. Much less with intensive waste surveys will cut consumption to a point where filtration may be talked of as within reason.

But does Chicago need filtration from the sanitary standpoint? Her typhoid rate in 1920 was 1.1 per 100,000, the lowest of any of the large cities. Unmistakably the lake is polluted, the polluting matter varying from domestic sewage sweeping down from the north shore suburban districts not yet under the Sanitary District to sewage and trade wastes from the intensely industrial districts of South Chicago and Indiana towns at the southern end of the lake. Some amelioration, it is true, is to be expected. Evanston seven years ago determined to take no further chance and built filters. Winnetka is soon to ask for bids. Waukegan has long agitated filtration. Last fall, to the south, East Chicago and Whiting each put filters into service. Chlorine kills microscopic organisms and to it must be given much credit for Chicago's very low typhoid rate, but filtration must eventually be the first line of defense. Continually there are complaints of medicinal tastes and odors which the public lays to chlorine, but which may be produced by its combinations with phenol trade wastes.

Clear water, free from taste, eventually will be demanded, but no filter salesman need hasten to pack his grip for an assault upon Chicago, for the waste problem must first be solved.

Government Reorganization

WE COMMEND to the careful study of every reader of *Engineering News-Record* Mr. Hoover's views on government reorganization. He has, as usual, put the nub of the situation with unusual clarity.

"The administrative units of the government," he says, "must be regrouped so as to give each of the great departments more nearly a single purpose." And, again, in expanding his views he gives this succinct reason for what he advocates: "The real economy to the nation lies in their [the departments'] more effective functioning in their daily relation to the public. The extra cost imposed upon business in general in the determination of the relation of any particular business to the different functions of the government, with the unnecessary duplicating interferences and demands, is a real charge on national wealth, probably as great in some directions as the actual cost of the administrations themselves.

In addition to laying down broad principles of government reorganization he jams into one brief paragraph what an ordinary man would consider a lifetime program for his own department, that of Commerce. That last paragraph of his address if studied and expanded would be found to be a synthesis of all that we have been told, or in our fondest dreams imagined, that the British and the German governments have done for their trade, industry and transportation—the prompt and accurate diagnosis of economic events, economic tendencies, and economic ills; the prompt and accurate survey of economic opportunity, economic discrimination, and economic opposition; the giving of scientific advice and assistance to industry through furnishing prompt and accurate data upon production, supplies and consumption; co-operation on standardization and simplification, on the elimination of waste in industry, on economy in production and use of power, the synchronizing of industry and transportation; in fact, assistance so far as government can assist in the solution of the broad problems of trade, industry and transportation.

We had something to say in a laudatory way in our issue of March 3 regarding Mr. Hoover's entrance into the Cabinet. That was prediction of a certainty. We were relying on Mr. Hoover's past accomplishments. Now there is being presented to the Cabinet, to Congress, to the broad ranks of government officials and to the public a conception of the service that government can render commerce such as has never before been given expression in our public life.

So far all of this, however, is merely proposal. Realization depends upon the sturdy backing of Mr. Hoover's vision by business men and by the public at large.

Water Supply and Other Sanitation in Greece

Climate, Meteorology and Hydrology Outlined—Scanty Water Supplies and Lack of Sewers and Other Sanitary Facilities—The Athens Water-Suppy and Sewerage Project—Land Drainage and Malaria

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The following notes are the outcome of a visit in Greece of nearly eight months, during the past year, as the representative of Ford, Bacon & Davis, engineers of New York City. Under a contract between this firm and a group of Greek bankers, a large staff of American and Greek engineers was employed on investigations for a complete system of water and sewerage for the cities of Athens and Piraeus and adjacent seashore villages. These investigations required that all water resources within 100 miles of the city of Athens be considered and took the writer over a large part of southern Greece.

EUROPEAN civilization first dawned in Greece and attained there, 2,400 years ago, a brilliancy never surpassed elsewhere. After centuries of decay and stagnation and long years of alien misrule, Greece has but recently recovered her independence and is slowly repairing the neglect and waste of ages. Greece is still one of the backward countries of Europe, however, poor in natural resources and as yet without very many necessary public improvements. Among other needs, Greece lacks modern sanitation. A few large urban communities have been created, a few beautiful public buildings erected, streets and parks constructed and some transportation provided but, on the whole, the problems of sanitation have been neglected. Little, indeed, has been done in a large way in Greece on the construction of water and drainage works since the early days of Imperial Rome, 1,800 years ago. The attitude of the Greek people toward some questions of water supply and sanitation presents problems quite unlike those encountered in this country and the climate and topography of Greece, the peculiar geology of the country, the profusion of troublesome and injurious insect life and the all pervading dust provide other sanitary problems that are somewhat unusual and, if viewed upon the background of ancient Greece, they cannot but be of interest to American engineers.

FIG. 1 THE KINGDOM OF GREECE BEFORE THE BALKAN WAR

Climate and Hydrology.—The Kingdom of Greece as constituted before the Balkan wars, comprising the lands first liberated from the Turks in 1829 and that portion of Epirus and Thessaly, ceded in 1881, lies between 36° 30′ and 40° north latitude, corresponding to that section of our Atlantic coast between the southerly limits of Virginia and the city of Philadelphia. Greece has, however, an entirely different climate from this part of our country, somewhat warmer and very much drier, more like the climate of portions of our Pacific coast or the semi-arid southwest. A sketch map of southern Greece is shown in Fig. 1.

Temperatures—Athens, the capital of Greece, located near the sea on the Saronic Gulf, is in about the same latitude as Washington, D. C. The Greek capital has a long, hot summer from June to September, inclusive, but suffers no higher extremes of temperature than our capital. The winter in Athens is, however, less severe. It never freezes there nor elsewhere in southern Greece near the sea and snow seldom falls. Back in the mountains, however, it is naturally cooler in both summer and winter and, at an elevation of 2,000 ft. freezing temperatures are common and the winter climate more nearly resembles that of our Atlantic seaboard in the same latitude. The high summer temperatures in Athens are less trying than those of Washington, with

FIG. 2. ST. ELEOUSA SPRING AT HEADWATERS OF BOEOTIAN CEPHISUS

This spring has a flow of from 5 to 100 sec.-ft. or more.

FIG. 3. FOUNTAIN ON ROAD OVER MT. CITHAERON

its greater humidity, and the winters in Athens would be more agreeable than in our capital if adequate provisions were made to heat the hotels and houses. According to our standards, the Greeks are not overfond of ventilation, even in warm weather, and in winter they wish little or none. The vitiated atmosphere of inadequately heated and poorly ventilated houses cannot be healthful, even for as hardy a people as the Greeks.

Rainfall and Humidity.—With respect to the amount and distribution of the rainfall and the humidity, the climate of southern Greece differs in a marked degree from that of our Atlantic seaboard. In Athens the average rainfall is only 15.5 in. and this occurs mainly during the months of October to May inclusive. Only in the mountains at El. 3,000 ft. or more, does the annual precipitation approximate that on our Atlantic coast but, even in the mountains, the rainfall during the summer is light and is limited to local showers.

The amount of humidity during the long, almost rainless summer is exceedingly small throughout southern Greece. The sunlight there has a brilliancy unknown in this part of the world, the stars seem as near and bright as in the desert, and, generally speaking, there is no dew. Under these moisture conditions, the high summer temperatures are more endurable than here and, but for the dust, the climate in the summer should be healthful. High winds are, however, frequent; barren, rocky hillsides are only imperfectly covered with vegetation; large areas of dry soil are left exposed by the summer harvest; the roads and unpaved streets are usually deep in dust, and, in consequence, the air is generally filled with fine dust. This dust causes the visitor much discomfort and may cause some ailments of the respiratory organs, even among the natives. The effect upon the nervous system of the intense sunlight, the hot winds and a relative humidity sometimes as low as 15 per cent, is hardly a matter for an engineer to discuss. These conditions give the visitor from a northern climate a constant feeling of irritability and may account for the nervous, emotional and capricious temperament of people exposed to them for generations.

That the climate of Greece, before the Christian era, was more favorable than now is suggested by some evidence there of a slightly greater rainfall in antiquity and it was probably somewhat cooler and cloudier then. Evidence of such a change in climate in that part of the world has been noted by Professor Huntington ("Pulse of Asia," etc.) and others in Asia Minor, Syria and Egypt.

Hydrology.—Greece is a mountainous country, at once beautiful and, in its general aspects, barren and rocky. Neither the topography, the soil nor the rock structure of the country is favorable to conserving a large proportion of the scanty rainfall. About the only water available, during the summer, for any purpose comes from the winter and spring rains that are stored as ground water in the fissured limestones that make up the mass of the mountains, in the occasional interbedded layers of schist or shale, and in the still more uncommon strata of sands, gravels and conglomerates of the larger valleys. Such stored ground waters, which for the most part appear as small springs, are here and there concentrated in the underground channels of the limestone into large flows, as illustrated in Fig. 2, a photograph of one of the large springs representing the principal source of the Boeotian Cephisus on the north side of Mount Parnassus. Taking the country as a whole, such large springs are by no means common and the aggregate amount of all spring flows is small. A high percentage of the rains that fall upon the steep mountain sides and upon the fine clayey soils of the valleys runs off quickly

FIG. 4. FOUNTAIN ON THE OUTSKIRTS OF THEBES

into the sea and only a relatively small amount enters the ground. Because of the generally unfavorable conditions for the storage of ground water in the formations noted above, the underground storage becomes greatly depleted at the end of a long, dry summer and the amount of water available in the flow of springs is correspondingly small. In all Attica, for example, there are only two rivers that do not dry up by early summer and this statement applies to rivers with drainage areas of as much as 100 sq.mi., rivers that during the winter become impassible torrents. Throughout the country, lakes and ponds are few and favorable opportunities for artificially creating large surface reservoirs are rare. So far as known, conditions are nowhere favorable for pumping large volumes of water from the ground; bodies of coarse-grained sandstone or other porous rocks and deep beds of coarse sand and gravel, in which ground water storage might be developed, do not exist.

Water Supply

In a country so poorly supplied with water, the problem of providing a sufficient amount for large urban populations is a more serious one than in our more favored land. Without irrigation, agriculture in Greece is impossible during the summer and every drop of water not required for the needs of men and animals is, therefore, applied to the land. The diversion of springs for new public water supplies means a corresponding reduction in the amount of food produced and Greece does not grow enough food for her own needs.

Development of Surface Water.—The obvious solution of the problem of insufficient water is to develop the surface run-off that now goes to waste in the sea. This solution, however, has its difficulties. In the first place, most of the mountain valleys are narrow and steep and do not lend themselves to the creation of adequate storage reservoirs; even where the topography offers the necessary volume of storage behind a dam of reasonable height, there would remain in most localities the difficult problem of making the reservoirs tight, because the walls of most of the valleys consist of seamy, fissured limestone and there are frequently underground channels in the rock of some magnitude. Some very promising reservoir sites exist, however, and considerable storage could be developed for either water supply or irrigation needs. Where such surface water could be used to replace ground waters that are now being utilized for irrigation, no difficulty would arise. A proposal, on the other hand, to use surface water, or "rain water" as the Greeks speak of it, as a public water supply would meet with some opposition. Even among the more intelligent Greeks, there appears to be a strong prejudice, perhaps an age-long inheritance of these people, against the employment of any water for domestic use, except that from springs and wells.

Use of Ground Water.—In a country as hot and dry in summer as that of Greece, it is but natural that a cool sparkling ground water makes a strong appeal as a domestic supply. There is very little ice in Greece and the people drink a surprisingly large amount of water. Without our modern means of purifying surface waters, the ancients rightly chose ground waters for the supply of their cities and most of the cities of the Mediterranean are still so supplied. Whether the confidence of the ancient Greeks in the purity of the ground waters from the fissured limestones of their country, or from their open wells was ever misplaced history does not tell us. Certain it is that disease often stalked through the land and it may have been spread sometimes by impure water supplies. The open well with its imperfect protection, from which many people still draw their supply by means of a bucket and a rope, must in times past as now, have been a source of infection. Some of the public ground water supplies in Greece are not today as safe as a surface water may readily be made; some of these supplies are quite as warm in mid-summer as a surface water when delivered to the consumer and all are harder than a surface supply would be, if drawn from the same locality.

Methods of Distribution.—During antiquity, the flow of springs and galleries was carried to constantly flowing fountains, to which all could go for their water. Only the privileged few had water in their homes. When only such lead pipes as the ancients had were available for large distribution mains, water in closed spigots under considerable pressure was, of course, impossible. It is of interest to note that the method of distribution in freely flowing fountains is still almost universal in Greece, although iron pipes instead of lead are used. A curious type of fountain in the smaller towns and villages, where shade trees exist along the streets, consists of a half or three-quarters inch supply pipe, which is carried up the back of a tree in a vertical groove made for the purpose, and afterwards covered with a strip of metal, and which is taken through the tree, at a height of 3 to 4 ft. above the ground, to an outlet on the street side. A more common and substantial type of construction is of masonry, a solid mass of rubble or ashlar 4 to 5 ft. high, with one or more outlets in the face, each discharging 5 to 10 gal. per minute, either into a small circular stone basin projecting from the face of the fountain just below the outlet or into a larger trough or basin on the ground below. A fountain with a Turkish inscription, on the road over Mount Cithaeron between Attica and Boeotia, is seen in Fig. 3. This is near ancient Eleutherae, the fabled birthplace of Bacchus. The spring back of the fountain appears to be that mentioned by Pausanias as the place where Antiope, the Theban princess, left her babies.

Rate of Consumption

A larger fountain on the outskirts of Thebes in the valley of the ancient Ismenos is shown in Fig. 4. This is fed by the spring of St. Theodorus, anciently called the Oedipodeia, because Oedipus was believed to have purified himself there. The laundry work of the neighborhood was evidently being done at this fountain.

The obvious advantage of a constantly flowing fountain is that of always providing a supply of water at a low temperature, an important consideration in a hot climate where no ice is available. Of course, all the water not carried away for use in the houses or used at the fountains for washing is apparently wasted, but the waste, after all, is more apparent than real, since all water that flows away from these fountains is utilized for irrigation in the village gardens or in the fields beyond. As long as the minimum yield of the sources of supply is largely in excess of the actual water supply needs of a community, it is not apparent that any better plan of distribution could be devised. It is probable that in the small Greek towns such water supply needs do not exceed 5 or 6 gal. per capita daily. When, in the future, they begin to pipe water to their houses and the

daily public and private use of water increases to 40 or 50 gal. per capita, the average of Mediterranean cities, the system of freely flowing fountains will naturally disapepar, as it has already done in Athens.

Water Supply of Athens.—Water-works of some importance were built in the past, both in the days of classic Greece and in the period of Roman domination. Those built in Athens during Roman times are still in use, and it may be of interest to trace the development of water supply in that city from the earliest times.

Springs at some elevation on the Acropolis and other hills within the bounds of the old city of Athens no doubt attracted settlement on that site and represented the first water supply. Subsequently, wells penetrating the limestone to the impervious shale below furnished additional water in some parts of the city and this supply, it appears, was supplemented by rain water stored in underground cisterns. Long galleries were sometimes driven from the wells in the limestone to increase the amount of ground water infiltration and investigation has disclosed some of these galleries of great length.

Ancient Works

One of the best known of the ancient public fountains was the "Old Hallirrhoe," on the hill of the Pnyx, which was evidently fed by a spring in a rock-hewn chamber in the hillside behind it. Near this fountain was the "Enneacrounos," the nine fountains supplied through an adjacent reservoir in the rock by the aqueduct of Pisistratus, a conduit that was built in the 6th century B.C. from the valley of the Ilissus, for the most part as a rock tunnel. An earlier aqueduct from the direction of the Acropolis may have furnished a supply to these fountains before the aqueduct of Pisistratus. In the second century of this era, the Roman Emperor Hadrian, who did so much for Athens and Greece, began an aqueduct, still known by his name, which was finished by his successor, the Emperor Antoninus Pius. This aqueduct, which still furnishes the major part of the supply of the modern city, has been located from the present terminus on Lykabettus, the conspicuous hill within the present city but outside the ancient town, to the suburb of Ampelokipi and thence northerly to the valley of the Cephisus and northeasterly to the slopes of Pentelikon and Hymettus. The total length of the aqueduct, as far as known, is about 16 miles and for most of this distance it is really an infiltration gallery. It was driven as a tunnel, partly in limestone, partly in earth and partly in the porous limestone conglomerate that occurs as lenses in the semi-impervious alluvium valley and about the slopes of the limestone mountains noted above. At the end of the aqueduct, on Lykabettus, are two small reservoirs of 340,000 gal. capacity, representing the only storage in the entire system and but one-ninth of the average daily supply. The face of the structure over one of these two reservoirs is seen in Fig. 5. Semicircular barrel arches form the roof above the reservoir.

At present the Hadrian aqueduct, with some wells in the rock at Kokinari near Cephissia, provides an average supply of 2.8 m.g.d., but the minimum summer yield is only 1.85 m.g.d. Incrustations of lime on the walls of the aqueduct have greatly restricted its cross section and reduced its carrying capacity. The municipality has recently been engaged in cleaning the aqueduct and a drift is now being driven above a portion of its channel to give access for cleaning and enlargements.

In addition to the supply from the Hadrian aqueduct, the city purchases a small supplemental supply for the northerly portion of the city from the owners of some open wells just north of Patisia. These wells give on the average an estimated supply of about 700,000 gal. per day, but this falls off to a minimum of about 30 per cent less than the above. Imagine what it means for a city of 240,000 inhabitants to have during a hot, dry, Attic summer, but 2,500,000 gal. of water daily, or only a little more than 10 gal. per capita, for all purposes. In consequence of this shortage, there is often insufficient water with which to flush the water-closets in the hotels and houses. Except for one district, occupied by the legations and the larger hotels, which is continuously served, each of the six separate services, through which the Hadrian aqueduct supply is distributed, receives water in turn for a few hours daily. The mains in the higher portions of the city are empty most of the time and, in consequence, they become filled with deposits of lime from the hard water. A supply of water is not delivered to the houses of the poorer classes; public spigots are provided in the streets for them and some of these spigots run constantly when water is available.

The scarcity of water in Athens would expose the city to a serious conflagration hazard but for the fireproof type of building construction—stone walls and tile roofs. Several fires occurred, last year, but they were confined to the buildings in which they originated. Fire hydrants, so conspicuous a feature of the streets of our American cities, are almost unknown in Athens. A fire engine is accompanied to a fire by a motor truck carrying a tank full of water with which to put out the blaze. This equipment was also used to restore order during the rioting in the streets that occurred prior to the last national election.

Quality of Supply

The quality of the public water supply of Athens is not such as to be acceptable in this country, because of its high mineral content. The supply from the Hadrian aqueduct has a total hardness of 378 p.p.m., practically all carbonates, and a chlorine content of 62.2 p.p.m.; otherwise, it is satisfactory, moderately cool, about 60° F., low in organic matter, attractive in appearance, and without sensible color, taste or odor. The supply appears to be naturally well protected from a surface pollution and seems perfectly safe to drink except at such times as work is being done in the galleries. The supplementary supply from the wells near Patisia has a somewhat smaller mineral content than that from the Hadrian aqueduct but the large open wells are more exposed to pollution. The public supply is not used in Athens by the well-to-do for drinking water. They purchase water for this purpose in earthenware jars of 2 to 3 gal. capacity, which are brought in daily from springs in nearby villages. These spring waters are of excellent quality at their source, the jars are sealed when filled, but they are not sterilized and are constantly interchanged among the consumers, so that the opportunity for carrying disease is great. All this water is, of course, warm when delivered and the Hadrian aqueduct supply is over 70° F. in July and August, as it comes from the tap in some parts of the city. Ice is used to some extent for cooling the drinking water but those who cannot afford this luxury keep their drinking water cool in the customary way of the East by placing it in

FIG. 5. ONE OF TWO COVERED RESERVOIRS ON MT. LYKABETTUS AT END OF HADRIAN AQUEDUCT, ATHENS

porous jars. Sufficient water escapes through the walls of the jars and evaporates to lower the temperature of the whole. In hot weather, however, when the air temperature is above 90° F., water in these porous jars is seldom cooler than 75° F. This is rather warm to drink until one becomes accustomed to it.

The subject of an additional supply of water for Athens has been agitated for many years. The source of supply that has received most consideration is the group of springs at El. 2,000 ft. near Lake Stymphalia, in the Peloponnessus, about 70 miles in a direct line from Athens. The large springs at the headwaters of the Melas River in the Lake Copais basin have also been proposed, but these springs are low, only 300 ft. above sea level, and would have to be pumped. Another source of supply that has been strongly advocated, and the one on which the writer recently reported, is a large group of springs at El. 1,000 ft. about 80 miles from Athens, on the northerly slope of Mount Parnassus and at the headwaters of the Boeotian Cephisus at the northwesterly end of the great Boeotian-Phocian-Locrian plain. The yield of all the above sources falls off materially in the late summer, and, for the Mount Parnassus sources, the writer proposed, in the absence of any underground storage, to construct about 15 miles from Athens a storage reservoir, in which to impound the larger winter flows of the Mount Parnassus springs for use in the summer months. With this storage, the Mount Parnassus sources would yield, throughout the year, about 20 m.g.d. Fortunately, the drainage area above the proposed reservoir near Athens has a sufficient area to provide a first supply of surface water of excellent quality, amounting to nearly 10 m.g.d., and the development of this source was recommended. The proposed surface reservoir would have considerable depth and, if not drawn too low, would insure a summer supply of an agreeable temperature. Aëration and filtration of this supply would probably be necessary.

Supply of Other Cities.—In Piraeus, the seaport of Athens, which has a population of about 130,000, the water supply conditions are worse than in Athens. About the same amount of water is supplied per capita, but it is of a poorer quality. In ancient times, the city of Piraeus is said to have been supplied by an aqueduct in the valley of the Cephisus. Now, a few open wells near the city, some of them so near the sea as to receive brackish water, provide a supply of 1.25 m.g.d., which is pumped to the Kastelli reservoir, a covered basin in the city of 2,640,000 gal. capacity, seen in Fig. 6. All water for shipping and much of that used for drinking in Piraeus is brought by boats from the island of Poros. About 80,000 gal. are supplied daily from that source. Of this amount, approximately one-third is used for household purposes and is sold from tank carts in the streets or distributed in earthenware jars, as in Athens. It is planned that the proposed new supply for Athens be shared by the city of Piraeus.

Corinth, the ancient city near the isthmus of that name, was supplied by local springs of some importance and by an aqueduct built by the Emperor Hadrian, which is said to have come from the springs at Lake Stymphalia. Little trace of it now remains. The present city of Corinth is not built on the site of the old one and obtains its water supply from local springs and wells.

Chalkis, a city of about 12,000 inhabitants, the capital of the island of Euboea, had an aqueduct in the days of the Venetians which supplied the city from small springs back in the mountains, about 20 miles away. Judging from the size of the small trapezoidal trough in the top of a section of this aqueduct, still standing in the city and seen in Fig. 7, the supply of water could not have been large. Now, most of the water used in the

FIG. 6. KASTELLI COVERED RESERVOIR AT PIRAEUS

city is carted in large barrels from a spring near the sea, about two miles away.

Thebes, the ancient capital of Boeotia, now a country town containing hardly 4,000 inhabitants, is well supplied with water by springs in the vicinity, which feed the many public fountains. That fed by the ancient Oedipodeia has been seen in Fig. 4. The Dircean springs, the most famous of the ancient sources, appear in the low hills about a mile south of the city. The ancient aqueduct, which served the Cadmeia or acropolis of the old city, the high ground to which the modern town is largely confined, was attributed to Cadmus, the legendary founder of the city. This aqueduct has not been traced to its source, but is said to draw its supply from springs on Mount Cithaeron, seven or eight miles away.

Sewerage.—The standards of cleanliness among the Greeks of the classic age were not high and, today, according to our ideas, there is still much room for improvement. The ancient Greeks had water but they did not keep their cities clean, and they retained the most primitive methods in the removal of human wastes. It is fairly probable, from what we know of the Greeks in the time of Pericles, that, in their concern for wealth and power and their interest in the higher attainments of life—in art, music and literature—sanitation did not

seem important to them. In their city life, the Greeks constructed beautiful public buildings and monuments still the admiration of the world, and built up a civilization that in many ways surpassed our own, yet they apparently accepted without protest their modest, uncomfortable dwelling houses, their narrow, dirty streets and all the stench and filth that must have accompanied the unorganized removal of human excrements by dry disposal methods. They were evidently content with the "squalid magnificence" in which they lived, or they would have effected some improvements, for the Greeks did well all things they attempted. The Greeks, however, were hardly less enterprising as regards the sanitation of their cities than other peoples of antiquity. If the purpose of the drainage system in the old Cretan palaces is correctly interpreted, the pipes and fixtures in the palace of Cnossus, built about 1500 B.C. by the predecessors of the Greeks, represented about the last word in sewage disposal until the modern system of water carriage was developed in western Europe, about 75 years ago. It is generally agreed that the few sewers of the ancient cities were built to carry storm water and to drain the land and that they were not primarily intended, at least not in Greece, for the carriage of house sewage.

Present Status of Sewage Disposal.—Modern plumbing has been introduced to some extent in Greece, but little or no progress has been made in the construction of municipal sewerage works. In a country where flies abound and few houses or even hospitals are screened, the absence of proper methods of sewage disposal and, more particularly, the common use by the poorer classes of open pits or privies, or of still more primitive means disposal of excreta in courts and streets, constitute a serious menace to public health.

Difficulties of Water Carriage.—Aside from the serious question of finding sufficient funds to do any public work, a difficulty that is not just now peculiar to Greece, the most serious obstacle to providing modern sewerage for the cities and towns of Greece is the difficulty of finding sufficient water. In some communities a system of water carriage would for this reason be impossible and some method of dry disposal would have to be adopted. To be successful, such a system would necessarily require the adoption by the people of habits of order and cleanliness that are now generally lacking. This would be more important than if water carriage were introduced, but a great deal of educational work would have to be carried on before any system of sewage disposal could be introduced.

Sewerage of Athens and Piraeus.—It may be of interest to speak of the sewers of ancient Athens, to outline the existing sewerage system and to briefly describe the proposed new works for Athens and Piraeus.

Several sewers, or, more properly speaking, storm-water drains, belonging to ancient Athens have been found. A drain from the Theater of Bacchus, near the Acropolis, leading to an outlet in the channel of the Ilissus, has been identified as of the 5th century B. C. The river Eradnus, which rose on the slopes of Lykabettus, was carried through the old city, first as an open ditch and later as a storm-water sewer, to a point of discharge near the old city gate, known as the Dipylon, where a portion of the sewer and a sluice-gate may still be seen. It is believed that some house sewage may have reached these ancient drains, but such use was

FIG. 7. REMAINS OF VENETIAN AQUEDUCT FOR CHALKIS, ISLAND OF EUBOEA

probably limited, in the sense in which we use the term sewage as meaning water-borne wastes.

Only a part of the modern city of Athens is sewered. The existing sewers are of good size, 3 to 11 ft. of trapezoidal section, with semi-circular arch and constructed of rubble masonry lined with cement mortar. They have somewhat irregular sections and grades and were built for storm-water drains, to relieve the streets of the city of the floods of water that rush down from the adjacent hills, at times of heavy rain. In spite of legal prohibition, however, these sewers carry the house sewage of the limited districts served. Large areas of the city depend on cess-pools and open pits. In the poorer quarters of the city, wash water is often carried in the street to the nearest drain, as shown in Fig. 8. The house sewage of Athens is all discharged, at a locality known as Daniel's Church, into an irregular unpaved open channel within the limits of the city, whence it flows to the Cephisus. This channel and the end of the outfall sewer are shown in Fig. 9. During the summer, all the sewage in this channel is diverted for irrigation in the district known as the "Olive Groves," just outside the city; in the winter, most of it is carried by storm waters into the Bay of Phaleron. The city of Athens derives some revenue from the use of the sewage for irrigation. No vegetables to be eaten uncooked may, however, be grown on lands so irrigated. Considering how little water is available, it is not surprising that this sewage is strong and black. Its delivery in open ditches, frequently beside the roads, is very offensive during the hot summer weather.

Proposed Sewerage System.—The writer in his report of last fall recommended the construction of a separate system of sewers for Athens, as well as for the neighboring city of Piraeus and the villages of Old and New Phaleron, which are even less adequately served than Athens. The house sewage of these latter communities and that of a small area in Athens would have to be pumped into the main gravity outfall from Athens, in which all sewage, not diverted for purposes of irrigation, would be discharged in deep water in the Saronic Gulf, well off the beach at a point several miles from the nearest community served. In connection with this plan of disposal, it will be of interest to note that the city of Naples discharges all the house sewage of a population of 900,000 people into the Tyrrhenian Sea near the old city of Cumae, about 15 miles north of Naples. Except for coarse screening before the sewage reaches the pumps in the city, where most of it is lifted

sufficiently to carry it by gravity to the outfall, the sewage is untreated and is discharged on the beach at low-water level without creating any nuisance.

It is proposed to discharge the storm-water drains of Athens, in which the present system of sewers would be incorporated, into the nearest channels of the Ilissus and the Cephisus and to discharge the storm-water drains in Piraeus and the Phalerons directly into the harbor or the sea. Among other reasons for recommending a separate system of sewers, instead of a combined system that had been previously proposed by French and German engineers, it was believed to be impossible to prevent the accumulation, in a system of large combined sewers, of the sand and detritus that come down during the rainy season from the steep, rocky hillsides in and about these cities, and to avoid the nuisance that would occur, during the long, rainless summers, from the lodgment of fecal matter on such

FIG. 8. WASH WATER FLOWING IN A STREET OF ATHENS

obstructions in the sewers. The pollution of the river channels and the harbor of Piraeus by dilute sewage from the necessary overflows of a combined system, and the high cost of constructing and operating the larger pumping stations required in Piraeus for the combined system of sewers, were further considerations that influenced the decision in favor of a separate system. By utilizing the existing sewers, a measure that would not be practicable if a combined system were chosen, the cost of the separate system proposed would be no greater than that of a combined system. The early construction of sewers in Athens and Piraeus is most necessary, yet, if a system of water carriage is to be introduced and such a system seems best under the conditions existing there, nothing can be done until a sufficient supply of water is assured.

Other Sanitary Problems.—The furnishing of sufficient water of good quality and the satisfactory disposal of the human wastes in the cities and towns of Greece are, of course, only two of sanitary problems there. Besides the prevalence of typhoid fever and other filth diseases, one of the serious consequences in modern Greece of the general lack of cleanliness, so common in the Near East and in the Mediterranean, is the high infant mortality. This is a question that is bound up with the general problem of clean food and the proper care of infants and is now receiving the earnest attention of the Greek Government, with which the American Red Cross has been co-operating.

The presence of the flea and the bedbug, the constant evidence in Greece of uncleanliness and poor housekeeping, makes the life of a visitor from a cooler, cleaner land a most uncomfortable one, even though he may not receive any disease through their bites. That these insects, particularly the flea, may be important, however, in transmitting certain diseases is recognized, even if no country-wide aversion to them seems to exist. Bubonic plague has frequently been a visitor in the Piraeus and the fumigation of the Athens sewers with sulphur dioxide to kill the rats was observed last fall.

FIG. 9. UNPAVED CHANNEL AT END OF ATHENS SEWER

The removal of garbage and rubbish in the city of Athens appeared to be as well done as in many of our own cities. The violent ringing of a gong on the garbage carts in Athens at 6 o'clock on a summer morning is hard on light sleepers who, unlike the Greeks, sleep with their windows open, but the ringing is effective in getting out the garbage. This material is fed to hogs; rubbish and ashes are carried to dumps outside the city.

The prevention of dust in the cities and towns, already referred to, must wait upon the delivery of sufficient water with which to sprinkle and flush the streets. The construction of hard pavements, both in the cities and in the country, will improve conditions in this respect. The continued construction of water-bound macadam roads without surface treatment has nothing but economy to recommend it in that climate.

Malaria Prevention.—The gravest public health problem in Greece, today, is the high prevalence of malaria. This disease is a more serious ailment there than ordinarily encountered in our climate. As observed last year in the men of the writer's organization, it is characterized by a high fever with vomiting and severe pains. Under the most effective treatment of daily sub-cutaneous injections of bi-chloride of quinine, the fever lasts several days and may recur if large doses of sulphate of quinine are not taken internally for some time afterward. Quinine prophylaxis just prior to or during exposure does not always appear to be effective.

Some published figures indicate that, before the war, from one-third to one-half of the whole population of Greece had the fever annually, and that in some districts all the people had it every year. That malaria, if neglected, may lower the vitality and lead to more serious disease, such as tuberculosis, can be readily believed. That it must result, throughout Greece, in a great loss of man power is evident, and this loss occurs when labor can least be spared.

According to Ross ("The Prevention of Malaria"), Greece may have suffered seriously in the past from this disease, although the evidence is not conclusive. He believes from references to malaria in the literature of early Greece that malaria was probably introduced into that country during the 5th century B. C., by soldiers or slaves from abroad and that the ravages of this disease may account for the depopulation of Greece, which occurred between the 5th and the 2nd centuries B. C., and which has not previously been satisfactorily explained.

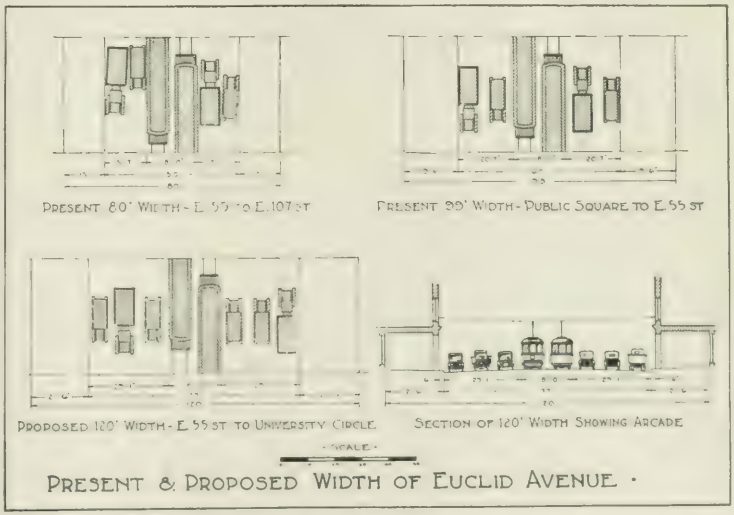
Lack of Drainage.—It is not surprising that the villages in the Plain of Marathon should have, it is said, more malaria than any other district in Southern Greece, because of a constantly flowing stream and the extensive swamps there, beside the sea, into which the Persians were driven in their defeat, 490 B. C. Nor is it remarkable that one of the worst districts for malaria is that in and about the basin of Lake Copais in Boeotia, which an English company drained about 20 years ago and now keeps fairly well pumped out. The floor of the old lake is nearly level and there remains, even in midsummer, much stagnant water about the basin and large areas of marshy lands, that are constantly flooded by the flows of tributary springs. There are some other districts which form natural breeding grounds for mosquitos, such as the picturesque mountain valley of Lake Stymphalia, which is subject to large changes in elevation when the drainage tunnel through the mountain, said to have been driven by the Emperor Hadrian, becomes obstructed.

Such large areas of wet ground as those mentioned above are not common in Southern Greece, however, and it seems curious, at first sight, that a country that is in general so mountainous and, for four or five months of the year, so rainless and dry, should have so many mosquitos and, in consequence, so much malaria. This situation must be explained by the existence of numerous small springs throughout the country and of many open wells and shallow storage tanks, the very complete application of all available water to fine, semi-impervious soils, the absence of any effort about the springs and wells and along the irrigating ditches to avoid stagnant pools and wet ground, and the almost universal lack of screens in dwelling houses. Even in the city of Athens, in districts that are naturally as dry and dusty as can be imagined, the mosquito is very annoying, although there is comparatively little malaria. The mosquitos apparently breed there in the uncovered water tanks on the roofs of buildings and in the many gardens, where some water is constantly being used.

The Greek Government has been at work on the problem of lessening the ravages of malaria. It has issued literature to educate the people, has bought and dispensed quinine, and, in some districts, taken active measures against the mosquito in the direction of draining and oiling, and has even given treatment to the people. Such work can hardly be considered much more than a beginning. The greatest problem appears to be that of educating the people to some realization of the necessity of taking radical measures to eliminate the mosquito—no small task among a conservative and ignorant peasantry. It may be assumed that the last eight years of war have greatly interfered with the anti-malaria work that the government has been doing. Large drainage projects have recently been under consideration, but their object is primarily to increase the area of cultivable land, rather than to combat the mosquito.

Plan for Widening and Arcading Parts of Euclid Avenue, Cleveland

As a part of its thoroughfare plan (*Engineering News-Record*, March 3, p. 382) the Cleveland City Plan Commission proposes the widening of Euclid Ave. from E. 55th St. to University Circle, a distance of over two miles. Euclid Ave. is now 80 ft. wide in this section. It is proposed to widen it to 120 ft. by taking 20 ft. from each side. While most of the frontage is now improved with residences standing well back from the street line, three important sections have been developed with business buildings coming clear out to the present street line. A number of these buildings are substantial structures, and in order that the widening may be effected at a minimum expense it is proposed to leave the present buildings standing but to push back the store fronts on the first floor and run the sidewalk in an open arcade along and under the front 20 ft. of the present buildings. This will leave almost the entire width of the present street, 80 ft., for roadway purposes. The arcade plan will be applied to about 10 per cent of the frontage along the two-mile stretch proposed for widening. Robert H. Whitten and Froule R. Walker are advisers and C. E. Cooley is engineer of the City Plan Commission, and Robert Hoffman is city engineer.



Steel Shops of Samson Tractor Co. at Janesville, Wis.

Double Faced Sawtooth and M-Truss Roofs—Crane Runways Suspended From Foundry Roof Trusses—Yard Cranes

ROOF framing designed to carry fixed and moving loads with economy of material, double faced sawtooth roofs and supplementary tension members in trusses carrying trolley and crane runways, are features of the large new plant for the Samson Tractor Co. at Janesville, Wis. An extensive equipment of mechanical handling systems in the buildings and yards includes conveyors, trolley hoists and overhead cranes. At present the plant consists of a machine and assembly shop, foundry, heating plant and two-story office building, but provision is made for additional shops and foundries.

The machine shop, Fig. 1, a one-story steel-frame structure 400 x 500 ft., was built in two units of practically equal size, each having an office building 40 ft. wide across the front. Each unit is divided transversely into six 30-ft. bays, with longitudinal spacing of 40 ft. for the columns. The roof framing consists of 30-ft. sawtooth trusses supported on columns and spaced 40 ft. c. to c. Between each pair of trusses on columns are three intermediate trusses of 10-ft. spacing, supported by inclined longitudinal trusses in the plane of the sawteeth. In erection, the 30-ft. trusses were placed first, then the inclined longitudinal trusses, and finally the intermediate trusses.

In the first unit of the building the steel framing is designed for ordinary roof loads. In the second unit, a heavier design was employed, with stiffer bottom chords and heavier bracing in order to take care of possible future loads due to shafting and monorail tracks. It is pointed out by the designer that in buildings of this kind, such appliances are likely to be attached to the roof, whether or not the design has provided for them, and they may add a considerable percentage to the calculated load. The trusses and framing were designed specially with a view to provide for these roof loads without excessive weight of material. Further, to facilitate the placing and shifting of motors and shafting and their rearrangement at any time, the bottom chord of each truss is made of two channels set far enough apart to allow of slipping attachment bolts between them.

For the central bay, forming the assembly shop, a Pond or M-truss construction is used, as shown, this arrangement giving exceptionally good ventilation. With this roof design there is a good distribution of light over the entire floor, and although the sawteeth face both north and south there has been no complaint on account of the direct sunlight from the south. Reinforced-concrete roof slabs are used in the first unit and gypsum slabs in the second unit. Details of the sawtooth and M-truss design are shown in Fig. 2.

An essential point which was impressed upon all connected with the design and construction of the building was the necessity of keeping the shop floor clear. The six toilet and locker rooms therefore are arranged in pent houses at the roof level (see Fig. 1), with iron stairways from the floor. These rooms are of concrete with metal fittings, so that they can be washed out with a hose. Of the two large fans for a supplementary heating and ventilating system, the first was installed on the floor, but proved to be such an obstruction that it was raised above the roof trusses, the second fan being installed in a similar position. For the main steam heating system cast-iron radiators are placed on the trusses as well as on the side walls. These conditions illustrate the unforeseen loads that roof trusses may be called upon to carry through the necessity of accessory apparatus.

Foundation and Floors.—Plain concrete footings on coarse gravel are designed for the conservative loading of 3,500 lb. per square foot. A bearing test showed that the gravel would carry 10,000 lb. without excessive settlement. It is pointed out that in view of the unexpected loads which are likely to be placed on parts of a building of this kind when it is in service the designer may be glad to remember that he has an ample margin of safety in the foundations.

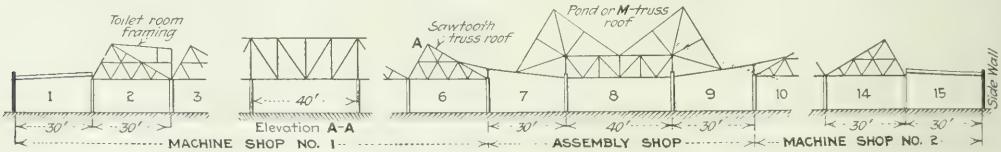


FIG. 1. CROSS-SECTION THROUGH MACHINE SHOPS AND ASSEMBLY SHOP OF SAMSON TRACTOR CO.

Stepped footings were designed, but for the first unit the contractor was permitted to build a footing course carrying tapered piers, wires embedded in the footing being attached to the forms so that they would not rise when the concrete was poured. Reinforced footings with vertical pedestals were used in the later buildings, the contractor's superintendent claiming that the expense of reinforcement was less than that of tieing or weighting the pyramidal forms to hold them in place.

The machine shop floor is of $\frac{13}{16}$ x $2\frac{1}{4}$-in. maple strips dipped in hot paraffin oil, these being laid diagonally on 3 x 6-in. hemlock planks dipped in creosote. These planks are on a 1-in. layer of Tarrock with a 6-in. concrete base over a 4-ft. fill of sand and gravel. This fill, made by dumping from small industrial cars, was not deposited in layers and was not rolled, but was carefully puddled. The concrete base was placed as soon as the puddling was finished, but no appreciable settlement has been noticed, although loads of 1,500 lb. per square foot are not uncommon under piles of plates and structural shapes. The maple floor is found excellent for storage and shop purposes, but soon began to wear badly where the sharp wheels of the tractors run over it continually between the assembly shop and the loading dock.

Asphalt blocks $2\frac{1}{4}$ in. thick laid in lean cement mortar are used to pave the reinforced-concrete loading dock and have given good service under the tractor wheels. This paving was tried in a part of the shop but was not

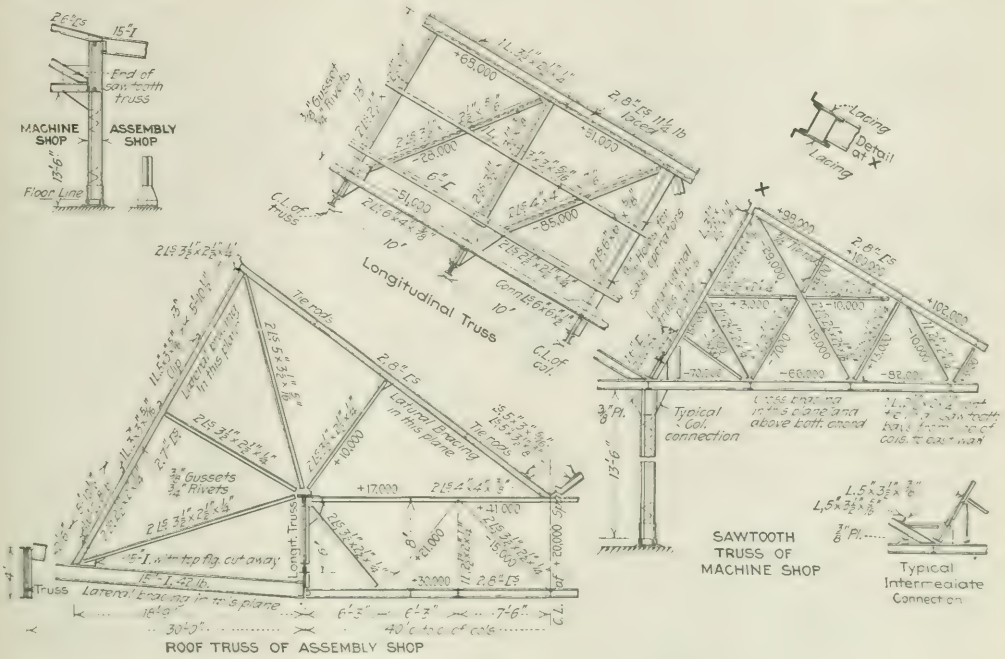


FIG. 2. ROOF TRUSSES OF MACHINE SHOP AND ASSEMBLY SHOP

satisfactory where it was exposed to the action of oil and gasoline droppings.

Foundry Building

A steel frame structure 330 x 530 ft. forms the foundry, which has a main floor about 130 x 500 ft. flanked on one sde by pattern shop, sand bin and core room, and on the other side by bins for pig iron and other supplies. Along the front extends a cupola building with heavy steel charging floor, and a three-story service building containing offices, wash and locker rooms and a pattern loft. Four rows of columns support parallel chord trusses, the columns of the two interior rows extending to the ridges of a double saw-tooth roof bay having movable sash on both the north and south sides, Fig. 3. Tar and gravel roofing is laid on the flat portions, the sloping Pond or M-truss roof being covered with two plies of felt and a 3-ply roofing.

An extensive system of monorails and overhead transfer cranes serves the foundry and is supported directly from the lower chords of the roof trusses and from steel hangers at a lower level (see Fig. 3). To permit of attaching monorails at any desired point the lower chord of each truss is stiffened by a continuous 12-in. web plate which is not figured in the chord section. Cast steel bolted clips were used at first to attach the monorail tracks to the trusses, but subsequently clips of structural steel were used and are said to answer the

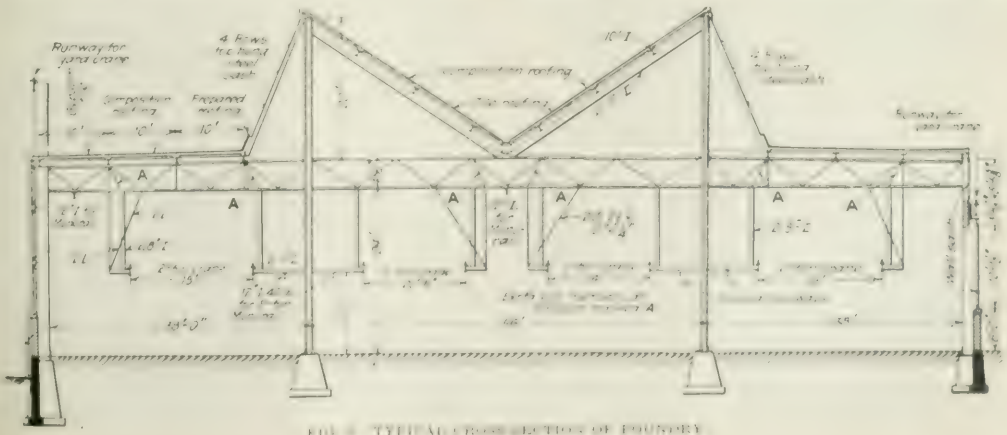


FIG. 3. TYPICAL CROSS SECTION OF FOUNDRY

purpose equally well. Where hangers are attached to the lower chords between panel points, supplemental web members are placed to carry the loads to the upper panel points and thus avoid bending the chords.

Brick walls were planned for the cupola and service buildings, but concrete pilasters and brick panels were used on account of difficulty in obtaining a sufficient force of bricklayers. This change hastened the progress of the work materially. As bids on ironwork for stairways in the foundry indicated high cost and late delivery, a change was made to reinforced concrete, with a saving in cost and time, while the appearance is found to be satisfactory. Patent non-slip treads were difficult to obtain, and the surface concrete of the treads was finished by mixing carborundum in the proportion of 2 lb. per square foot. At the charging floor, designed for a load of 1,200 lb. per sq.ft., closely spaced I-beams are framed between I-beam girders and covered with $\frac{3}{8}$-in. steel plates.

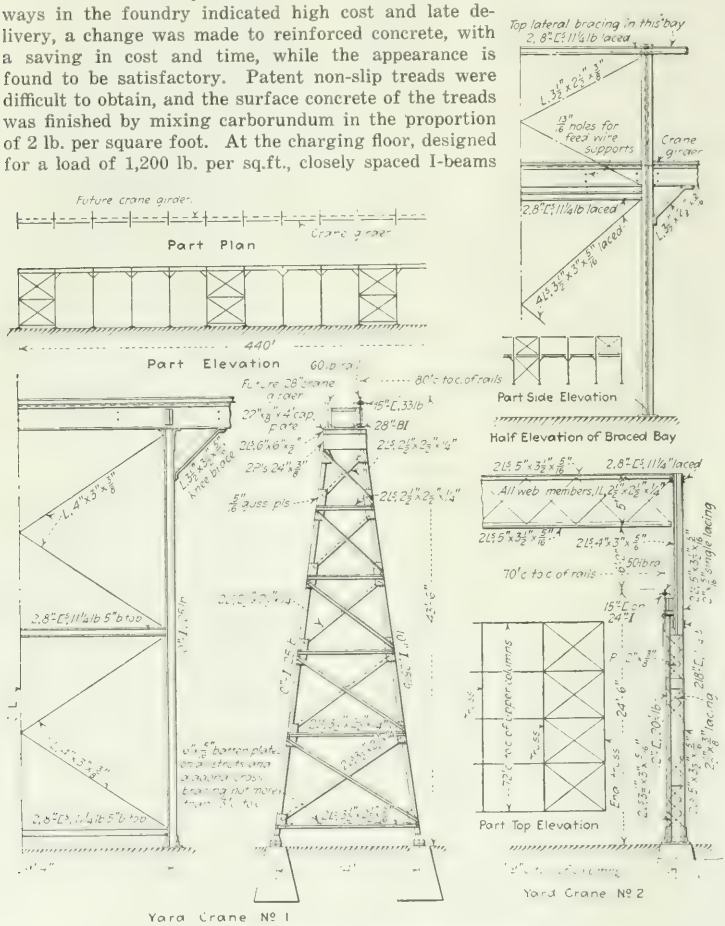


FIG. 4 RUNWAYS FOR YARD CRANES

As steel for the heating plant building was delayed by strikes, two 500-hp. boilers with automatic stokers were set in place before the superstructure was erected. These boilers were on the main floor, 16 ft. above the basement and supported by heavy concrete columns and girder beams. As soon as these beams were received, the erection of the boilers was begun and a wooden shelter was built over them. Steam pipes were hung temporarily and secured to the permanent structure later. This work was done in severe winter weather and added largely to the cost of construction, but the boilers were ready for service as soon as the building was enclosed, or at about the time that their erection would have been started ordinarily. A breakdown in the local electric plant occurred just then and these boilers, with a turbo-generator that had been installed in a similar manner, carried the entire plant load for several weeks.

Pipes for water-supply and steam heat are led from the power house to the buildings in a tunnel 10 ft. wide and $6\frac{1}{2}$ ft. high, with its top 2 ft. below the surface. Pipe trenches in the buildings are covered with removable slabs of concrete about 4 ft. long, occasional slabs being provided with handles to facilitate removal. At doorways or partitions the concrete cover is cast permanently in place.

Yard cranes are provided for handling raw material, equipment and finished product. Two designs are shown in Fig. 4. The 5-ton crane of 80-ft. span has 28-in. I-beam runway girders supported by A-frame bents with a longitudinal spacing of 29 ft. 4 in., four pairs of the bents being connected by struts and diagonal bracing to form towers. The 5-ton, 70-ft. yard crane has posts built of angles and lacing up to the 24-in. I-beam runway; above which they are extended in smaller section to carry transverse trusses. These posts are spaced $26\frac{1}{2}$ ft. and are connected by diagonal bracing at intervals.

Steel erection on the main buildings and crane runways was done mainly by locomotive cranes. At one time a strike stopped the assemblage of trusses in the shops, and in order to avoid delay the parts were shipped to the work and assembled during erection. This caused comparatively little delay. Concrete for the greater part of the work was made in a $\frac{3}{4}$-yd. mixer serving a 75-ft. tower with steel spouting suspended from cables and having a reach of about 500 ft. A $\frac{1}{2}$-yd. mixer and small tower were used for the office building and portable mixers served various isolated sections. When concrete for the power house walls and other parts was placed during very cold weather, the materials were heated.

Design and supervision of construction of the entire plant were in the hands of Frank D. Chase, Inc., engineers, Chicago, the structural designs being made by G. W. Niestadt. H. S. Baker was engineer in charge, with F. M. Reynolds as superintendent of construction. The general building contract was handled by J. P. Cullen & Son, Janesville, Wis., and the du Pont Engineering Co., Wilmington, Del.

Curve Traverse Chart for Lining Track

By J. G. Wetherell
Assistant Engineer, C., M. & St. P. Ry.

In staking curves for relining track a curve traverse has been found of great assistance. The curve is first divided into 31-ft. stations along the outside rail, the stations being numbered and care being taken to have Station 0 on the tangent. A string is then stretched from 0 to 2 and the distance from the string to the rail at Station 1 is measured in inches, giving the degree of curve at Station 1. The string is then moved ahead and the degree of curve determined in the same way at each of the other stations. A chart can be plotted in the notebook, using one square

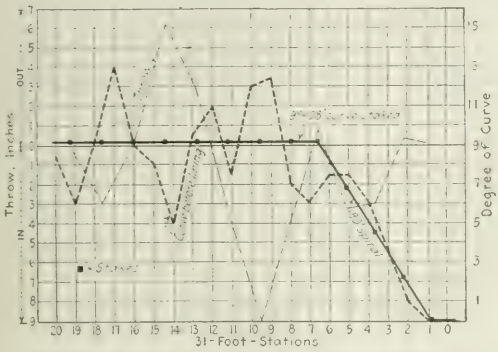


Chart of Curve Traverse and Adjustment for Relining Track

horizontally for each station and one square vertically for each degree of curve.

The accompanying diagram is a chart of one end of a Y-track at Bardwell, Wis., which the writer recently staked. Remembering that a true, simple curve plots as a straight horizontal line, and a spiral as a slope line, it will be seen that there was a fairly good spiral on this curve about 125 ft. long, but that the rest of the curve was badly out of line, varying between 5 and 13 degs. From the appearance of the traverse curve it was thought that a 9-deg. curve would give a fair average of throw in relining, but after the first trial staking it was found that a curve of 9 deg. 8 min. was better on account of a turnout and a platform. This was established and spiraled as shown. Stakes were set every 50 ft., according to usual custom (except on the spiral) and the amount of throw was measured in inches at each stake.

These throws were plotted as shown, care being taken to equalize the stationing. It will be seen that the chart is a complete diagram of the curve, showing what it was, what it was to be, what throws were necessary, and how these throws balanced. Further, it will be seen that there is no definite relation between the traverse curve, the located curve and the throw, although the greatest throw comes where there is the greatest divergence between the first two.

The writer does not believe that a "degree of curve" traverse is of any use on long flat curves, except possibly at the ends, to quickly determine the conditions there. It is well, however, to traverse a short, sharp curve entirely, in order to study the curve as a whole and to avoid compounding.

The Riensch-Wurl Sewage Screening Plant at Santa Barbara

Special Pump Handles Screenings Which Are Spread on Ground With Street Sweepings — Constant Attendance Unnecessary

By Ormond A. Stone
With Olmsted & Gillelen, Los Angeles, Cal.

Topographical conditions and the original layout of the old sewer system so limited the possible locations of a main gravity outfall sewer at Santa Barbara, Cal., that it was necessary to locate the sewage works within three blocks of a widely-advertised, all-year-'round resort and within 100 yd. of the ocean-front boulevard, which is also a trunk line of the state highway. Thus a primary requirement was a means of treating the sewage from a city of 20,000 people without nuisance to adjoining property. Imhoff tanks were considered, but because of unfavorable sentiment were abandoned. A fine-screen plant was ultimately decided upon after it was determined that the operating methods of a similar sewage screening plant at Long Beach, Cal., could be improved and the costs lowered.

The Long Beach screen (*Engineering Record*, May 20, 1916, p. 664, and *Engineering News*, May 4, 1916, p. 836) requires the constant attendance of an operator to move the cans of screenings as they are received from the revolving brushes and to be available in case of failure of the automatically operated sump pumps.

Study of the operation of the Long Beach plant over a period of some three years indicated the possibility of certain improvements being made in future installations which would materially lessen the cost of operation. Most important of these was a method of storing and handling the screenings so as to eliminate the need of constant attendance except where, as at Long Beach, the attendant was needed for other purposes than caring for the screen.

Santa Barbara officials were advised that by delivering the screenings to a concrete storage sump from which they could be periodically removed, the plant would require but part time of one man to keep it in operation; also that a feasible means of disposal of the screenings, other than by incineration, was possible, thus making the cost of operation and maintenance compare favorably with Imhoff tanks. Accordingly, a plant was designed with the arrangement shown in the accompanying drawings.

Before determining upon the use of a centrifugal pump to elevate the screenings from the pit every conceivable alternative was considered. Restricted space and quicksand eliminated the practicability of a driveway under the pit; compressed air as a means of lifting the screenings was too expensive both as to first cost and operation; and bucket or belt conveyors were considered unsanitary.

Many of the larger pump manufacturers were furnished with the data and informed of the type of service desired, with the request that they advise if a pump could be supplied to meet the requirements. Without exception the replies were to the effect that the conditions were not adaptable to the use of a centrifugal pump.

Convinced that a centrifugal pump could be designed to lift the screenings as they came from the screen

and strengthened in this belief by correspondence with A. B. Wood of New Orleans, the writer finally prevailed upon the Byron Jackson Iron Works of San Francisco to supply a pump for this service.

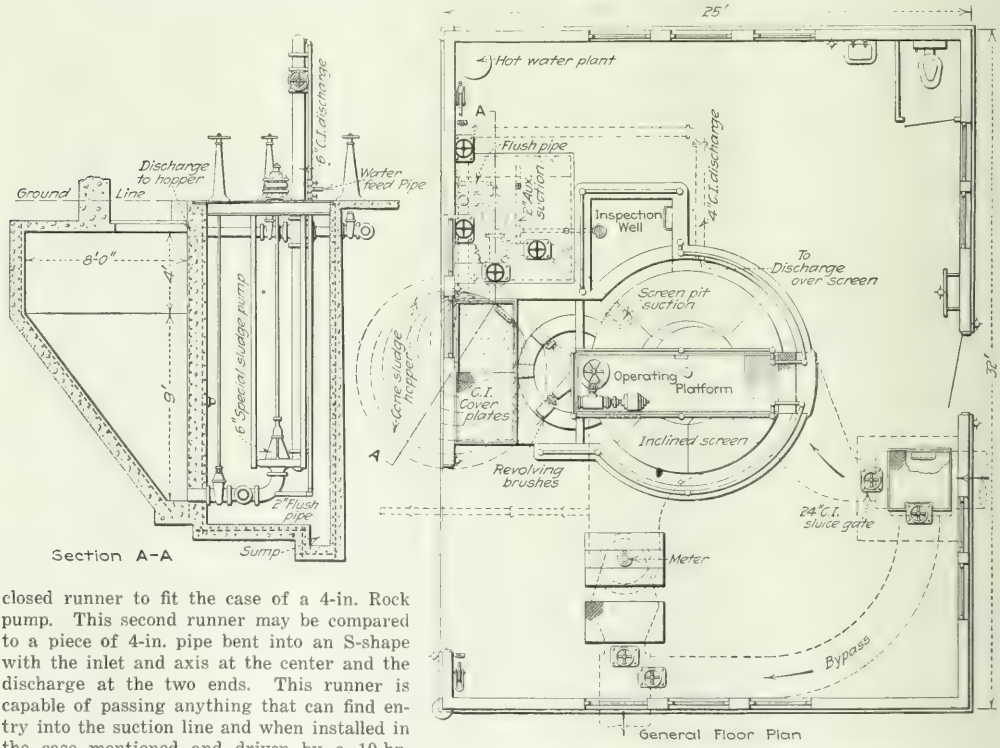
The first pump installed by them was a 4-in. vertical, centrifugal pump, having an open runner and driven by a 7.5-hp. motor. It was immediately apparent that this pump was unsuited to the conditions because rags and waste were wound up by the runner in such a way as to clog the suction. In attempting to empty the screenings pit for the first time, 22 gal. of rags and waste were removed from the pump, and a whole day was spent in an operation that should have taken but a few minutes.

A. C. Paulsmeier, designing engineer for the Byron Jackson Iron Works, next designed a special two-ported closed runner to fit the case of a 4-in. Rock pump. This second runner may be compared to a piece of 4-in. pipe bent into an S-shape with the inlet and axis at the center and the discharge at the two ends. This runner is capable of passing anything that can find entry into the suction line and when installed in the case mentioned and driven by a 10-hp. 720-r.p.m. motor, proved entirely satisfactory. The pump has been in operation for over 18 months and has given no material trouble.

Particular care, in the design, was given to the study of properly cleaning pump and sump after use. The method of operation is simple. After emptying the sump the operator so manipulates the valves that screened sewage is pumped into it as flush water. The valves are again manipulated and the flush water is pumped from the sump back into the screen pit, ahead of the screen.

Based on experience at Long Beach, a well, permitting inspection of the underside of the screen without shutting down the plant, was provided. This well permits the operator to remove with steam or boiling water the grease which adheres to the underside of the slot and eventually clogs the opening in the screen. After the Santa Barbara plant was put in operation, the man in charge evolved the simple scheme of suspending a 5-gal. can over the brush trough and allowing kerosene to drip slowly on the brushes as they revolved. About one gallon of kerosene per day serves to keep the plates clean and the slots clear from adhering grease. This scheme has been found so practical, in fact, that it has been unnecessary to use the steam plant for cleaning purposes.

The screen is 10 ft. in diameter, is set on a 15-deg. slope, has $\frac{1}{16}$ x 2-in. slots and in general conforms to the standards for this type of screen, which is the Riensch-Wurl. Its maximum capacity is 7 cu.ft. per second with a head loss of 18 in.



ARRANGEMENT OF SCREEN AND SCREENING PUMP AT SANTA BARBARA

An interesting feature of the plant is the method of disposing of the screenings. Originally it was intended to haul them in tank wagons to neighboring orange groves, there to be used as humus and fertilizer.

At the suggestion of Robert Craig, city manager of Santa Barbara, it was determined to try composting the screenings with street sweepings on the lot in which the screen plant is located. This lot is somewhat below the level of the plant proper and the adjoining roadways. The experiment was so successful that it has been continued as a permanent means of disposal. The procedure is exceedingly simple and the result is absolutely free from nuisance. The street sweepings, which

average from 3 to 5 dump-wagon loads per day, are used to build up dikes, marking off a series of basins approximately 20 ft. wide and 60 ft. long. Each night after dark the attendant starts the pump and delivers the screenings to the particular basin he is filling, through a 6-in. galvanized-metal pipe line such as is used for irrigating alfalfa. This pipe line is brought out each night and suspended from the discharge spout of the pump which projects through the pump-house wall well up toward the eaves. From this elevation the screenings flow by gravity to any part of the lot. The solids handled average about 5 cu.yd. daily, and are covered with enough dry sweepings to absorb most of the moisture and prevent the breeding of flies and mosquitoes.

This method of disposal has been continued for over a year and the beds first composted are being dug up for use on land in the parks. During the year the lot has been raised about 3 ft. over an area of approximately 20,000 sq.ft. No odor is apparent even when standing on the beds, the attendant reports no breeding of flies or mosquitoes and everyone who has visited the plant remarks about its neat appearance, cleanliness and freedom from offense.

A. B. Cook was city engineer when the plant was installed. Olmstead & Gillelen of Los Angeles acted as consulting engineers in charge of design.

Effect of Colorings on Concrete Strength Determined by Test

Discussing the paper on "Coloring Concrete" by John W. Lowell, before the recent annual meeting of the American Concrete Institute, Prof. Duff A. Abrams, of Lewis Institute, Chicago gave the following report of some tests on the effect of these coloring agents on the strength of concrete.

The accompanying table gives the averages of the compressive strengths of 3 x 6-in. cylinders, made of 1:2 mortar and tested at ages of 7 and 28 days. Portland cement was used; the aggregate was a coarse sand from Elgin, Ill. The percentages of coloring materials are in terms of the weight of the cement. Each value is the average of three tests made from a single batch of concrete. The tests on each color were made at different times; this accounts for the three values given in the third column for the mortars without coloring.

Coloring Material	Age at Test Days	Compressive Strength of Mortar Mixed with Different Percentages of Color, Lb. per Sq. In.					
		None	0.5	2	5	10	15
French's C.C. Blue	7	2,100		2,500	2,960	3,210	3,720
French's C.C. Blue	28	3,390		3,490	3,990	4,630	4,900
J. M. Wells Co. No. 2 Red	7	2,790		2,730	2,790	2,430	2,270
J. M. Wells Co. No. 2 Red	28	4,900	.....	4,780	4,390	4,410	4,090
Cabot's Carbon Black	7	2,840	1,820	1,610	870	690	
Cabot's Carbon Black	28	5,080	4,240	3,020	2,000	940	

It will be seen that three different effects were produced: The blue appears to possess some hydraulic properties which caused it to show a steady increase in strength up to the highest percentage used (15 per cent of the weight of cement) at both 7 and 28 days. The red color caused a slight reduction in strength which is practically the same as the effect produced by other inert powdered materials in concrete. The carbon black produced a very great reduction in strength; 2 per cent of carbon black, reduced the concrete strength about 40 per cent. Bancroft in "Applied Colloidal Chemistry" 1921, states that "with a substance like carbon black which absorbs gas very markedly, as little as 5 per cent of the apparent volume may be due to the carbon black and a liter of carbon black may contain 2.5 liters of air." This peculiar property, no doubt, accounts for the effect on concrete shown by the tests.

Wing Walls of Concrete Arch Kept From Slipping by Tie Rods

By A. A. Blaeser
Allentown, Pennsylvania

In reinforcing the wing walls of a concrete bridge that had cracked loose and were pushing apart because of pressure exerted by a heavy fill, the method herein described was developed to save the expensive construction of new wing walls, to economize on excavation, and to keep the roadway in continuous use. The bridge is the coke works bridge of the Bethlehem plant of the Bethlehem Steel Co.

The bridge, 62 ft. out to out of walls, is crossed by double railway tracks and a switch, the point of which

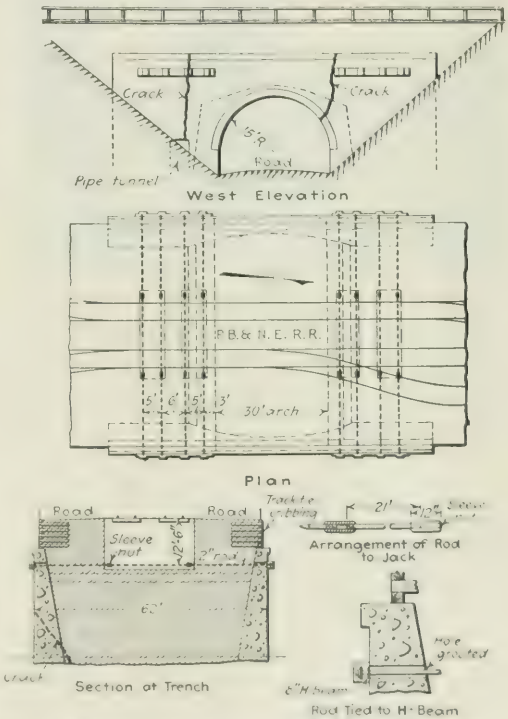


Fig. 1. Elevation, Plan, and Section of Bridge Showing Reinforcement and Reinforcing Details

is in the center of the arch. The reinforcement of the wing walls was effected through the excavation of trenches underneath these tracks and the jacking of rods through the remainder of the fill and through holes in the wing walls which had previously been drilled.

The rods were put through on 5-ft. centers on either side of the arch parallel to the roadway. The trenches were dug 6 ft. wide and 23 ft. long. They were dug deep enough so that the rods could be jacked into place at an elevation of 12½ ft. below the surface of the roadway. This did not represent the distance of the tie rods below the top of the wing wall coping as the road surface had been built up considerably by the addition of timber cribbing which retained an additional fill.

The bolts were jacked from these trenches to either side of the wing walls and out through 7½-in. diameter holes drilled in the concrete wall which is from 3½ to 3 ft. 9 in. thick. When these bolts were put through they were connected at the center to a third section with sleeve nuts. It took an average of one day to jack and force each bolt through the holes as we sometimes missed the holes and had to rejack on account of the character of the fill, which was composed of refuse

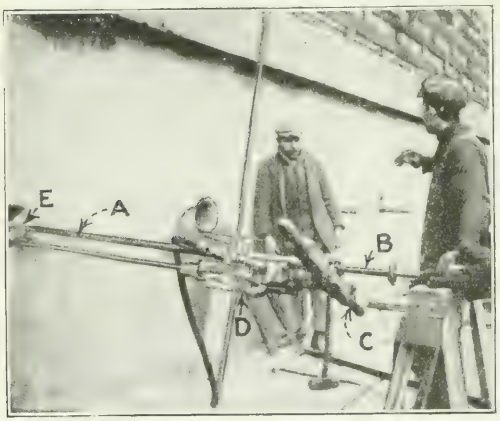


FIG. 2. AIR DRILL MOUNTED FOR HORIZONTAL BORING

from the plant, brickbats, ashes, salamander scrap, clay with large pieces of limestone, etc. Two rods were put in each trench, which was then back filled, and work started on the trench for the next pair. After the rods were jacked through the holes in the wing walls the work was completed by tying the four bolts in each set with an 8-in. H-beam and by grouting the cracks in the wall with a cement gun. The surface of the road over the arch was then spread with Tarvia to keep the water out, as freezing no doubt aggravated the trouble.

The drill rigging consisted of a drill mounted on a 1-in. pipe *A* (Fig. 2) by a band of sheet iron *B* with the handle bolted fast to the wooden handle *C*.

The handle *C* in turn was clamped to the pipe *A*. Near the forward end of the pipe *A* was clamped a guide *E*, this turning with the machine. The pipe *A* slid freely on a 1-in. rod *B*, which was long enough to reach into the core hole previously bored and back onto a horse. The cutting edge of the drill bar was about 10 in. ahead of the forward guide *E*. The drill was ground round when it rode in the guide *E* to save the strain on the ratchet.

The drilling operation was as follows: Before mounting the drill, a core hole was drilled through the wall, using a long drill bar and controlling its line and level by resting it on a guide frame. The drill was then clamped to the pipe and one man turned it continually several turns to the right and then to the left, while the other man with a handle pushed against the iron washer resting against the back end of the pipe and forced the drill ahead. We ran frequently 10 in. per hour, but averaged about 6 in. through a hard limestone concrete which at places contained some trap rock. The drill cut an annular space. In some cases we took out a 6-in. core, though generally, due to the smallness of the hole, the core crumbled.

Motor Vehicle Law Enforcement

Following the publication of the article "How Maryland Enforces its Motor Vehicle Law," in the issue of April 21, p. 666, letters were sent to several state highway engineers requesting comment. Their replies follow.—EDITOR.

By Charles J. Bennett
State Highway Commissioner, Hartford, Conn.

The motor vehicle department of Connecticut, which is not an adjunct of the state highway department, is doing excellent work by the use of loadometer jacks and also by the use of permanent platform scales. We are, however, not optimistic enough to say that we are preventing all the cases of overloading and our difficulty arises from the pirate truck that enters the State from outside with a very definite intention of violating the State law covering the loading of trucks.

Our highest limit is 25,000 lb. on four wheels, with restrictions to lesser amounts at certain seasons of the year. We can reach our own truck men and force them to live up to the law, but our greatest difficulty is with the out-of-state operator. We have installed checking stations at the State line in an endeavor to hold these trucks to a reasonable loading and are making headway against the difficulty.

There is in many cases an utter lack of principle in the operation of heavy trucks. The owner or operator fails to realize that in damaging the highway by the use of abnormally loaded vehicles he is hurting himself perhaps only a small amount, but is doing an infinite amount of damage to the property belonging to the general public.

The enforcing of the law is, of course, unpopular. While it is evidently a great benefit to the public investment, there is no agency which is particularly interested in aiding the department endeavoring to do this work, but we do have open opposition from the truck men when we try to put the truck in its proper place.

By T. J. Wasser
State Highway Engineer, Trenton, N. J.

The system of motor vehicle law enforcement in New Jersey is not unlike that in Maryland, save that we are functioning with five scales instead of two, and that all the weighing is done at these scales rather than by loadometers or jacks. The weighing is in charge of the chief inspector of motor vehicles, to whom are assigned eight inspectors who traverse the roads and bring the heavy haulage vehicles to the nearest scales. Thereupon, if the vehicles are found to be overloaded a summons is served upon the operator who is required to appear before the commissioner of motor vehicles, sitting as a magistrate.

In addition to a minimum penalty of $100 for the first offense, or a maximum penalty of $250, and double the penalty for any subsequent offense, if the load is excessive it is removed from the vehicle and placed along the highway at the owner's risk. The scales which we are using were placed at the disposal of the motor vehicle department by the state highway commission, which appreciated the necessity of removing from the highways overloaded vehicles and those inadequately equipped with rubber tires, etc.

The New Jersey Highway Commission is expending

a considerable sum of money in locating these scales at advantageous points along the main arteries of the state highway system. Every scale has a weighing capacity of 40,000 lb., and is of the modern type, discharging a weight ticket immediately the weight of the load is determined. The state highway department, and the department of motor vehicles, work in close co-operation with each other in the apprehending of violators of the overloading clause.

By Clifford Older

Chief Highway Engineer, Department of Public Works, Springfield, Ill.

There has been on the statute books of Illinois for two years a law providing for the regulation of vehicle loads, but owing to a carelessly worded paragraph in this law it has been impossible to enforce it.

Part of the difficulty heretofore has been due to the fact that the State has no police force, nor have the officials of the division of highways any authority in carrying out the law other than that possessed by private citizens. County police officials have had no particular interest in the matter, inasmuch as the maintenance in connection with all improved trunk line roads falls upon the State. It is believed that means for the enforcement of the load limit law will be provided by the present session of the Illinois Legislature.

By J. C. Finch

Acting Secretary, State Highway Commission, Albany, N. Y.

We have read the article on the enforcement of motor vehicle laws in Maryland with a great deal of interest, particularly as it deals with a subject which is of vast importance in the State of New York at the present time. We are very favorably impressed with the means adopted in Maryland for the protection of its highways with regard to limiting the weight and speed of trucks and intend to incorporate some, if not all, of these features in a recommendation to be made to the Legislature for enactment into law next year.

The New York State Highway Commission is severely handicapped at the present time because of the fact that our authority to regulate the weight and speed of trucks is somewhat limited. Our present law prohibits the operation on public highways outside of cities of an auto truck or trailer having a width of body of more than 8 ft., a height of more than 12 ft. 6 in. and a gross weight of truck or trailer and load of more than 25,000 lb., the load to be so distributed that there shall not be more than 800 lb. per inch in width of tire on any one wheel, but no distinction is made in our law between rubber and metal tires.

The highway commission at the present time finds it difficult to enforce the provisions of this law because of the fact that the law places the enforcement primarily in the local authorities. The commissioner is given broad powers in the highway law to adopt rules for the protection of highways, but the difficulty we encounter is that the commissioner must act usually through local officials.

During last season we sent out a truck equipped with loadometers which patrolled the main thoroughfares of the State and stopped and weighed a number of trucks which appeared to be overloaded, but the system did not work to the entire satisfaction of the department, because it was difficult to secure conviction, owing to certain technicalities in our law which it is not necessary to go into in this communication. We intend to continue the weighing of trucks during the coming season and will do the best we can under our handicap in the law as it is at present.

I wish to thank you for sending us this article from the *Engineering News-Record* and to assure you that it will be of considerable value and assistance to us in the recommendation which we propose to make to the next legislature for a protective law with teeth in it.

By M. W. Watson

State Highway Engineer, Topeka, Kansas

The laws of Kansas do not grant to the highway commission authority to enforce the auto license law. Our traffic regulations are very lax, and even were we vested with authority there is very little to enforce at the present time.

By I. W. Patterson

Chief Engineer, State Board of Public Roads, Providence, R. I.

I was very much interested in the article, "How Maryland Enforces Its Motor Vehicle Law," especially in view of the fact that we are endeavoring at present to secure the passage by our General Assembly of legislation limiting weights, dimensions and speeds of all vehicles which may operate upon public highways. In Rhode Island it is not a case of discussing enforcement measures, but of considering the need for legislation. As far as our law is concerned, anyone in this State may operate any sort of a vehicle with any sort of tires upon any public road. Since 1916 we have been trying to secure the passage of legislation to protect our roads from abuse by excessively loaded vehicles and by excessive tire pressures. Our attempts so far have been without success, but we are optimistic concerning the prospects of the passage of an act before our General Assembly now.

Highway Transport Needs

Every state highway department should have a highway transport division to conduct economic surveys of projected new highways, according to Prof. Arthur H. Blanchard, University of Michigan, in a paper presented at a conference on highway transport education held in Ann Arbor, Mich., Feb. 23. In determining the location of a highway, said Prof. Blanchard, it is desirable to look ahead 25 to 50 years. In the case of a certain highway traffic increased 1,000 per cent in seven years (1913 to 1920). Possible future industrial developments along the route of the highway should be given consideration. It has been found to be neither economical nor safe to build highways with a single-track paved surface and earth shoulders. The paved surface should have a minimum width of 20 ft. since a vehicle width of 8 ft. is now permitted. In many cases, of course, it will be necessary to provide for at least four lines of traffic. Prof. Blanchard cited the case of the state highway engineer of Wisconsin, who recently resigned because he was not permitted to pay adequate salaries to his subordinates, as typical of conditions which must be corrected to insure the success of the highway program. He estimated that in order to carry on the projected new highway work for the next five years there should be trained by the colleges a total of 1,500 highway engineers and 4,000 traffic men per year.

The Case Against Engineering Practice by Corporations

Prominent New York Engineers Urge Governor to Veto Bill Amending Existing License Law—Ask for New Hearing

AS NOTED in the news columns of last week's issue, p. 696, forty-nine prominent New York engineers on April 14 addressed to Governor Miller a communication requesting his veto of the bill now before him for action (Senate No. 147,716), which would specifically permit the practice of engineering by corporations and unrestricted partnerships. Most of the text of the main body of the communication follows:

We, the undersigned members of the engineering profession practising in this State, respectfully ask that you veto the bill now before you entitled, "An act to amend the general business law, in relation to the licensing of professional engineers and land surveyors, generally," heretofore known as Senate Bill 147,716.

It may, perhaps, be helpful briefly to state that originally a bill, known as Senate Bill 147, was prepared with a view to effecting several amendments to the existing law, among which were a definition of professional engineering, not provided in the present act, and the elimination of section 39-k which permits non-engineers, under the guise of corporations and unrestricted partnerships, to engage in the practice of professional engineering. Later, the bill which is now before you, formerly Senate Bill 147,716, was introduced, in which were incorporated many of the amendments contained in the first bill, but in two respects radically differing from it, in that the definition of professional engineering is rephrased in a manner which we believe to be objectionable, and the right of corporations and unrestricted partnerships to practice engineering is reaffirmed in language even stronger than in the existing act.

It will be seen that the issues are clearly defined. A very large proportion of the leading engineers resident in this State, whose practice is purely professional, and representatives of the American Institute of Consulting Engineers, the American Association of Engineers, and of the New York Section of the American Society of Civil Engineers, believing that the interests of the public and of the profession are not served in the bill before you, voiced their reasons in a petition to the Senate Judiciary Committee dated March 9, 1921, and those who are in favor of the bill spoke in their petition dated March 21, 1921, addressed to the members of the Legislature.

While the proponents of the bill before you have had ample opportunity to consider and reply to their opponents' petition of March 9, in time to reach the Legislature, it was not until March 24, 1921, that we were placed in possession of the petition of the proponents, too late to prepare and deliver an effective answer before senatorial action was taken.

Hence we beg to bring to your attention the seven points contained in the above-mentioned petition of the opponents to the bill, the essence of the replies made thereto by the proponents and our comments on the latter.

Discrimination Nullifies Intent of Law

First, the opponents of the bill allege that the intent of the law nullified in permitting groups of non-engineers—bankers or what-not—under the guise of corporations, unrestricted partnerships and joint stock associations, indirectly to do those very things which the individual non-engineer is prohibited from doing; and, it may be added, to do those things which the qualified engineers may only do after he has had his technical and moral qualifications subjected to a searching examination and after he has paid the prescribed fee.

The proponents of the bill fail to reply to this charge of discrimination, which would seem to have sufficient weight to warrant a veto of the bill on this point alone.

Second, the opponents consider that the bill sanctions a practice that easily may be made an immoral one, in permitting an aggregation of individuals, in whole or part non-engineers, to serve in the dual capacity of supposedly disinterested professional advisers to a client and at the same time as self-interested financiers, sellers or contractors in the execution and supervision of the work in connection with which such professional advice is given, such sanction being diametrically opposed to the universally recognized rule that the engineer shall not be personally interested, directly or indirectly, in a company with which he has relations on behalf of his employer or client.

The proponents say that is is impossible to discover any serving in a dual capacity, in the simultaneous performance of "the functions of design and of construction or in performing the function of design for one client and of construction for another * * *". They have missed the point. What is viewed by us with alarm is the sanctioning of a condition under which an engineering corporation may have bankers, manufacturers and contractors on its board who may so dominate its policy as to influence its management, including its engineering employees, in the preparaton of reports, plans, contracts and specifications and in the supervision of work, in such manner as to favor the outside interests of such directors to the injury of the client (the public). This is no idle fear. In the case of common carriers this practice of interlocking directorates is forbidden by law.

Loss of Professional Responsibility

Third, the opponents feel that the professional engineer in the employ of an engineering corporation or unrestricted partnership, made up in whole or part of non-engineers, is relegated to a position of anonymity or that of the servant, relieving him of all professional responsibility to the client and placing him under the direction of those whose primary interest is a banker's or contractor's profit.

The proponents mistake this point to mean that were it to have weight, even the independent engineer could not employ assistants, which, of course, is not the case. The professional engineer who signs a report or an engineering plan or specification is personally responsible. The engineer who works for an engineering corporation controlled by bankers or contractors is responsible only to the corporation upon which no equivalent responsibility is imposed by the State.

Violation of Codes of Ethics

Fourth, the opponents assert that conditions are permitted under which a group, constituted in whole or in part of non-engineers, with impunity may violate the codes of ethics which have been adopted by various professional societies for the guidance of their members and for the protection of the public.

The proponents of the bill do not reply to this, and it is therefore to be inferred that it is unanswerable. Corporations are free blatantly to advertise and to solicit patronage, while independent engineers are restrained from doing so either by good taste or by professional ethics. In fact there are well known instances of practices by engineering corporations and unrestricted partnerships which are in direct violation of the professional ethics to which some of their officers or members in their individual capacities have subscribed. This is unfair to the independent engineer and destructive of that high respect for the profession which is of public concern.

Inferiority Compared With Other States

Fifth, the opponents call attention to the fact that the holder of a license issued by this state is placed on a plane inferior to that existing in seven of the ten other states of

the Union in which licenses to practice the profession are now required, and on a plane inferior to that existing in Canada.

The proponents of the bill avoid touching on this feature and, consequently, may be assumed to find it unanswerable. It places licenses in this state at a distinct disadvantage when applying for the right to practice elsewhere. As time goes on and more states adhere to the view which we advocate, the status of the engineers of New York will become increasingly unenviable, unless we set our face against the practice of engineering by corporations and unrestricted partnerships, made up in whole or in part of non-engineers.

Lowering Dignity of Profession

Sixth, the opponents state that the dignity and standing of the profession of engineerng is lowered by legalizing that which, in the Penal Law and other laws of the State, is stamped as illegal in the cases of law, medicine, dentistry, veterinary surgery and nursing.

The proponents admit that this point of view "would to a certain extent apply" if engineering resembled the other professions named; but they say that while law deals with rights and medicine with life, engineering has to do with materials and occupies a field to a high degree less personal than the fields of law and medicine and, inferentially, less than the fields of dentistry, nursing and veterinary surgery. If this were true it should be frankly admitted that engineering is a trade devoted solely to money getting, and not a profession in the true meaning of the term, animated by an impartial spirit of service in "instructing, guiding and advising others."

It may be safely assumed that engineers generally will not accept this low valuation placed upon them by the proponents and will not submit to the charge that they are "the servants of economics or business, submitted invariably to the test and the involvements of commercial costs." The engineer, in directing the force of nature for the use and benefit of man, is a leader in the highest sense and a trustee of the savings entrusted to him by his client, the public. He must be as faithful to the principles of justice and as observant of the sacredness of human life as members of the other professions. In fact, the very purpose of the license law is to serve these ends.

If it is true, as asserted by the proponents, that "the ethics of engineering revolve about a different axis from the ethics of law and medicine," it is high time that engineers took a stand against the practice of their profession by corporations which have such a low conception of its obligations.

Detrimental to Public Interest

Seventh, the opponents consider that the bill is detrimental to public welfare in that it tends to force engineers in independent practice to abandon their purely professional work and affiliate with contracting or banking organizations, thus depriving the public of the disinterested and effective service of the men who hitherto have been chiefly responsible for the progress of the engineering art.

The proponents' reply to this is to the effect that it is desirable and necessary, in the public interest, that the engineer who is identified with the creating of large and complicated projects shall associate himself with moneyed and business groups, in order that he may have greater pecuniary and legal responsibility, especially in connection with cost-plus (assured profit) contracts for which a special plea is made, and in order that he may be better fitted for commanding a force of specialists.

From a policy of this kind, with no inhibition on interlocking directorates, as in the case of common carriers, organizations are to be expected in which the engineer shares with his non-engineer associates in the distribution of his purely professional fee, and in addition shares in the bankers', manufacturers' or contractors' profits flowing from the execution of the work which he initiates, investigates, plans and directs.

It would seem that merely to state this proposition is to condemn it as utterly opposed to public interest. No man can even-handedly serve two or more masters, neither is wealth a necessary possession of the professional man in giving efficient and honorable service to his fellows, no matter how large or complicated may be the problem.

The proponents of the bill themselves have raised several points which require answers:

It is stated that the elimination from the license law of the clause that permits corporations and unrestricted partnerships to practice engineering would put existing concerns of that nature into the hands of receivers. It is of course, understood that partnerships embracing engineers only will in no manner be affected any more than they are so affected in the other states of the Union where there is no special reference to this matter in their license laws. Several engineers united in a partnership from which non-engineers are excluded naturally have the right to refer to themselves in the plural sense if they are properly licensed. It is the unrestricted partnerships embracing non-engineers as well as engineers that, in company with engineering corporations and joint stock associations, would have to effect changes on or before May 1922. This would not necessarily mean receiverships. Where there is a will there is a way to bring about the separation of professional and business functions without financial hardship.

The opponents of the bill have no desire to prevent any proper professional practice by engineers eligible to license under the existing law. On the contrary they seek not only to protect the public and the profession by definitely fixing responsibility, but also to secure for all professional engineers a just recognition and prevent the exploitation of the profession by banking or commercial interests.

Changes in "Model Bill"

The proponents affirm that the position taken by the opponents is contrary to the provisions of the model bill (so-called) of Engineering Council and the impression is given that in so doing the opponents of the bill are running counter to the engineering sentiment of the country.

That the so-called model bill in all particulars is not to be considered as sacrosanct is prove by the proponents' own many departures from its provisions; by dissimilarities in the drafting of license bills in the other states; and by the action of the American Institute of Consulting Engineers, the New York Chapter of the American Society of Civil Engineers and the New York Chapter and State Assembly of the American Association of Engineers, in voicing their protest against the provision that sanctions the practicing of engineering by non-engineers.

It should be realized that the so-called model bill is the product of a few minds, acting in committee, and that it has not been considered in detail and passed upon by the society memberships. The engineering societies above named, we believe, are the only ones which have taken action since the issue of Senate Bill 147,716 was raised in this state. If this bill be now vetoed and time thus afforded for investigation and action by other national and state engineering societies we regard it as practically certain that a great majority of the membership of every professional engineering society will be found in opposition to the bill.

Conclusion

Shall we see the creative work of the engineer pass from his control to that of "the exploiter, the speculator, and service become the handmaiden of profit," and shall we see the door of opportunity narrowed or closed to the young engineer who looks forward to the independent practice of his profession? May we express the hope that you will answer these queries in the negative by vetoing the bill and thereby leave the existing law unchanged. Then the engineering profession will have before it an unprejudged clean-cut issue on which to go to its membership, with a view to offering suitable amendments at the next session of the Legislature.

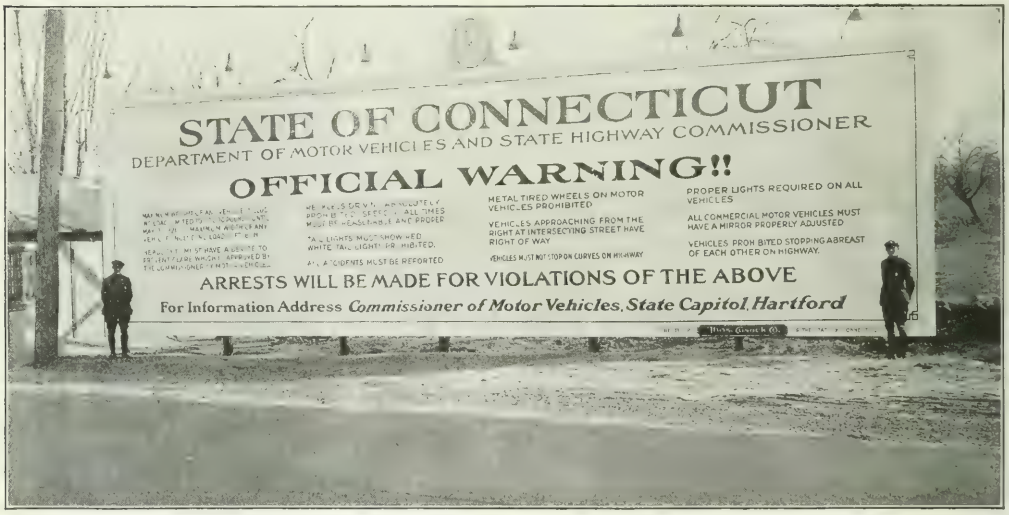
May we ask that you kindly give us a hearing at such time as you may fix so that first-handed you may see who we are, and so that we may orally supplement what we have here said with such additional data or arguments as may be required for the clarification of a matter that means so much to our profession and to the public.

State Highway Department Notes

Readers of this column are urged to send us news regarding the work which their State Highway Departments are doing. Information is particularly desired on such subjects as administrative policy, legislation, contracts, changes in design or specifications, research work, traffic studies, motor vehicle control and construction and maintenance.—Editor.

New Jersey—As part of its program for the study of subgrade failures, drainage and strength of concrete the state highway commission has ordered a large core drill for the purpose of securing samples of existing pavements which have been in service for varying periods.

Connecticut—To aid in the enforcement of the motor vehicle law large illuminated sign-boards informing drivers of the more important state regulations governing automobiles and trucks have been erected along some of the state highways, as shown in the accompanying photo. The signs are 50 ft. long and 15 ft. high. An inspector of the motor vehicle department is stationed at each sign and scrutinizes every car as it passes. If a vehicle appears to be violating the Connecticut law it is stopped and the driver is required to correct the forbidden conditions if possible or else is refused admittance to the state and is forced to turn back.



HOW CONNECTICUT INFORMS DRIVERS OF MAIN PROVISIONS OF STATE MOTOR VEHICLE LAW

At night the signs are illuminated by six 200-watt nitrogen lamps. At the present time, according to information received from Alden L. McMurtry, chief inspector of the State Department of Motor Vehicles, there are nine of these signs located on the most important highways leading into the state and it is intended to erect more as traffic over the smaller roads increases. On all routes entering the state, however, there are small signs calling attention to the more important motor vehicle regulations which must be observed. The policy of enforcement of the motor vehicle law in Connecticut is such that it is preferred not to make arrests unless conditions require that the violator be dealt with harshly. An effort is made to distinguish between violations due to negligence or ignorance of the law and those of a wilful nature.

California—Experiments in the preparation of subgrades on soils which have proved to be poor foundations for highways are to be conducted in California under an arrangement which has just been entered into between the California Highway Commission and the U. S. Bureau of Public Roads, which recently submitted an exhaustive report (see *Engineering News-Record*, March 17, p. 469, on California's highways. It has been discovered that the presence of colloidal matter, capable of extraordinary absorption and retention of water, in the clay and adobe soils of California has been responsible in large measure for subgrade troubles. Colloids have been extracted from these soils, and the result has been that the soil has been left inert and deprived of its quality of absorption. Experiments show that the colloids found in these soils are capable of absorbing and retaining water up to several hundred times the volume of the colloids.

According to a statement issued April 14 by A. B. Fletcher, chief engineer of the California Highway Commission, following his return from a conference at Washington, D. C., with Thomas H. McDonald, chief of the Bureau of Public Roads, the chief difficulty that highway engineers have found in building roads over these soils has been due to the large expansion and later contraction of the subgrade, resulting in longitudinal and other cracks in the surface slab. The attempt heretofore has been to overcome this by increasing the thickness of the surface slab.

The effort now is to be made to overcome this tendency to large expansion and contraction by neutralizing the colloidal properties of the soil and rendering the subgrade a suitable base upon which to build the concrete slab. Discussing this phase of the matter, Mr. McDonald, in a letter to the California Highway Com-

mission, has outlined the policy of the Bureau of Public Roads relative to approval for federal-aid allotments as follows:

The report of the California study made by this bureau is in your hands and you will note that the accent is all placed upon the kind of subgrade under the roads, and this we hold to be the most important consideration in the building of future highways in your state. It is the hope of this bureau in co-operation with the state highway department to carry on certain experimental and research studies in the preparation of the subgrades over those soils which have proven to be poor foundations. We believe that such studies will point the way to the construction which will prove to be adequate. There should be no contention as to minor differences in the details of design for surface construction. Minor changes in the specifications for road surfacing will not insure their future integrity. We feel that the big problem is to stabilize conditions under the surface and this is the line of research that we feel can be most profitably carried out between your department and the bureau and that these studies and experimental construction should proceed at once.

In connection with the statement of the experiments to be conducted in treating adverse subgrade soils announcement has also been made by the Bureau of Public Roads that a regional office is to be established in San Francisco, having jurisdiction over eleven states and which will exercise a large degree of authority. This office will probably be in charge of Dr. L. I. Hewes, who conducted the study of California highways for the U. S. Bureau.

North Carolina—A motor equipment field for the storage and repair of surplus war material in the form of motor trucks, tractors, concrete mixers, derricks, etc., received from the U. S. Army for state highway construction, is being built on a 3.84-acre lot 2½ miles west of Raleigh. The project consists of a 50 x 118-ft. machine shop, a 50 x 150-ft. storage warehouse, and truck sheds 50 ft. wide with an aggregate length of 1,150 ft. The truck sheds are of steel construction with galvanized corrugated metal roofing and siding. Most of the trucks received from the War Department have been rented for a nominal sum to the various counties and to contractors working on federal-aid projects; others are being used by the highway commission on work done by force account. The new motor equipment field will cost about $60,000. State convicts are performing most of the labor.

New Hampshire—Acting on the authority granted March 17 by an amendment to the state road laws, F. E. Everett, State Highway Commissioner, issued a notice, effective March 21, prohibiting vehicles of more than 3 tons gross weight from using the trunk line, cross-state, and state-aid highways. The purpose of the order, it was explained, is to protect highways during the spring thaw and will be withdrawn as soon as conditions permit.

Louisiana—A proposal to levy a tax of 2c. a gallon on gasoline used in motor vehicles operating over state highways is under consideration by the State Constitutional Convention at Baton Rouge.

Kansas—The 1921 Legislature rejected the idea of state-aid and adopted the county unit plan whereby automobile license funds are to revert to the counties in which collected for use at the discretion of the county commissioners.

Pennsylvania—Road contractors in Pennsylvania were notified to begin construction in orders issued March 31 by Colonel W. D. Uhler, chief engineer. The advanced season gave contractors a two weeks' start over 1920.

Bascule Bridge Repaired by Electric Welding

LAST year repairs were made in the operating machinery and structural parts of the South Michigan Ave. bascule bridge over the city ship canal in Buffalo (Fig. 1), in simple and effective manner by electric welding. The bridge is of the Scherzer type, of 110-ft. span, built in 1905, and has been operating continuously since that date. Wear and final seating of both the horizontal and circular operating track plates allowed the bridge parts to settle to such an extent as to cause the teeth of the rack and pinion on each side of the bridge to seat hard, reducing the clearance between tooth and tooth to nothing. This brought

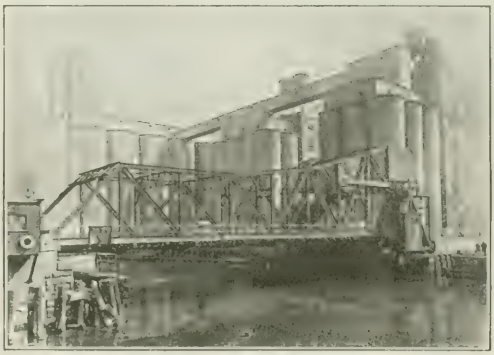


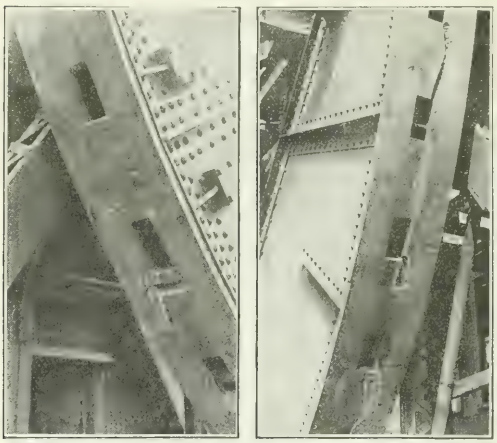
FIG. 1. SOUTH MICHIGAN AVE. BASCULE, BUFFALO

undue strains upon the bearings of the operating machinery and upon the structural members carrying the machinery, especially when pinion bearing and rack bearing were directly over each other, and ultimately broke the backs of the girders carrying the main bearings of the machinery. The bridge was thrown out of alignment and the metal of the circular 2 x 21-in. track plates fouled the lugs on the horizontal plates, cracking and breaking out the metal between the lug holes.

Repairs had to be made. The question was what was the best method of procedure. At first it was thought best to renew the 2 x 21-in. plates, but owing to the difficulty in having them made, the delays, the high costs, and the fact that the present plates have found their proper bearing, this idea was given up, and arrangements were made with the Marine Welding Co. of Buffalo to electric-weld the broken places between lug holes in the arc plates.

The usual method of electric welding was employed, namely, burning out a V-shaped trough, using the pieces broken out and building up with new metal. From the views (Figs. 2 and 3), the nature and extent of this work is clearly shown, and has proven satisfactory in every way. The job was done in three weeks' less time than would have been required for renewal, and without disturbing the bearing plates.

In connection with this work it was found that the angles to which the arc plates were bolted were cracked in the throat, in some places one-third of their length, in others two-thirds the distance between vertical angle stiffeners. These breaks were entirely through the angles, and were probably caused by the extra load brought to bear on the angles by the breaking out of the metal of the track plates between lug holes. The



FIGS. 2 AND 3. ELECTRIC WELDING OF TRACK PLATES

breaks in the angles were welded without disturbing the bolts or nuts.

As a further feature of the work, illustrating the applicability of the welding process, a broken tooth in the steel pinion between engine and main operating shaft was pinned by three pins to the pinion body and then electric-welded. The job was satisfactory in every way.

Under the main bearings of the operating machinery two new girders were put in to replace the two broken ones, and the bottom of the main bearings were planed off $\frac{5}{8}$ in. to give proper clearance between teeth in racks and pinions.

The bridge as repaired has been in service since February, 1920. In summary, a cheaper, quicker and more satisfactory job resulted than could have been obtained by disturbing the old properly seated parts. The work was done under the direction of George H. Norton, city engineer of Buffalo, and Frank D. Jackson, assistant engineer of the bridge, river and harbor department.

Tamped-in Wearing Course for Concrete Roads in Iowa

Besides the usual one-course concrete pavement a full depth slab "with a wearing course of abrasion-resisting stone forced into the surface of the concrete and made a part thereof" is provided in the 1921 specifications of the Iowa State Highway Commission. A coarse aggregate—100 per cent passing a $2\frac{1}{2}$-in. screen and 90 per cent retained on a 1-in. screen—is required. Crushed trap, quartzite or granite, or clean pebbles, are specified, with not more than 15 per cent of sandstone, limestone or other similarly soft rock and not more than $2\frac{1}{2}$ per cent of disintegrated particles, and with no sound stone having a French coefficient of wear less than eight. After the concrete slab is struck off to profile in the usual way a layer of surfacing stone is spread evenly and closely on top. This stone, it is specified, "shall be forced into the surface of the concrete and made a part thereof and the whole mass thoroughly compacted by means of any mechanical device or appliance which will force out excess water and will leave the course of abrasion resisting stone embedded in mortar and parallel to the finished surface of the pavement."

Industrial Opportunity of Federated Engineering Societies

Profession Confronted with Ages-Old Problem of Division of Fruits of Labor, and in Very Complex Form

TAKING the position that the problem of the division of the fruits of industry is one of the most important confronting the engineer—and in fact is *the* problem which most differentiates the present task of the engineer from that of his predecessors—Dexter S. Kimball, dean of the College of Engineering of Cornell University, maintained in an address at the Philadelphia Engineers' Club dinner to Herbert Hoover, April 16, that some organization like the Federated American Engineering Societies was necessary to back up the engineers in this great work. Single societies aim to serve the individual. The federation, on the other hand, is dedicated to national service, and no greater service is possible, he believed, than the solution of the major problems of industrial management.

Dean Kimball spoke in part as follows:

Division of Labor

Industry is the life of our nation, and engineering is the backbone of industry. Surely if any class of men have a right, or better still a duty, to band themselves together for the betterment of the fundamental industrial principles of our nation, engineers, using the term in a broad sense, have full justification for so doing.

There is, however, a much greater and deeper reason why we have need for a society of this kind. We are all prone to think that the problems of our day and date are peculiar and unlike any that have gone before. As a matter of fact, history teaches us just the contrary. The great fundamental principal of all civilization is division of labor: at once the most effective tool that man has ever devised, it is at the same time the cause of his greatest difficulties. Because wherever division of labor is employed co-ordinated effort necessarily follows. We know of no civilizations built up by a single individual. But with co-ordinated effort comes always the difficult problem of awarding fairly and justly the fruits of labor, and from the beginning of time men have wrestled unsuccessfully with the problem of "What Is Mine and What Is Thine." The Mosaic code, based on a much more ancient Egyption code, the remarkable code of Hamurabi and a still more ancient code recently discovered, all bear witness that this problem is very ancient. The solutions offered by these ancient codes are for the most part of a legal character, often very arbitrary and intended more as a means of keeping the peace rather than as a solution of the problem on the ground of merit and justice. And to a large extent we have inherited these viewpoints in our modern industrial codes.

Wherein does modern industry differ from these ancient civilizations? The advent of the modern machine era and the extension of the use of scientific methods have carried division of labor to a degree undreamed of by our ancestors a few hundred years ago. If the ancient civilizations were complex ours is infinitely more so and the difficulty of defining "What Is Mine and What Is Thine" has increased many fold.

Out of this chaotic condition, however, three viewpoints today stand out above all others and are well worthy of careful consideration. The first is the conviction that is rapidly taking root in the minds of thinking men that industry should be considered a means of supporting the human race, and not as a means of personal, corporate or state profit; the conviction furthermore that all men are entitled to a certain amount of physical, mental and spiritual well-being, and that the nation which can develop such well-being is the one that will endure.

The second is a conviction that no adjustment of these difficult industrial matters can be enduring that is not

based upon justice. This conviction differs from the old legal viewpoint quite markedly, and it is well illustrated in our changed point of view concerning accident compensation. For hundreds of years accident compensation was based on legal verdicts inherited by us from old English common law and having sometimes little to do with justice. The modern compensation law is an effort to adjust these matters on the ground of justice and the fair deal.

The third conviction is that there can be no justice where there is no knowledge. Any one who has read carefully the history of industrial disputes during the last few years cannot fail to be impressed with the truth of this statement. Wherever a wide knowledge of fact can be obtained adjustments usually are not difficult, but an enduring adjustment can never be accomplished where facts are not known.

The Engineer's Function

What has this to do with the work of the engineer? A very great deal indeed. A few years ago the engineer was looked upon as one who built and designed machines or structures. With the growth of his technical and scientific background it has become necessary for him to assume the management of industry and today he stands as the foremost figure in industrial management. This has brought him for the first time in close touch with the human element of industry and face to face with the great problem of the distribution of wealth.

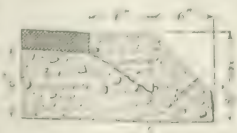
It should be remembered that the engineer in thus enlarging his field has brought with him the most powerful mental tool that the human race has devised, and which we call commonly the "scientific method." With this method he has conquered and subdued nature. At the present time is teaching the human race a better and more efficient means of organizing industry. It remains to be seen whether he can apply this method to the solution of the old-time problem of "What Is Mine and What Is Thine." It should be remembered that this problem has been wrestled with by many able minds, but it will also be remembered that many of those who have given much time and thought to the problems did not have the intimate knowledge of industry, and of those who work in industry, that is the possession of the engineer today. If he undertakes the solution of this problem with the same energy and vision that he has applied to fields that he has already conquered I am hopeful for the result.

I see, therefore, in the Federated American Engineering Societies something more than an organization to assist city, state and nation in the solution of technical problems. I see in it an opportunity for the engineer to study and to solve the last remaining problem of civilization. I see in it a means of gathering data on the industrial problem such as we have not possessed, and in a general of obtaining that knowledge which, as I have already indicated, is absolutely essential to the solution of this great problem.

Back of a movement as great as this we need an all-embracing society of engineers. The functions of such a society will differentiate sharply from those of an individual society in that the individual society is more likely to deal with service to the individual. This society is organized for service to the nation. It is a challenge to national service.

Replacing Header Curbing

Where renewal of header curbing is necessary because of wear or poor alignment the method illustrated by the accompanying sketch is employed in Pennsylvania. The old concrete is broken away along the line *abc* so as to leave a rough surface. This surface is cleaned of loose particles, then is thoroughly wetted and finally is plastered with neat cement mortar before the new concrete is placed. Until the new curb is hard it is protected from traffic.



Engineering Standards Committee Reports on Year's Work

THREE standards were approved by the American Engineering Standards Committee in its first year, or to the end of 1920, and six others were submitted to the committee for approval but have not yet been acted upon. Work was started during the year on fourteen standards to be formulated under the direction of the committee, and on twenty-four safety codes. International co-operation on standardization has also been initiated in four or five subjects. These figures summarize the activities of the committee as outlined in the committee's first annual report, which has just been presented.

During its first year it experienced a very large growth, no less than nine bodies joining in addition to the eight which formed the original committee; the working committee is composed of 47 delegates representing the 17 members. The new members are the Fire Protection Group, the National Safety Council, the Electrical Manufacturers' Council, the National Electric Light Association, the Society of Automotive Engineers, the Gas Group, the American Electric Railway Association, the Department of Agriculture and the Department of the Interior. Although the committee's income increased with the growth of membership (the dues being $500 for each representative on the committee) yet the committee reports that "a substantial increase in revenue is necessary to support and develop the work," and that "it has been decided to seek contributions from industrial associations and companies interested in standardization."

Approved Standards—The standards already approved by the committee are those of the American Society for Testing Materials for portland cement and for fire tests of materials and construction, and those of the American Society of Mechanical Engineers and the American Gas Association for pipe threads. However, as the American Society for Testing Materials amended its portland cement specifications last year, the revised specifications have been submitted for approval to supersede those already approved.

Standards Submitted—The "National Electrical Code" of the National Fire Protection Association, and the Bureau of Standards' safety code for head and eye protection have been submitted for adoption as standards. Four standards of the American Society for Testing Materials are also up for approval, these being the revised cement specification, a test for toughness of rock, a method for sampling coal, and a method for distillation of bituminous materials suitable for road treatment.

Work in Progress—Standardization work now in progress under the jurisdiction of the committee is being carried on by a large number of organizations that have been named as sponsors of the respective subjects. The subjects include: Ball bearings, limit gages, gears, machine tools, nuts and bolt heads, pipe flanges and fittings, screw threads, shafting, colors for pipe lines, elevators, rating of electrical machinery, electric terminal markings, steel shapes, zinc ores and zinc. The twenty-four safety codes in process of formulation range over a wide field from aviation and foundries to ladders and industrial sanitation.

Several of the items of work just named were the outcome of discussion at conferences embracing all

interested parties, who met to consider the desirability of attempting standardization in the field in question. A conference of government departments and technical societies was held last August to consider whether aircraft standardization should be undertaken in conjunction with delegations from various foreign governments; the conference decided affirmatively. A similar conference on elevator standardization recommended that standardization should be sought on such fundamentals as traffic characteristics, material-handling conditions, factors of safety, capacities, platform sizes, and methods of test. Mining standardization was discussed in another conference, which recommended that a general correlating committee for mining standardization be organized to guide the organization of such work.

Work on screw threads and on the standardization of shapes for structural steel proceeded from suggestions received from abroad that a considerable degree of international unification might be attainable. The work on steel shapes is, in fact, on an international basis. There is also international co-operation with a Swiss standardizing body on ball bearings, nut and bolt heads, with a Belgian society on zinc, and with the British association on gages and machine tools.

A. A. Stevenson is chairman of the American Engineering Standards Committee, and Dr. P. G. Agnew is secretary, with offices in the Engineering Societies Building, New York City.

Comparison of Three Filters Near Chicago

FEW people realize the great difference in the character of the water of Lake Michigan north and south of Chicago. A comparison of the operation of three filter plants, Evanston, Whiting and East Chicago, given recently by S. A. Greeley, consulting engineer, Chicago, before the joint meeting of the Iowa and Illinois sections of the American Water-Works Association, indicates that the north plant had little pollution and only that of domestic origin to deal with. The southern plants were greatly handicapped by the intense industrial development in their vicinity, where 500 m. g. d. of industrially used water is poured into the lake, making the water an ideal medium for the development of filter clogging diatoms, and giving it a medicinal taste from quench waters and oil refinery discharges.

Both the Evanston and East Chicago plants started with the handicap of overload reduced eventually by meters. Relative detention periods of the three plants are 1⅔ hours for Evanston, 3¾ hours for the East Chicago and 4¼ hours for Whiting. During the first, second, third and fourth months of operation at Evanston when the plant was started in 1914 the length of runs was 3.8, 5.3, 8.3 and 7.3 hours respectively. Runs of 7 to 8 hours continued to the spring of 1915, then gradually increased to several days' duration, as the rate of consumption has finally decreased from two-thirds capacity to one-half capacity. Alum application averages 0.7 gr. per gallon, seldom being increased to 0.9 gr. In January and February, 1921, the rates were 37 and 40 per cent of capacity, the runs 75 hours long and wash water 1.3 and 1.6 per cent.

At East Chicago, where the plant started last fall, the January capacity was exceeded by 25 per cent, making the runs 3.6 hours long and wash water 11.1 per cent, with 1.2 gr. of alum. In February an amount equal to the rated capacity was filtered. The runs were 6 hours long and the wash water dropped to 6 per cent, but to reduce the diatoms from 2,000 to 500 standard units 1.8 gr. of alum was required.

At Whiting an amount slightly less than the rated capacity of 4 m. g. d. was filtered, the runs being of 8 and 9.4 hours length, alum 1.5 and 1.4 gr. and lime 0.7 and 0.8 gr. per gallon for January and February respectively. One of the specific requirements of this plant was to remove by aërators the oily taste and odor. A distinct improvement is noted and there is a distinct odor emanating from the aërators.

Machine "Perforates" Timber To Facilitate Preservative Treatment

A MACHINE designed to perforate cross-ties and dimension timber before treatment by the creosoting process has recently been installed at the plant of the St. Helens Creosoting Co. at St. Helens, Ore. This machine is expected to bring the perforating process out of the laboratory and into the commercial field by doing on a wholesale scale that which has been done by hand in an experimental way for several years. The perforating process, according to the "Cross-Tie Bulletin," consists in puncturing all the exposed surfaces of the wood, except the ends, with saw-tooth holes made on lines running across the grain diagonally.

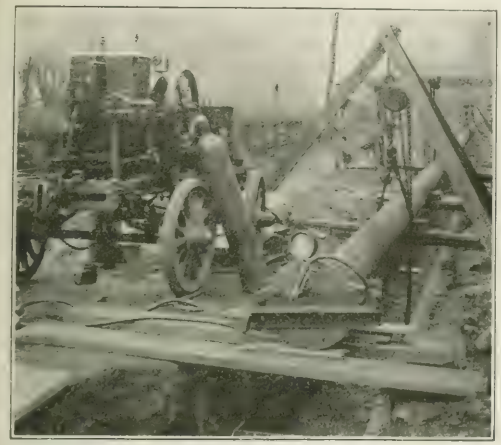
Fundamentally, the machine consists of four perforating rolls or drums mounted substantially and provided with driving mechanism. Two of the drums are horizontal and two vertical and all four have a diameter of 14½ in. The tooth spacing in the horizontal drums is 14 in. wide and in the vertical drums 8 in. wide. The axis of one horizontal and one vertical drum is fixed rigidly and both are driven by 10-hp. 440-volt a.c. motors, geared directly to the drums. The other two drums are adjustable for timbers of various sizes, the range being from 3 x 6 to 8 x 14-in. cross-sections. The adjustable drums also have flexible connections which permit of rocking or tilting as much as ½ in. to conform to variations in the shape of the timber. The adjustable drums are fitted with heavy coil springs.

Each drum contains twenty-five tooth-ways, arranged to carry the teeth for perforating on approximately 2-in. centers lengthwise of the timber. Teeth of tempered tool steel are placed in the tooth-ways with spacing blocks as required and project ⅞ in. from the surface of the drums. The faces of the drums are kept in contact with the timbers passing between them, so the teeth penetrate into the wood for their full length. The speed of the machine is such that about 70 lin.ft. of timber is handled per minute.

Based on results secured with hand-perforated timber, the following advantages are claimed for preservative treatments applied after perforation: (1) Control, reduction or complete elimination of checking in green ties and timber if perforating is done promptly after cutting: (2) Reduction of the temperatures required to secure satisfactory impregnation. This will reduce the injury to the fiber. (3) Reduction of the time required to treat ties and timber in the retort. This will reduce the loss in mechanical strength. (4) A complete and uniform penetration of the preservatives to the depth of the perforation. (5) Reduction of not over 8 to 10 per cent in the strength of the timber.

Welded Joints on a Steel Gas Main

IN THE construction of an eight-mile gas main of 12- and 16-in. steel pipe near Philadelphia, Pa., the joints are welded by the oxyacetylene process. For the greater part of the work the welds were made above the trench, the pipe being turned for the convenience of the operator in making a weld all around the joint. This method was found to be more efficient and economical than welding the pipe either in or above the trench



WELDED GAS MAIN UNDER TEST

without turning it. If its cost is taken at unity the other methods would be 1.6 and 1.3 respectively.

The 20-ft. lengths of pipe, with beveled ends, were butted together and tack welded at four points to maintain the alignment, this being done without turning the pipe. As the welder worked at a joint, the pipe was turned by laborers with chain tongs. With the filler rod and pipe ends thoroughly fused, the V formed by the beveled ends was filled with metal to about ⅛ in. above the surface of the pipe.

About fifteen lengths of pipe were welded and the 300-ft. section was then lowered into the trench. Leakage tests were made on sections 200 to 300 ft. long, both ends being closed by a steel plate fitted over a rubber gasket and secured by bolts through a ring clamp around the pipe, lugs being welded on the pipe as bearings for this clamp. A 30-lb. air pressure was then maintained in the pipe, while soap water was brushed over the joint in order to reveal leaks. Most of the sections were tight. Leaks were closed readily with the torch and could be traced usually to defective pipe or to the welders working without protection on windy days. Joints between the sections were welded in the trench, pockets being cut to enable the operator to work on the bottom of the pipe. An air test of the two combined sections was then made, the air pressure being left on all night to insure tightness of the joints.

This welding was done by the Air Reduction Sales Co., New York City. Joints made in this way are said to cost 25 to 50 per cent less than joints made with threaded pipe and couplings, and are said also to involve much less maintenance cost than the latter. The pipe line is to convey byproduct gas for the Counties Gas and Electric Co., which is a subsidiary of the United Gas Improvement Co., Philadelphia.

Hoover Outlines Principles of Government Reorganization

Each Department Must Have Single Purpose—Government Aid to Business Must Not Be Paternal

HERBERT HOOVER, Secretary of Commerce, explained his ideas regarding the reorganization of the government and the expansion of the functions of the Department of Commerce in an address at the dinner given in his honor by the engineers of the Philadelphia District, under the auspices of the Philadelphia Engineers' Club, April 16.

The main theses of the address were that "the administrative units of the government must be reorganized so as to give each of the great departments more nearly a single purpose," and that the work of the Department of Commerce must be so strengthened that "we shall concentrate and enlarge our national effort in the aid, protection, stimulation and perfection of our industrial and commercial life."

The address in part follows:

Reasons for Reorganization

There is one problem of the new administration that has received the attention and thought of the organized engineers of America for many years past. This is the problem of the reorganization of the federal government. The inadequacy, the wastefulness, and the inefficiency of our federal organization was evident enough under pre-war conditions. These inadequacies, these inefficiencies, these wastes were exhibited to the country during the war at the cost of millions.

Congress has placed the problem in the hands of a very able Congressional Joint Committee. But if this joint committee succeeds in securing the imminently necessary results it will only be by full insistent support to it by public opinion. Many attempts have been made at reorganization before but all of them have gone to the same crematory—the interminable differences in opinion among the executive and legislative officials over details.

To any student of federal organization one sweeping and fundamental necessity stands out above all others, and that is that the administrative units of the government must be regrouped so as to give each of the great departments more nearly a single purpose. The hodge-podge of aims in certain administrative branches is scarcely believable when we consider our national pride and skill in organization. Such functions as public domain, public works, assistance to veterans, public health functions, aids to navigation, to industry, to trade, purchasing of major supplies, are each and every one scattered over from four to eight departments, most of which are devoted to some other major purpose.

Economies can be accomplished from a public point of view by an elimination of the overlap in these different units of administration through unification into groups of similar purpose. The real economy to the nation, however, does not lie here, however great this may be, but it lies in their more effective functioning in their daily relation to the public. The extra cost imposed upon business in general in the determination of the relation of any particular business to the different functions of the government, with the unnecessarily duplicating interferences and demands, is a real charge on national wealth, probably as great in some directions as the actual costs of the administrations themselves.

Of equal importance with economy is to secure effective concentration of government effort into service to the community. No constructive vision or policies can be built around a national service directed by from two to ten Cabinet members, more especially when this particular purpose is a side issue to all of them.

We have also some confusion between executive, advisory, and semi-judicial functions. One of the tendencies of government both local and national during the last twenty years

has been to add executive functions to commissions and boards created primarily for advisory or regulatory purposes. It requires no argument with our business public that the executive functions can not rise to high efficiecy in the hands of government boards where from the very nature of things each member has a separate responsibility to the public and is primarily engaged in a semi-judicial function.

Furthermore, during the last few years there has been a great growth of independent agencies in the government reporting directly to the President until his office is overburdened almost beyond the point of endurance. The original and sound conception was that the executive functions should be reported up to the President directly through his Cabinet officials. Not only do these outside functions today overburden the President but they render co-ordination with executive departments extremely difficult. It is neither possible nor advisable to place all these outside organizations into the departments, but much could be done to mitigate the situation.

Department of Commerce

I have daily evidence in the Department of Commerce of all these forces. The question of governmental aids to navigation is not by any means one of the principal functions of our government, but it must be a sore trial to the hardy mariner. He must obtain his domestic charts from the Department of Commerce, his foreign charts from the Navy Department, and his nautical almanac from the Navy Observatory—and he will in some circumstances get sailing directions from the Army. In a fog he may get radio signals from both the Navy and Commerce, and listen to foghorns and look for lights and buoys provided him by Commerce; if he sinks his life is saved by the Treasury. He will anchor at the direction of the Army, who rely upon the Treasury to enforce their will. His boilers and lifeboats are inspected by the Department of Commerce; his crew is certificated by one bureau in Commerce, signed off in the presence of another, and inspected at sailing by the Treasury, and on arrival by the Department of Labor.

The moral of all this is that economy could be made by placing most of these functions under one head, not only economy to the government but to the mariner. Congress would know what it spends in aid to navigation and the government could develop definite policies in giving proper assistance, and lastly could remove from the hardy mariner's mind his well founded contempt for the government as a business organization.

The economic changes in the world, growing out of the war, and their reflex upon our trade and industry make it vital if we are to maintain our standards of living against increasing ferocity of competition that we shall concentrate and enlarge our national effort in the aid, protection, stimulation and perfection of our industrial and commercial life. There can be no real Department of Commerce or commercial policies to these broad purposes so long as the instrumentalities of the government bearing on these questions lie in half a dozen departments.

We want no paternalism in government. We do need in government aids to business in a collective sense. In a department we do not want to either engage in business or to regulate business. We need a department that can give prompt and accurate diagnosis from both a foreign and domestic point of view of economic events, of economic tendencies; of economic ills; that can promptly and accurately survey economic opportunity, economic discrimination and opposition; that can give scientific advice and assistance and stability to industry in furnishing it with prompt and accurate data upon production, supplies and consumption; that can co-operate with it in finding standards and simplifications; than can by broad study promote national conservation in industry and the elimination of waste; that can study and ventilate the commercial side of our power possibilities; that can study and advise national policies in development of rail, water, and overseas transportation; that, in fact, covers, so far as government functions can cover, the broad commercial problems of trade, industry, and transportation. This can be accomplished more by co-ordination of existing governmental facilities than by increased expenditures.

Notes From Foreign Fields

BARRANQUILLA, THE KEY CITY OF COLOMBIA, SOUTH AMERICA

By George C. Bunker
Sanitary Engineer, Balboa Heights, Canal Zone

Like many other South American cities Barranquilla, Colombia, has grown so rapidly in the last few years that it is decidedly congested. It feels keenly the lack of houses, dock facilities, public utilities, paving and sewers and an improved water supply. Its geographical location near the mouth of the Magdalena River, the commercial highway of the whole country puts it inevitably into a key position. Already 80 per cent of the foreign commerce of Colombia passes through the city to and from the interior. Three years ago there were four banks; now there are eleven, some operated by Colombians and others recently established to assist foreign trade as branches of American and Canadian institutions.

The port for Barranquilla is Puerto Colombia, which is connected to the former by an 18-mile railroad owned by an English company. Steamers of 14 lines call at this port for passenger and freight traffic. One well-built pier, extending out into the harbor for one mile accommodates four ships. It is entirely inadequate, for during the current year there has been such a congestion of freight on this pier, due to the lack of warehouses and of rolling stock to handle the unusually large incoming shipments of general merchandise, that it has not been unsual for ships to lay at anchor for several days waiting for some other steamer to move away from the pier. The loading and discharging of cargo as well as its transfer to Barranquilla proceed slowly.

Engineers and others who are called upon to make a trip to Colombia are advised to take all instruments and material as baggage, in cases provided with handles and not weighing over 250 lb. each. Excess baggage is more expensive than freight but it will pass through the Custom House with comparatively little delay.

When the bar at the mouth of the Magdalena River has been dredged ocean-going steamers may discharge and load their cargoes at piers built opposite the city. The necessary surveys of the lower end of the river have been made by American engineers and the plans of the work will be delivered to the promoters before the end of 1920.

From the Plaza Bolivar in the business district on low ground near the river there is an easy slope to a ridge of low hills although high enough to take advantage of the trade winds. The urbanization of a section of these heights which overlook the river and ocean was started two years ago by an American mining engineer, K. C. Parrish, with the result that a considerable number of fine modern residences have been erected, together with well laid out streets, cement side walks and gutters. In this section tarvia-covered macadam roads have eliminated the dust, the mosquitos are not so annoying and the air is much cooler than in the lower part of the city.

No Paving or Sewers—The streets are unpaved, with the result that one moves in an atmosphere of dust. As the houses are built close to the sidewalks a large amount of dirt is carried through the rooms by the air currents.

The covering of the nose by men and women, as they walk and ride, to prevent the breathing in of the dust is a common sight.

There is no sewerage system. In the business section a few private sewers discharge into the canal, and in the *patios* of the better class of houses, large cesspools or septic tanks have been provided as receptacles for the toilet flushings and waste water. They are cleaned at intervals of one to four years, depending upon the size of the tank and the number of inhabitants in the house.

On some of the streets in the business section the storm water frequently rises above the sidewalks and is kept from running into the stores only by the use of planks inserted on the door-sills. In general the sidewalks have been built high enough to avoid flooding, but the street intersections are generally so low that it is impossible for the pedestrian to cross from one side of the street to the other without making a detour of one or more blocks.

Both pavements and a sewerage system are under consideration, a survey of the city having been made by American engineers during the first half of 1920. As in the States many desired and necessary improvements in Colombia are delayed for lack of funds. It seems probable that these improvements will be started in 1921.

Several motor bus companies operate in competition with the mule-drawn street cars and carry most of the people who ride. Coaches and jitneys are also available. The number of automobiles is steadily increasing although the mileage of suitable roads is small. Projects are on foot to build a road to Cartagena, 90 miles to the west, and work has been started on several routes up and down the river and into the back country.

Building Materials—The city is underlaid with a limestone formation, covered with a thin layer of sand in the higher sections and a deep layer in the lower sections. Consequently sand is readily obtained for building purposes. Rock for concrete is difficult to obtain in large quantities and of suitable size, as there is only one small crusher and the limestone must first be broken by hand. Gravel is not available in the immediate vicinity. Cement has to be imported but lime is made in rough native kilns.

Native-made bricks of poor quality and of low strength are used almost exclusively in building construction. Both the interior and exterior walls of the buildings are plastered over. The supply of native lumber is insufficient to meet the demands of the building work and is imperfectly seasoned, the logs going almost directly from the canal through the sawmill to the consumer. A seasoning kiln will soon be installed. Bricks are generally used for roofs instead of tiles, two layers laid upon wooden rafters being used. A large number of the older houses are covered with thatched roofs made of palm leaves, and as they are cheaper than the brick roofs they are still used to a limited extent. Pre-war wages of from $1.20 to $1.50 for native carpenters and masons for a 10-hour day have risen to from $2 to $3 for an 8-hour day.

There is a small hospital operated by American doctors and a company has recently been formed from local capital to build a larger one. It is estimated that the sum of $1,500,000 is carried to Panama yearly by Colombians who go there for operations and treatments.

In presenting this article the writer desires its readers to understand clearly that he has endeavored to give an impartial review of conditions as he has seen them during visits in the latter part of 1919 and in June and August of 1920. His unfavorable criticisms are made neither as "knocks" nor in an unfriendly attitude toward Colombia, for in truth he feels kindly disposed toward that country and counts a considerable number of Colombians as warm friends, men as courteous and honorable as one may wish to meet in any part of the world. Many unfavorable conditions are noted but the outstanding features are that sanitation has taken an upward trend in Colombia and that Barranquilla has given a strong impetus to the movement by the disinfection of her water supply and the decision to erect a purification plant.

Board Finds Columbia Basin Cost Estimates Are Low

THE Columbia Basin project, a plan for the irrigation of 1,753,000 acres in the state of Washington, which was described in *Engineering News-Record* Nov. 11, 1920, p. 944, has been reviewed by a board of engineers appointed by A. P. Davis, director of the U. S. Reclamation Service. The board consisted of D. C. Henny, James Munn and D. T. Pearse; their work included both an analysis of the report submitted by the Columbia Basin survey commission and a field examination of the points where the principal engineering works are proposed. Their findings as submitted to the director of the Reclamation Service comprise 21 typewritten pages and, in the main, state that while the estimates of the commission are low, the project should receive further study. The engineers who made the studies and prepared the report for the commission are commended highly.

In commenting on the commission's cost estimates, which are $190 per acre for land ready to start farming, the reviewing board states that (a) it may not be possible to place sagebrush lands in the hands of the irrigator at the price estimated; (b) the cost of preparation for much of the land will be more than is estimated; (c) the incoming farmer will probably be unable to buy much of the land heretofore cultivated at from $18 to $20 per acre; (d) additions must be made to construction costs.

Considering the three projects investigated, the data is compared in tabular form and the comparative advantages discussed. No conclusions on the financial and organization plans are given, the opinion of the board being that these would be premature at present and should await the completion of the commission's supplemental report. In recommending further engineering studies, which the board urges should be undertaken at an early date, the feasibility of the Columbia River dam should be determined; consideration should be directed particularly toward laying out canals so as to use natural stream beds as carriers, thereby relieving high line canals from part of their load; and the advisability of including lands south of the Snake River and in other outlying areas should be weighed carefully.

If further action is required before financial plans are finally developed and feasibility has been considered, the board recommends that $150,000 be provided for further studies and that of this $50,000 might well be used for Columbia River dam site borings and related work, the expenditure of the balance being conditioned upon the resultant comparative showing of the gravity and the pumping projects.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

A City That Is Recognizing Engineers

Sir—If you would like to tell the readers of *Engineering News-Record* about a city that is recognizing its engineers, tell them about Memphis. Recently one of our city commissioners resigned and an engineer was appointed to fill the vacancy. This makes two engineers on the city commission of five. In addition, Memphis has the following engineers in important offices: city clerk, chairman water-works commission, city engineer, assistant city engineer, superintendent of water-works and city sanitary engineer. All of these men are engineers of standing who have the full confidence and respect of their fellows in the profession. All of them are members of the Engineers' Club of Memphis.

The engineer-commissioners are Major Thos. H. Allen (formerly Capt. Allen, 306th Engrs.), commissioner of fire and police, and Harry Northrop Howe, commissioner of streets and bridges. A. L. DABNEY.

Memphis, Tenn., March 25.

[Some reflections suggested by the foregoing letter will be found in our editorial columns.—EDITOR.]

The Belle Isle Bridge and the Status of the Engineer

Sir—Engineers are supposed to be professionally competent to direct the use of materials and men in a safe and economical manner; to produce definite results devoid of the element of gambling or "taking a chance" with a client's money in experimental directions without full advice to the client.

It has been said that all engineers look alike to the layman; and from recent articles in *Engineering News-Record* in relation to the Belle Isle Bridge at Detroit it does not appear that any exception need be made of Detroit citizens who selected the consulting board for the Belle Isle Bridge.

It appears that the consulting board was not partciularly pleased with the foundation prospects—that they were not sure of the footings, so they made some borings and tested *a* pile. The test shows that under a steady load of 20 tons the pile settled progressively for 32 days without coming to rest; and without testing a group of piles to determine whether the load per pile should be more or less the consulting board decided that a load of 18 tons per pile would be safe.

That looks like taking a chance, or gambling on one pile with a $5,000,000 structure at stake.

It would be difficult to select a type of construction more destructive to yielding or pile foundations than the cantilever design used in this case. The alternating and rolling action produced by the moving load may be compared to that of the rolling bascule bridge that has been destructive to several foundations in this country after safely sustaining a greater stationary load.

With the loads provided for in this structure the maximum rolling action or moment will be 9,130 foot-tons to the right and to the left, or a variation in load on the outer row of piles under the 135-ft. spans, amounting to 304 tons, which could be reduced to 62.25 tons by common construction. This is gambling on the safety of a confessedly suspicious foundation.

If the hearts of the engineers, architects and the people are set for a cantilever bridge, and this novel type of a cantilever bridge, the stresses on foundations and cost of construction can be materially reduced by using shorter arms and longer suspended spans, with distinctly better conditions in service at the hinges.

On the foundations which it is admitted can have a factor of safety of only about one, it is proposed to construct a superstructure with a factor of safety of four. Can any engineer give a plausible reason for such a combination?

The doubt of the consulting board regarding the foundation conditions is apparent from reading pages 55 and 56 of their report, and regarding the superstructure we find their first recommendation "that it should be as light as possible."

In the design submitted for construction we find nine steel ribs formed into imitations of arches and covered with a masquerade costume of concrete weighing probably four times as much as the steel alone. For economical construction and lightness, less than half the number of ribs should be used and the concrete be replaced with a coat of paint.

In numerous combinations of structural steel shapes and concrete the results have not proved satisfactory. As an example see the report on Third St. Bridge in Dayton, Ohio, in *Engineering News-Record*, March 24, 1921, p. 511. in which it is estimated that 85 per cent of the surface of steel was exposed to corrosion by failure of concrete to adhere to the steel. Note from the report that while this bridge is only sixteen years old the "steel ribs are decidedly rusty" throughout the structure and that their location is clearly evidenced by cracks, leaking water, streaks of rust on the surface and by the scaling off of the concrete exposing the steel. For this condition the engineer admits he can see no remedy and that it "will limit the life of the bridge to comparatively few years."

While concrete is easily one of the most valuable materials of construction, it can only serve the engineer particularly well when used in compression. It is too heavy for a costume, or for a mantle to cover a skeleton, and give it the solid appearance of an arch, and it is not an ideal substitute for paint for protecting steel.

It now appears that the artistic temperament that was to be satisfied by the deception practiced in this freak design was due to cost the taxpayers about $2,000,000, or the same engineers could not have undertaken the commission to redesign the structure and retain the same length, width, height, strength and general appearance for $2,000,000 less than the prices bid upon two previous occasions.

If the client received competent and loyal service in each case it is but fair to expect that when the first set of proposals amounted to over $5,000,000, the client was advised that $2,000,000 of that was for decorations. If the client was not so advised until an outside engineer forced the issue, what confidence can the layman now be justified in placing in the engineers? In which case were they true to their trust?

Is the Detroit Engineering Society upholding the standards of engineering or slaughtering the reputation of engineers generally by countenancing such procedure?

Chicago, April 13. J. W. PEARL.

Sir—The whole question of the Belle Isle Bridge goes back to the foundation problem, and unless this is successfully solved the bridge will be unsatisfactory no matter what the nature of the superstructure. The foundation should, if possible, be designed to stay put and not to settle. A foundation on piles is a cheap substitute for a rock foundation and it may or may not be entirely staisfactory. In some localities it is the best foundation obtainable. Heavy structures in New Orleans are now built on piles and some settlement is always expected. An inch or more of settlement is not serious when all the footings settle alike. It might be wise for the Detroit City Council to consider sinking piers to bedrock, using open reinforced-concrete caissons such as are now being put down for the new highway bridge across the Missouri River near Bismarck, North Dakota.

If the opinion of the commission that a pile foundation is the only practicable solution be accepted, the two designs now before the council may be compared on the basis of the merits of the superstructure. In either case, substantial settlement of one foundation pier without equivalent settlement of the other piers at the same time would destroy the

alignment and call into play large indefinite stresses which in the official design would be concentrated on the 6-in. pins connecting the ends of the umbrellas and on the two 2-in. foundation bolts. In the Luten design these stresses would be more evenly distributed throughout the structure, which is well reinforced.

The question of lateral thrusts against the foundation piers seems to be met in the Luten design by cleverly balancing the arches, and any possible unbalancing due to uneven settlement would be taken care of by the inclined piles.

Comparing the designs I note that in the use of materials the Luten design is very skillfully economical, while the official design is not very clever in this respect, due to the limitations under which it was made. The Luten design with its wide mat and well reinforced pier is strong and light. The official design is heavier and weak at the crown joint and at the piers. In appearance the Luten design with its secondary arches is more attractive than the official design, and in cost the Luten design again has the advantage. It is a clever piece of engineering and by no means a cheap substitute.

The Detroit City Council is in a dilemma. It must either get more money for this project, or wait until prices go down enough to bring the cost of the official design within the means available, or abandon the official design and adopt one that can be built now with the fund on hand.

I have never met Mr. Luten and he does not know me, but it appears from the material published that he has done the City of Detroit a real service by submitting his design.

On the ethical side it is quite as much to be regretted that an engineer should allow a client to get into a dilemma as for a doctor to allow a patient to get so sick that some other doctor is prompted to suggest a proper remedy.

Minneapolis, Minn., April 15. WILLIAM B. NEWHALL.
Consulting engineer.

Higher Stresses for Bridge Pins

Sir—I appreciate the comments made by A. W. Carpenter in your issue of April 14 on my article on "Higher Stresses for Bridge Pins," which appeared in the March 24 issue. Permit me to offer a few words in reply.

Mr. Carpenter objects to my designation of the test specimens as "comparatively short beams." The tests cited in my article covered pins or cylindrical beams ranging in length from 2 to 16 diameters. The lower ratios in this range certainly constitute "short beams," to which the common theory of flexure is not strictly applicable. As the length-ratio increases, the test results approach the normal values for long beams. When the slenderness ratio reaches 16, my proposed formula

$$K = 40{,}000 - 1{,}000\ l/d$$

would give a designing stress of 24,000 lb. per square inch, which is the value allowed in present specifications.

No one can state at what ratio of length to diameter a pin becomes a "long beam." The designation is, after all, immaterial. It is the test results that count. No matter what the theoretical explanation may be, the fact remains that the tests cited showed ultimate bending resistances greater than that which the common theory would indicate, the excess rapidly diminishing as the pins became longer. With a factor of safety of 5, the results of the tests gave the working formula quoted above.

I regret, with Mr. Carpenter, that editorial limitations of space necessitated the omission from my article of information regarding the details of the tests. Exact references by page and volume to original sources were given, however, so that the interested reader could secure the desired information at first hand.

Mr. Carpenter is right in questioning the justification for suggesting that the elastic limit points follow inclined lines. I disclaim responsibility for the lines in question; they were inserted through a misunderstanding and erroneously designated by the *Engineering News-Record* draftsman.

None of the tests cited produced actual rupture. The ultimate strength was taken as the load producing a deflection too large for structural security.

The case for higher pin stresses does not rest on laboratory tests alone. Many bridge engineers know of pins in actual structures having calculated fiber stresses over 80,000 lb. per square inch. The other day W. H. Burr told me that he personally figured stresses as high as 200,000 lb. per square inch in the pins of the former railroad bridge over the Hudson River at Albany.

There is little to be gained by any further elaboration of the subject matter of my article as suggested by Mr. Carpenter. Full details of the tests can be found in the original sources cited. The results seem conclusive so far as the data extended. What is needed now is a more comprehensive series of tests, scientifically arranged and carefully analyzed, under the auspices of one of the national engineering societies, in order to throw more light on some of the important questions involved. D. B. STEINMAN,

New York, April 15. Consulting Engineer.

Perforated Pipe Filter Underdrains

Sir—The article in your issue of Jan. 27, p. 162, by Harry N. Jenks, entitled "An Investigation of Perforated Pipe Filter Underdrains," is an interesting and instructive one. Where the observations and conclusions relate to the perforated pipes themselves Mr. Jenks appears to be on perfectly safe ground. On the other hand, the placing of the gravel about the perforated pipes and the experiments showing a uniform disturbance of a thin layer of sand do not insure a perfectly satisfactory filter underdrain system. It appears to be a relatively simple matter to produce a filter underdrain system as Mr. Jenks has done, which will yield a fairly uniform backwash if the sand above it is always in a condition to take it so (which would be the case with a 3-in. layer of clean sand), but unfortunately this is not a typical practical case. Actually one part of a bed of dirty sand in a filter is more easily lifted than another. When such lifting does take place over or near a particular orifice all the orifies around about will also contribute water by cross communication in the open gravel and a progressive disturbance of the gravel at its contact with the sand will take place with failure at some period later. This phase seems to be aggravated in Mr. Jenks' design by the open spaces under the pipes and the considerable depth of coarse gravel. Curiously enough, Mr. Jenks considers this to be of importance in the opposite way. I believe that in this type of underdrain system the coarse bottom gravel should be quite shallow, of depth just sufficient to cover the pipes, and be composed of rounded stones from ¾ to 1-in. maximum dimensions or less. In this way cross communication is reduced to a minimum.

At the edges and corners of a filter underdrain system of this type experience shows that the loose gravel slowly but surely creeps up the sides of the filter and this tendency is greater at the corners. WILLIAM GORE,

Toronto, Ont. Consulting Engineer.

Sir—The sizes and depth of gravel to be used in conjunction with the perforated-pipe underdrain system of water filters, discussed by Mr. Gore above, is a subject of much interest. It is also one which does not lend itself readily to experimental study on a small scale, as the factors involved are largely indeterminate.

The criticism regarding the grading of the gravel and particularly the maximum sizes of stones to be used in the bed appears to be well taken. In such matters there is always room for considerable difference of opinion as well as materially different methods of securing the desired results. The use of 3-in. cobbles along the pipes themselves, and of graded gravel from 2½ to 1½ in. in size in the intervening space up to a plane about 3 in. above the laterals, is recommended more especially to serve as a foundation for the upper layers, and in order to prevent the lodgement of gravel underneath the pipes with the possible choking of the orifices. The writer is convinced that the deep gravel bed is highly desirable, not only because of the progressively better diffusion that takes place as the

depth increases, but also on account of the added stability secured, considering the bed as a foundation for the sand above. The tendency of current practice is evidently also toward the use of deeper gravel beds than formerly obtained.

As to the grading of the gravel, considerable latitude may indeed be allowed. The writer can see no objection to using a smaller gravel than the one proposed. In fact, experiments made subsequent to the underdrain studies on a full-size cross-section of filter bed showed that it might be advisable to increase the thickness of the top layer of finest gravel to 5 or 6 in., omitting 2 or 3 in. of the coarser material. It is believed that the true function of the finer gravel at the top of the bed is to prevent the sand from working its way down to the underdrain system; it should be of sufficient depth to act as a stable sustaining medium, but should not be so fine as to be lifted along with the sand. To determine this matter more definitely, it is proposed to test a full-size unit of the Sacramento plant before placing in operation.

Referring to the cross-communication mentioned by Mr. Gore, it appears doubtful whether material that would come under the definition of "gravel" would actually prevent the water from passing from any point to any other within the bed, because of the very low loss of head through gravel.

Discussion of this subject; and particularly experimental data, should prove of much value in the perfecting of a type of filter underdrain which possesses so may inherent advantages.

HARRY N. JENKS,
Sacramento, Cal., March 21. Filtration Division.

Sir—With regard to the article by H. A. Jenks in *Engineering News-Record*, Jan. 27, p. 162, on "An Investigation of Perforated-Pipe Underdrains," I think all engineers have long realized the advantages of thick beds of gravel, 18 in. and even greater in thickness. The greatest value of the experiments at Sacramento is that they reduce to figures the relation between gravel thickness, gravel size, size of laterals, length of laterals and perforations. Once this has been done, one wonders at the great length of time we have been willing to worry along without these data, simply basing design on previous practice.

One reason why basic factors of design are not more frequently determined than they are, is because engineers have such difficulty in persuading their clients to spend reasonable amounts on preliminary investigations. In this case the engineers have been very fortunate in inducing the city of Sacramento to approach its water supply problems on a rational engineering basis.

PAUL HANSEN,
Chicago, Feb. 21. Consulting Engineer.

Selling Cement Through Dealers

Sir—I read with interest an editorial comment on page 410 of your issue of March 10, entitled "Indictment of Cement Companies."

I believe it is a fact that no contractor can purchase cement except through the local dealer, it making no particular difference whether the contractor's job is large or small. If the contractor should purchase through a cement company that did not have an agent in the particular locality, the cement company would charge the contractor a market price and then look for a dealer in the locality to handle their brand, using as an argument that they have sold direct and the dealer might just as well have the benefit of the dealer's discount. The dealers we believe receive all the way from 5 to 20 cents a barrel and in some cases more. This, on large contracts, adds materially to the expense of the contract.

We do not think that this is a proper way of doing business between large contractors and the cement mills. Everyone knows that at the present time the price of cement is exactly the same from any mill and it looks as if there must be an arrangement between the various mills in order to assure themselves uniformity in price.

Do you know of any reason why contractors should pay local dealers commission as above outlined?

Springfield, Mass., S. M. GREEN,
March 31. President, Samuel M. Green Co.

[The following letter sent by the Atlas Portland Cement Co., in response to an inquiry similar to that of Mr. Green, gives one cement company's position on selling through dealers. It is, we believe, representative of that of other cement manufacturers as well.—*Editor.*]

"You ask if we sell to contractors by carload or if we are tied up by agreement to sell only to dealers. We certainly are not tied up by an agreement of any kind, but it is our policy to sell through the dealer, and we are quite sure that when you understand the analysis of our business you will feel it has been a sound policy.

"We distribute on an average ten million barrels of cement a year. Of this amount 60 per cent is sold to dealers throughout the country, goes into their warehouses, and is shipped in small lots by them to customers unknown to us. We estimate that about 5 per cent of the balance of our output goes into government work. The remaining 35 per cent is shipped on contracts placed with dealers.

"Now the question you would naturally ask is: 'Why do you ship on these contracts through the dealer instead of direct to the contractor?' We believe that fully half of this 35 per cent is controlled by the local dealer; he is better able to judge of the credit; he sells the contractors sand, gravel and other building materials; and he performs a service that entitles him to that business, and oftentimes has influence that would prevent our getting it even if we attempted to. On the other half of the 35 per cent we believe that we could go and get the business direct from the contractor but we do not do it for the reason that it is good business to give the dealer the 17½ per cent because of the 75 per cent which he gives us.

"We do not believe we could buy a suit of clothes, or a hundred suits of clothes, to wear, direct from Hart, Schaffner & Marx. They would refer us to one of the dealers who handled their brand.

"We believe that it cannot be the policy of sound dealers—and most of the Atlas dealers are sound—to make their margin of profit too large. You must remember, however, that oftentimes their cost of doing business is high and that they hold an organization that is expensive, especially when business is light. We dare say that there are abuses, and that last year when cement was scarce in some locations advantage was taken of this and too high a price asked; but it will not do in the long run for any dealer to assume that attitude, because, if our judgment is correct, it will be far better for him to stimulate buying and get the volume than to expect to make too much on one transaction. The wise dealer who adopts that policy will get most of the business and build up a trade that will make the other fellow pretty uncomfortable.

"We think that you will find upon examination that the prices we have secured as a manufacturer have been fair, and that the price of cement has not gone up so much as the average of other building materials. The Atlas company could have sold hundreds of thousands of barrels of its cement last year at a dollar a barrel, at least, more than it asked. We did not refuse this business from any highbrow point of view but because we thought it was better to take care of our regular clientele and maintain our reputation for dependability, than to make an extreme profit over a short period of time."

Filtration of Great Lakes' Water

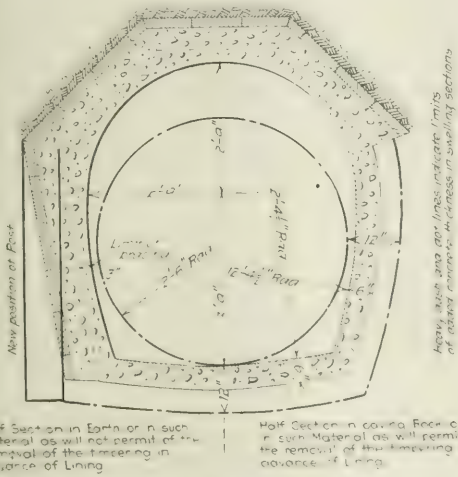
Sir—In an editorial note appearing in your issue of March 24, p. 492, on "Filtration of Great Lakes, Water," you state that in the adoption of filtration "Cleveland led the way." Although in your opening sentence you qualify your statement by the word "large" and although later on you say that many of the smaller cities on the Great Lakes adopted filtration before the larger ones, yet it seems likely that many of your readers may not catch these qualifying words and that therefore injustice may be done to the city of Erie, Pa., which has had a 24,000,000-gal filtration plant in successful operation for the past eight years. In fact, the Erie plant was in use before Cleveland began to mature its plan for filtration.

J. N. CHESTER.
Pittsburgh, Pa., March 26.

HINTS FOR THE CONTRACTOR

Circular Forms and Tamped Concrete Hold Swelling Tunnel Ground

IN CONSTRUCTING the San Pablo tunnel, a 14,000-ft. bore driven to carry water from the San Pablo reservoir to the west side of the Berkeley hills near Oakland, Cal., the line occasionally traversed a serpentine formation that would swell after being exposed to the air. Where this condition was met 12 x 12-in. segments and posts were substituted for the 6 x 8-in.



SECTION SHOWS TUNNEL LINING ORDINARILY USED AND THAT EMPLOYED IN SWELLING AREAS

timbers otherwise used, the spacing between sets was reduced to 18 or 24 in., and lagging was omitted. As the ground swelled and came in between the timbers muckers picked it out from between and behind the sets, thus relieving the pressure. After a period of about ten days to two weeks the swelling action ceased. The cessation was ascribed to the penetration of the air into the material as far as it would go and the stabilizing of the strata under the new conditions.

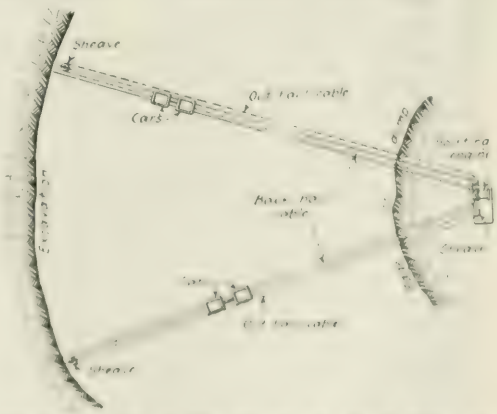
A more difficult situation was encountered, however, at a point about 2,700 ft. from the west portal. Here there were two stretches, 110 and 232 ft. long respectively, where the swelling showed no tendency to decrease after the lapse of the usual time despite the large amount of material that was continually taken out. Moreover, in these sections the methods previously successful could not relieve the pressure fast enough. The material crowded in from all sides as much as 2 ft. in 24 hours and several times wrecked the track, as well as air and water lines. The timbers could not be replaced fast enough to hold the tunnel, and the engineer's report on this part of the work states that "the crushing and rumbling of these timbers was deafening." Operations at the heading were then closed down and concreting was commenced.

The method used by the concreting crew at the swelling sections was to timber ahead for a length of 30 to 60 ft., setting the timbers back far enough to allow 12 in. for the concrete lining and 2 to 3 ft. for the swell of the material. Concrete forms, consisting of 5-ft. corrugated-iron pipe, delivered to the job in semicircular sections 5 ft. long, were then set to grade and a mixture of 1:3:5 concrete, mixed "rather stiff," was rammed and tamped in place. Twenty to thirty lineal feet of lining was placed in this way by each shift. The timbers were left in place, of course, as there was no means of removing them after concreting. Both stretches of the continuously swelling earth were successfully lined in this way, and no damage to the concrete due to pressure was reported during the period of setting. The tunnel was made in horse-shoe section, 5 ft. 6 in. wide and 6 ft. 6 in. high for convenience in driving, but the 5-ft. pipe used in the swelling sections is expected to afford ample capacity for the maximum flow of water.

The work was done for the East Bay Water Co. by the Bates & Borland Contracting Co. George W. Hawley was resident engineer for the water company.

Cable Haulage for Dump Cars

In distributing about 7,000 cu.yd. of excavated material with a haul of only a few hundred feet a cable system with dump cars was installed to eliminate the use of teams. Two 24-in. tracks were laid from the excavation to converge at a hoisting engine, the tracks serving a triangular area about 250 ft. wide and 300 ft. long. On each track were two 1½-yd. dump cars coupled together. A ¾-in. cable led from the head of one car to a drum on the engine. From the rear end of the other car a similar cable was led to a block hitched to a deadman at the excavation end of the track and then back to another drum on the engine. The



engine remained in position for the entire work, but the tracks were shifted to suit the loading and dumping operations. This plan was worked out by J. M. Egan, Jr., of the Egan Construction Co., Aurora, Ill.

NEWS OF THE WEEK

New York, April 28, 1921

New York Has New Water Power Act

Governor Miller, of New York, last week signed the water-power bill passed by the recent legislature. This act creates a water-power commission, consisting of the conservation commissioner, state engineer, attorney-general, president of the Senate and speaker of the Assembly. This commission shall collect information regarding water power in the state and issue 50-year licenses authorizing the diversion and use for power, "or other purposes," any of the waters of the state in which the state has a proprietary right or interest. In general the operations of the law are similar to those of the Federal act.

Engineer Becomes President of National Municipal League

Col. Henry M. Waite, New York City, has been made president of the National Municipal League to fill the vacancy caused by the resignation of Charles E. Hughes on becoming Secretary of State. Col. Waite was city manager of Dayton, Ohio, until he resigned, and went to France, where he served in the transportation department of the American Expeditionary Forces. Before becoming city manager at Dayton Col. Waite was city engineer of Cincinnati.

Engineer Mission to England

To express the obligation which the world owes to the engineers of Great Britain for the part they played in winning the war, the organized engineers of America will send a mission to London this summer. This mission, consisting of nationally known engineers and representing the Founder Societies, will make the award of the John Fritz medal to Sir Robert Hadfield for his invention of manganese steel at the opening meeting of the British Institution of Civil Engineers on June 29.

The deputation to England will consist of a representative of each of the four Founder Societies represented on the John Fritz Medal Board of Award as follows: Charles T. Main of Boston, American Society of Civil Engineers; Colonel Arthur S. Dwight of New York, American Institute of Mining and Metallurgical Engineers; Ambrose Swasey of Cleveland, the John Fritz Medal Board of Award and American Society of Mechanical Engineers; Dr. F. B. Jewett of New York, American Institute of Electrical Engineers. Dr. Ira N. Hollis, president of Worcester Polytechnic Institute will bear the message from the American engineers.

New Federal-Aid Road Bill Calls for Highway Classification and State Systems

Measure Drafted by Highway Officials Contains Rigid Maintenance Requirements—Government Funds for Roads of "Interstate Character" Only

(Washington Correspondence)

Drastic revision of the conditions under which states may receive federal aid in the construction of highways is embodied in a bill, drafted by the executive committee of the American Association of State Highway Officials and introduced in the House of Representatives this week by Cassius Dowell of Iowa, amending the present Federal-Aid Road Act. The bill requires each state receiving federal aid to designate a connected system of roads, "interstate in character," not to exceed 7 per cent of its total road mileage, and to classify the roads of this system in two groups, primary or interstate and secondary or intercounty. Federal money is required to be matched with state funds. The expenditure of federal funds is specifically limited to the roads forming this system and the Secretary of Agriculture is empowered to require modifications or revisions of the systems selected by the states.

There is a clause in the bill requiring at least 60 per cent of the federal-aid allotments to be expended on the primary or interstate roads of the state systems. Rigid maintenance requirements are embodied in the amendments to the existing law. No project will receive government approval until a state has provided funds adequate for maintenance under direct state control. Where maintenance is neglected, the Secretary of Agriculture is authorized to withhold federal-aid money and to put a highway in proper condition by drawing upon the state's allotment of federal funds for that purpose. Prior to its introduction in the House the draft of the bill was submitted to the President and to the Secretary of Agriculture. A number of changes suggested by the Secretary of Agriculture were embodied in the bill.

Comment on Bill

According to W. C. Markham, legislative representative of the American Association of State Highway Officials, that organization is unanimously behind President Harding's demand for continued federal co-operation with the states in building highways, based on a system of roads interstate in character and maintained by daily care with state funds. Accepting as a fixed policy President Harding's statement in his message that:

> "With the principle of federal participation acceptably established, probably never to be abandoned, it is important to exert federal influence in developing comprehensive plans looking to the promotion of commerce and apply our expenditures in the surest way to guarantee a public return for money expended";

the state highway officials propose, according to the language of the pending bill, that

> "in approving projects to received federal aid the Secretary of Agriculture shall give preference to such projects as will expedite the completion of an adequate and connected system of roads, interstate in character. Before any projects are approved, each state through its state highway department, shall select or designate not to exceed 7 per cent of the total road mileage of said state as shown by the records of the state highway department at the time of the passage of this act. Upon this system all federal-aid apportionments shall be expended.
>
> "Roads which may receive federal aid shall be divided into two classes, one of which shall be known as primary or interstate roads and shall not exceed three-sevenths of the total mileage which may

Store-Door Service From New York State Barge Canal

A plan for store-door delivery service at Buffalo and New York has been adopted by the Inland Marine Corporation and the Transmarine Corporation operating on the New York State Barge Canal. Superintendent of Public Works, Charles L. Cadle, has been informed by the Canal Carriers' Association that merchandise handled from New York City to Buffalo by canal will be delivered direct to the warehouse of the consignee at a net cost 20 per cent lower than the railroad rate. At New York City, where it is impracticable for the canal lines to operate delivery trucks, an allowance of 7c. per hundred weight will be made shippers to cover the cost of delivery to and from canal terminals. Shippers at New York and Buffalo have complained that the cost of trucking to and from the canal terminals exceeded the saving in the rate. It is expected that the new arrangement will influence a large volume of tonnage.

receive federal aid, and the other of which shall be known as secondary or inter-county roads and shall consist of the remainder of the mileage which may receive federal aid

"The Secretary of Agriculture shall have authority to approve in whole or in part the systems as designated or to require modifications or revisions thereof; provided, that the states shall submit to the Secretary of Agriculture, for his approval any proposed revisions of the designated systems of roads above provided for. Not less than 60 per cent of all federal aid allotted to any state shall be expended upon the primary or interstate roads until provision has been made for the improvement of the entire systems of such roads. Whenever provision has been made by or in behalf of any state for the completion and maintenance of a system of interstate and inter-county roads equal to 7 per cent of the total milage of such state, as required by this act, said state, through its state highway department, by and with the approval of the Secretary of Agriculture, is hereby authorized to add to the mileage of the interstate and inter-county road system as funds become available for the construction and maintenance of such additional mileage."

With the foregoing section added to the present law the state highway officials believe that the position taken by the President will be met where he says: "Congress ought to prescribe conditions to federal appropriations which will necessitate a consistent program of uniformity which will justify the federal outlay."

To meet criticisms of ill-advised highway financing it is proposed that any state desiring to avail itself of the benefits of federal aid shall, not later than two years after the adjournment of the first regular session of the state legislature from and after the passage and approval of the act, provide state funds each year at least equal to the amount apportioned for such year by the Federal Government to said state for the construction of highways. It is believed that this requirement will meet the statement of President Harding when he said that "Congress cannot justify a mere gift from the federal purse to the several states to be prorated among counties for road betterment."

PENALTY FOR LACK OF MAINTENANCE

To prevent neglect of highway maintenance the bill proposes, first, that the Secretary of Agriculture

"Shall not approve any projects in any state until said state shall provide a state fund adequate for the maintenance of federal-aid roads, and by law shall place said maintenance work under the direct control of the state highway department" and Second, "To maintain the rural post roads constructed under the provisions of this act shall be the duty of the state. If at any time the Secretary of Agriculture shall find that any road in any state constructed under the provisions of this act is not being properly maintained he shall give notice of such fact to the highway department of such state and if within 60 days from the receipt of said notice said road has not been put in a proper condition of maintenance by the state highway department then the Secretary of Agriculture shall thereafter refuse to approve any project for road construction in said state until such road has been put in a condition of proper maintenance and if within 90 days from the receipt of said notice the said road has not been put in a proper condition of maintenance then the Secretary of Agriculture in addition to such refusal to approve any further project for road construction in said state, shall proceed immediately to have such road put in a condition of proper maintenance and charge the costs thereof against the federal fund allotted to such state. Upon the reimbursement by the state of the amount expended by the Federal Government for such maintenance work, said amount shall be paid into the United States Treasury to the credit of miscellaneous receipts and the Secretary of Agriculture shall then approve further projects for said state."

When it is appreciated that a refund by the state goes back to the general treasury of the Federal Government and is lost forever to that state, it is believed by the proponents of the bill that this provision will give adequate protection to the funds expended and give a patrol system of maintenance essential to present traffic demands throughout the country.

Today the expenditure under the direction of the Bureau of Public Roads is more each year than the total expenditure of all the rest of the Department of Agriculture. Whether because of the growing importance of this work, the Bureau of Public Roads should be changed to a department, is said to be of no vital concern to the state highway officials who have come in contact with the bureau and testify to its ability to function creditably when measured with any other body created by Congress to carry on some stated work.

There are those who think that a Federal Highway Commission should be charged with this work, operating directly under the supervision of the President; others think that there should be a Department of Public Works and that under such an organization roads would find an influential position; still others, since the highways have become such an important factor in transportation, believe that all methods of transportation, water, rail, road and air, should be controlled by the Secretary of Commerce.

The state highway officials, according to their spokesmen, are not so much concerned about who shall administer the duties as they are that the government shall recognize the fact that it is as much a federal function to co-operate with the states in road building as it is for the states to aid their minor subdivisions.

Senate Passes Resolution To Investigate Railroads

A resolution to conduct an investigation of the railroad situation, and particularly operating expenses, was passed by the Senate April 19, 1921, after being introduced the week before by Senator Cummins, chairman of the Senate Interstate Commerce Committee. Under the terms of the resolution the committee is authorized to investigate operating revenues and expenses of the railroads since 1912, the reason for the high maintenance cost since March 1, 1920, the falling off of traffic, the efficiency or inefficiency of the railroad management during Federal control, and the best means of bringing about a condition that will warrant the Interstate Commerce Commission in reducing freight and passenger rates. Under the resolution the committee would be authorized to employ counsel and experts and subpoena witnesses for hearings.

Nichols New President of M. I. T.

Dr. Ernest F. Nichols, past-president of Dartmouth College and, for the past year, director of physical science at the Nela Park Research Laboratory of the National Electric Lamp Association, Cleveland, has been elected president of the Massachusetts Institute of Technology. He was born at Leavenworth, Kan., in 1869 and received the degree of B.Sc. from Kansas' Agricultural College in 1888, M.Sc. from Cornell University in 1893 and Sc.D. from Cornell in 1897. From 1889 to 1892 he was a graduate student in physics at Cornell and from 1894-96 at the University of Berlin. In 1903 he received the honorary degree of Sc.D. from Dartmouth College and later LL.D. degrees from Colgate, Clark, Wesleyan, Vermont, Pittsburgh and Denison Universities and Dartmouth College. His early career includes professorial work in physics at Colgate University, Dartmouth College and Columbia University. From 1909-1916 he was president of Dartmouth College and from 1916-1920, professor of physics at Yale University. From 1907 to 1909 he served as research associate at the Carnegie Institution, Washington, D. C., and from 1917 to 1919 was connected with the Bureau of Ordnance, U. S. N. In 1905 he received the Rumford Medal of the American Academy of Arts and Sciences. Dr. Nichols was a collaborator of the *Astrophysical Journal* and has contributed many papers to scientific journals on radiation and other subjects. While working for the Bureau of Naval Ordnance he developed valuable optical devices whose character has never been disclosed by the government. While a student at the University of Berlin, he discovered the metallic reflection of quartz and its anomalous dispersion in the infra-red spectrum.

Construction of Two Short Lines Approved by I. C. C.

On April 19 the Interstate Commerce Commmission decided to issue certificates of public convenience for the construction of spurs from the Texas Midland R.R. Co. and the Kentucky & Tennessee Ry. The former is to extend from Commerce to Greenville, Tex., a distance of 14 miles at a cost of $488,000, and the latter a short spur line from White Oak, Ky., to connect a tract of coal land.

Esch Confirmed to Membership on Commerce Commission

The nomination by President Harding of John J. Esch, of Wisconsin, to membership on the Interstate Commerce Commission was confirmed by the Senate, April 18. Mr. Esch was chairman of the House of Representative committee on interstate commerce and a joint author of the Transportation Act, otherwise known as the Esch Cummins bill. He has made an extensive study of the railroad problem

Zoning Powers Given to Three Minnesota Cities

Under an act recently passed by the legislature of Minnesota and approved by the Governor, effective immediately, cities of the state having 50,000 or more (Duluth, Minneapolis and St. Paul), and also any city of the first class operating under a home rule charter adopted pursuant to Section 36, Article 4 of the state constitution, are authorized to make zoning regulations under the exercise of the police power. The governing bodies of such cities, the act states:

> * * * may make different regulations for different districts thereof and may acquire or prepare and adopt a comprehensive city plan for such city or any portion thereof for the future physical development and improvement of the city in accordance with the regulations made as aforesaid and may thereafter alter said regulations or plan, such alterations, however, to be made only after the affirmative vote in favor thereof of two-thirds of the members of the governing body of such city.

In cities having a city planning commission "the act shall be construed as an addition to existing powers and not as an amendment to or repeal thereof, and the governing body may adopt a plan or plans prepared by such city planning commission."

A zoning survey is now under way in St. Paul and it is believed that a zoning ordinance will be ready to be submitted to the City Council this fall. The survey is being made by the St. Paul City Planning Board under the direction of George H. Herrald, city planning engineer. Bennett & Parsons, city planners, have been retained as consultants in the preparation of the St. Paul zoning ordinance.

Thirteenth National Conference on City Planning, May 9-11

The thirteenth National Conference on City Planning will be held at Pittsburgh, Pa., May 9-11, at the William Penn Hotel. Among the papers and discussions on the program are: "The City Plan and Living and Working Conditions," by John Ihlder, Manager Civic Development Department, U. S. Chamber of Commerce, Washington, D. C.

"How Zoning Affects Living Conditions," by Robert H. Whitten, Herbert S. Swan, Lawrence Veiller and George B. Ford; Luncheon topic, "The Place of Zoning in the City Plan," by Edward M. Bassett; "The Zoning Ordinance of Pittsburgh," by J. M. Clark and U. N. Arthur, "River Transportation" and "River Front Improvement and Flood Protection"; "The Enforcement of a Street Plan," by Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, New York City, with discussions by Frank B. Williams, Andrew Wright Crawford, B. Antrim Haldeman and Harland Bartholomew; "The Major Street Plan of Pittsburgh," by James D. Hailman; "Some New Suggestions for Street Widening"; The Use of Aërial Photography.

Western Society Protests Sanitary District Appointment

Protest against the appointment of E. H. Moore, former business agent of the Hoisting and Portable Engineers Union, as assistant chief engineer of the Sanitary District of Chicago (noted in *Engineering News-Record*, March 31, p. 572), has been made by the Western Society of Engineers to the board of trustees of the district. The board of direction of the Western Society, approving the recommendation of its public affairs committee, objects to the appointment on the ground that the office "should be filled by a professional engineer, selected on the basis of his qualifications and experience and that he should be a man capable of acting as technical adviser to the chief engineer and able to assume his duties if necessary."

Survey for Deeper Channel Over San Francisco Bay Entrance

The U. S. Coast and Geodetic Survey has completed surveys and soundings of the bar at the entrance to San Francisco Bay and has turned the data over to the U. S. Army engineers. The latter are making a more detailed survey and examination in the preparation of a cost estimate on dredging a deeper channel over the bar.

The channel along the north shore is fully 40 ft. deep at low water, but is somewhat tortuous. Over the center of the bar the depth is now 33 ft. at low water, and it is planned to increase this to 40 ft. to provide ample depth for the largest vessels. The shallow part of the bar is well outside the Golden Gate proper which is only one mile wide and has a depth of about 300 ft.

Philadelphia-Camden Bridge To Have Clearance of 135 Ft.

The War Department has accepted a clearance of 135 ft. over a channel width of 800 ft. for the Philadelphia-Camden bridge now being designed by the Delaware River Bridge Joint Commission and plans are now going ahead on that basis. The Board of engineers made the following progress report on April 15:

> Work on preliminary plans and report on the bridge has so far advanced that we will be ready to place them in your hands early in June.
>
> The contractor on test borings is now engaged in putting down the last test hole in the river on the Camden side south of the Federal St. ferry terminal. This work should be completed with the next few days.
>
> We have completed our analysis of the data on vehicular traffic over the ferries, secured in the three-day traffic count taken last December and from the records of the ferry companies. Studies are now under way of the vehicular traffic at present carried by those streets adjacent to the proposed approaches of the bridge.
>
> The drawings which we will submit accompanying our report will show the location studied, general design of the recommended type of structure and the results of the borings. Traffic and other special studies are well advanced toward completion. The architectural drawings of the principal features of the bridge are now being rendered.

Kern River Reaction Turbine in Service Under 806-Ft. Head

The first of two 22,500-hp. units in the Kern River No. 3 plant of the Southern California Edison Co. was put in service on April 1 and since that date has been delivering 17,000 kw. to the company's transmission system. Special interest attaches to this plant because the head of 806 ft. is said to be the highest thus far used on a reaction turbine. The second unit is expected to be in operation early in May and soon after the plant is handling its capacity load. Official tests are to be made of the larger units.

New Institution of Traffic Science in Cologne

Little attention has hitherto been the given to study of traffic problems in Germany. A few universities had introduced lectures on railroad traffic and shipping, without, however, treating the traffic problem in all its various branches. Various kinds of transportation, such as motor and aerial traffic, have not been touched.

German forwarding agents have now combined in the formation of an Institution for Traffic Science, at the suggestion of Privy Councillor Prof. Dr. Harms, president of the Institution for International Traffic, at Kiel. The seat of the Institution will be Cologne, which, on account of its commercial university, provides excellent accommodation. Another consideration in favor of Cologne was the fact that many prominent German shipping firms have settled down there, thus providing exceptional facilities for the students to round up their theoretical education by acquiring practical experience.

The idea has met with ready approval by the municipality of Cologne, which will probably grant a subsidy of 50,000 marks a year toward the maintenance of the Institution, and by the Cologne Chamber of Commerce and Trade, which has set aside an amount of 25,000 marks per annum for the same purpose. Several other public bodies throughout Germany have promised similar help.

Rail Unions Charge Neglect in Engineering Research

Neglect in engineering research is one of the nine principal causes of waste in the operation of the railroads cited by witnesses of the railroad labor unions before the Railway Labor Board at Chicago, April 20. The following paragraph embodying this specific charge was read into the record:

"Administrative neglect to maintain engineering research, and neglect or resistance to improvement generally. Railroad administrators have been so backward and so addicted to rule-of-thumb methods that they have neglected or refused to establish scientific laboratories and bureaus of research for the improvement of the railway service, as has been done successfully in all progressive industries."

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

The Massachusetts Highway Association at its annual meeting at Boston, Feb. 24, elected the following officers: President, Henry V. Macksey, superintendent of public works of Framingham; vice-president, Robert P. Marsh, department of streets, Springfield; secretary, John A. McCarthy, Natick; treasurer, Charles A. Brown, Wellesley; directors, John A. Gaffey and Henry A. Spates.

The Montana Society of Engineers, at its thirty-fourth annual convention, April 9, elected the following officers: President, George T. McGee, Helena; first vice-president, Chauncy L. Berrien, Butte; second vice-president, Leon D. Conkling, Bozeman; secretary and librarian, Earle B. Young, Butte; treasurer, Harry H. Cochrane, Butte. Papers were read by James Kyd who described the construction of pipe lines between Divide and Butte, and by E. L. Larison on the phosphate industry in Anaconda.

The Seattle (Wash.) Section Am. Soc. C. E., on April 4, was addressed by Stuart Mannell on "The Republic, and Why."

The Buffalo (N. Y.) Section, Am. Soc. C. E., at its first annual meeting, April 5, elected the following officers: President, A. L. Johnson; vice-president, G. B. Bassett; secretary-treasurer, B. L. Cushing.

The San Francisco Section, Am. Soc. C. E., made an inspection-excursion April 2-3 of pumping plants and land reclamation projects generally, along the Sacramento River below Colusa which is about 160 miles from San Francisco. The party, totaling 130 members and guests, drove to Colusa in automobiles on Saturday. Sunday morning the automobiles were put aboard a river steamer chartered for the trip down the river. Stops were made at points of interest en route. The drainage plant at District 1500 has six 50-in. pumps connected to six 800-hp. motors. Luncheon was served on the America, a dredge operating a 6-cu.yd. bucket on a 235-ft. boom. The automobiles were unloaded at Knights Landing, whence the return trip was made overland.

PERSONAL NOTES

WILLIAM E. SWIFT, who recently returned from Greece, where he was engaged on an examination for a new water supply for Athens, has opened an office in New York City as consulting engineer. He is a graduate of the Massachusetts Institute of Technology, class of 1895. His professional experience includes service with the Metropolitan Water Board, Boston, Mass., the New York subways, government irrigation in the west, the Panama Canal, and the Catskill aqueduct for New York City's additional water supply. On the latter work he served as division engineer in charge of the Hudson River division and had charge of the big inverted siphon tunnel which crosses under the bed of the river at a depth of about 1,100 ft. In 1911, after leaving the Catskill work, Mr. Swift became associated with the firm of Ford, Bacon & Davis, engineers, New York City, where his duties included the construction of extensive irrigation works in Montana, the building of dams and reports on engineering projects of various types. It was for this firm that he made his investigation of the water supply for Athens. Mr. Swift brings to his consulting work an extensive experience in hydraulic engineering, water supply, tunneling, dams, and irrigation, and will specialize in these lines.

CARL H. PETERSON, formerly city engineer of Cadillac, Mich., has been appointed city manager of Mt. Pleasant, Mich.

J. L. MAHAFFY has been appointed town engineer of Montreal West, Que.

FRANK S. PECK, former state highway engineer, South Dakota, has been appointed highway engineer of Minnehaha County, S. D.

JAMES P. BROWNELL, civil engineer with offices in Carthage, N. Y., has been appointed city engineer of Carthage.

PAUL A. LAZENBY, recently in private engineering practice in New York City, has been appointed engineer to the newly-organized Toronto Transportation Commission, Toronto, Ont. He was graduated from the Massachusetts Institute of Technology in 1904. He then spent four years in general engineering and construction work with the Chicago, Burlington & Quincy, and was also with the Grand Trunk Pacific Ry. in charge of construction. He has served as associate engineer with the Chicago Plan Commission and was also associate engineer in the preparation of city plans for Brooklyn, Minneapolis and Detroit, and for the Federal Plan Commission of Ottawa and Hull. He is now engaged in the preparation of a general plan for the unification of the civic railways of Toronto with the Toronto Railway Co.'s lines.

A. J. TEED has been appointed city engineer of Cadillac, Mich.

ELWIN S. HASTINGS and ALFRED E. WHITE have been appointed acting division engineers of the New Hampshire State Highway Department, with headquarters at Keene.

FRANK BURTON, an engineer with Donaldson & Miers, has been appointed commissioner of the department of Buildings and safety engineer, Detroit, Mich.

B. H. TONG, formerly assistant city engineer, Bismark, N. D., has been appointed superintendent of highways of Emmons County, N. D.

WARREN E. MOORE, civil engineer, of the engineering firm of Moore & McClure, Oklahoma City, has been elected commissioner of public works of Oklahoma City. He was graduated from Purdue University in 1897, and was employed in the city engineering department, Lafayette, Ind. Later he was connected with the Illinois Central R.R. in the maintenance of way department, the Chesapeake & Ohio R.R. and, in 1901, again with the Illinois Central in the bridge and building department.

ELIJAH H. OWEN, superintendent of construction of the H. M. Lane Co., Detroit, Mich., announces his association with Charles Roberts Seabrook, mechanical engineer, for the practice of industrial engineering. The firm of Owen & Seabrook proposes to handle industrial buildings, factory layout and mechanical handling of materials, valuation surveys and work routing.

C. E. RICE, who has for the past year been handling municipal improvements for real estate developing companies in Akron, Ohio, has been appointed city engineer of Wooster, Ohio.

B. C. FREEMAN, formerly with the county road commission of Sanilac County, Mich., has been appointed resident engineer of pavement projects and roads for the state highway department in Sanilac County.

L. C. READ, JR., has been reappointed city engineer of Sandusky, Mich.

W. C. COOPER has been appointed city engineer of Kalispell, Mont.

W. R. TALBOT, recently resident engineer on highway construction, Santo Domingo, is now engineer for the good roads committee of the Chamber of Commerce of Danville, Va.

JOHN L. SNEED has been appointed resident engineer for the Virginia State Highway Commission, with headquarters at Richmond, Va.

NORMAN F. BROWN, assistant to the chief engineer of the Pennsylvania R.R., has been appointed director of public works, City of Pittsburgh, Pa., by Mayor Babcock to succeed John Swan, resigned. He has been connected with the Pennsylvania R.R. for the past ten years. He has had charge of the tunnels recently completed on the Conemaugh division and of the work of shortening the line to Buffalo and has built four bridges over the Allegheny and Monongahela Rivers.

J. R. SEXTON, regional engineer, Erie R.R., with headquarters at Chicago, Ill., has been appointed division engineer at Huntington, Ind.

D. S. FARLEY, recently division engineer of the Atchison, Topeka & Santa Fe Ry., at Dodge City, Kan., has been appointed assistant general manager, western district, with headquarters at Topeka, Kan.

A. A. MILLER, formerly district engineer, Missouri Pacific R.R., with headquarters at Kansas City, Mo., has been appointed superintendent of the Missouri division with headquarters at Poplar Bluff, Mo.

ERNEST S. ALDERMAN, formerly U. S. senior highway engineer at Oklahoma City, Okla., has been appointed state engineer of Oklahoma. He has been with the U. S. Bureau of Public Roads since 1912, with the exception of two years during the World War, which he spent at Camp Travis, Tex., as supervising engineer and assistant utilities officer in charge of construction and maintenance of roads.

SAMUEL J. HUMES, former county engineer, King County, Wash., has organized the firm of Samuel J. Humes & Co., civil and consulting engineers, with offices in Seattle. The firm will specialize in surveys, estimates, municipal improvements, road and bridge construction.

OBITUARY

JOHN H. BLOOMSHIELD, consulting engineer, Bay City, Mich., died March 18. He was born near Lillehammer in the province of Hamar, Norway, in 1856, and was graduated from the Military Academy of Norway at Frederickshald, civil engineering course, in 1878. Until the latter part of 1880 he was employed as assistant engineer of the Norwegian Topographical Association at Christiania. He came to the United States in 1880 and in 1881 he was employed by the U. S. Government Coast Survey service. In 1882 he entered railroad engineering work, becoming assistant, division, and chief engineer for branch lines ultimately taken in as part of the Grand Trunk, Michigan Central, and Pere Marquette R.R. systems. He served as city engineer of Bay City for several years and also as local drainage commissioner. In 1899 he had charge of the construction of the water-works and electric lighting plant on Saginaw Bay. In 1901 he entered private practice as a consulting engineer, engaging in municipal and general engineering work. He has designed and supervised the construction of municipal improvements for numerous cities and towns in Michigan. For the past 23 years he served as engineer for the Bay City Bridge Commission and for the past 28 years he was highway engineer for the Bay County Road Commission, Mich.

SAMUEL E. TINKHAM, since 1874 connected with the engineering department of the City of Boston, Mass., and with its successor, the Department of Public Works, died April 21. He was graduated from the Massachusetts Institute of Technology in 1873, and began work in the engineering department of Boston in 1874. In 1914 and 1915 he was acting division engineer of the bridge and ferry division of the public-works department at Boston and later became engineer of construction of the division. He was prominently connected with the management of the Boston Society of Civil Engineers for more than 40 years and was its secretary from 1880 to 1882, and again continuously from 1887 to date.

HENRY K. PORTER, president of the H. K. Porter Co., Pittsburgh, locomotive manufacturer, died April 10 in Washington, D. C. He was born in Concord, N. H., in 1841, and was graduated from Brown University with the degree of Master of Arts in 1860. He served in the Union Army during the Civil War. In 1866 he began his business carreer in Pittsburgh with Smith & Porter, specializing in the building of light locomotives. In 1899 he became president of the H. K. Porter Co., for the past 20 years engaged in the manufacture of both heavy and light locomotives.

LESTER G. FRENCH, editor and manager of *Mechanical Engineering*, official journal of the American Society of Mechanical Engineers, of which he was assistant secretary, died April 18 at the French Hospital, New York City. He was born in Keene, N. H., 1869, and was graduated from the Massachusetts Institute of Technology in 1891. He began his career as a draftsman and later served with the International Correspondence Schools at Scranton, Pa., as instructor in mechanical engineering. In 1897 he became editor-in-chief of *Machinery*, resigning in 1906 to publish technical books. He wrote one of the earliest treatises on the steam turbine. In 1908 he was made editor of the journal of the American Society of Mechanical Engineers, of which society he was elected a junior in 1899 and a member in 1912.

H. A. CLAPP, president of Clapp, Norstrom & Riley, Chicago, handling railway and construction equipment, died April 11 in California. He was 68 years of age.

BUSINESS NOTES

C. S. KNOBLAUCH has been appointed general manager of the Machais Sand & Gravel Co., Machais, N. Y.

WILLIAM S. TURNER & CO., Portland, Ore., has been organized as manufacturers' agents for the sale of equipment for electric railways, lighting and power systems, pumping and industrial plants; to make investigations, reports and appraisals; and to design and construct public utility, municipal and manufacturing works.

THE PITTSBURGH DES MOINES STEEL CO., Pittsburgh, Pa., has opened an office in Detroit to handle the Michigan and northwestern Ohio territory. M. P. Cogswell will be in charge of the office.

THE CONVEYORS CORP. OF AMERICA, Chicago and New York, announces the appointment of Robert B. M. Wilson as sales engineer for the Chicago district.

WILLIAM H. NORDEN, formerly New York district manager of the Carbic Manufacturing Co., is now secretary and treasurer of the Dewey Supply Corp., New York, formerly known as the Parsons Engineering & Machinery Corp. This company handles a line of contractors' and municipal equipment and supplies.

VICTOR T. GOGGIN, recently New England sales manager of Fred T. Ley & Co., Inc., of Springfield, Boston and New York, has resigned to become associated with Dwight P. Robinson & Co., Inc., as contracting engineer.

W. R. NOXON, formerly sales manager for the Davis-Bournonville Co., New York, and, later, district manager at Chicago, has been appointed sales manager for the Alexander Milburn Co., Baltimore, Md.

H. M. DAVIDSON, who was from 1903 to 1919 with the Hayward Co., New York, manufacturers of orange-peel and clam-shell buckets, and for the past two years general sales manager for the Ohio Locomotive Crane Co., Bucyrus, Ohio, has again become associated with the Hayward Co. and will hereafter be connected with the management of the company. Among other duties he will have the general management of sales.

THE HALLIDIE MACHINERY CO., Seattle, Wash, has been appointed representative of the Conveyors Corporation of America, Chicago, to handle the sale of the American steam conveyor and American trolley carrier in Washington and Oregon.

J. E. TRACY, for the past four years general sales manager of the Sterling Motor Truck Co. of Milwaukee, Wis., became actively connected on April 1 with the Hicks-Parrett Tractor Co. of

Business Side of Construction

Facts and Events that Affect Cost and Volume

Weekly Car Report

An improvement in the demand for cars during the week which ended on April 15 is shown by reports just received from the railroads of the United States by the car service division of the American Railway Association. The number of surplus or idle freight cars on American railroads for the week was 499,479, or a decrease of 7,948, compared with that for the previous week, when a new high record in the number of idle cars was shown.

This reduction in the number of cars for which there is no freight was due entirely to an increase in the demand for coal cars, the number of surplus coal cars being 252,010, or a decrease of 9,284, compared with the previous week. Reports showed, however, that the number of idle box cars remained virtually unchanged, there being 176,805 on April 15, compared with 176,916 on April 8.

Compared by districts, decreases in the number of surplus cars were shown in the Allegheny, Pocahontas, southern, central western and southwestern regions, while increases were reported only in the eastern and northwestern.

Factors Delaying Readjustment

Recovery is delayed by several unsettling factors. These include, in about the order of their importance: (1) The uncompleted liquidation of labor. (2) The unexpectedly poor showing being made by the railroads under the Esch-Cummins law, and apprehension over impending labor developments. (3) Tardiness in reducing prices by numbers of basic industries. (4) Unforeseen delay in starting machinery to extend credits to foreign purchasers. (5) Retention of high money rates for a period almost without parallel in our financial annals. (6) The failure of the retail trade, as a whole, to lower prices commensurate with the drastic declines in wholesale prices. (7) Acute dissatisfaction in responsible circles over tax burdens and the absence of any definite plan in Washington to effect thoroughgoing reform and economy. (8) Tariff uncertainties. (9) Germany's refusal to meet the Allies' demands and the new outbursts of rebellious lawlessness by "Reds." Nevertheless, things are slowly getting better, not worse.—*Forbes Magazine*

A. G. C. Executive Board to Meet

The executive board of the Associated General Contractors will meet in Washington May 9 and 10 to outline the year's work and to discuss the legislative activities which will be undertaken.

British Emergency Act Gives Government Broad Powers

(London Correspondence)

Regulations recently made by an order in council under the emergency powers act enables the British government:

1. To take possession of land, buildings, or works, including those of public utility undertakings.
2. To take possession of food, forage, material and stores.
3. To regulate and control road transport, and to take possession of or hire compulsorily, horses and vehicles.
4. To take over tramways and light railways in whole or in part.
5. To control traffic on highways.
6. To grant motor driving licenses.
7. To control canals and canal traffic.
8. To close ports or harbors.
9. To regulate and restrict traffic by sea.
10. To prohibit the export of any goods.
11. To take possession of coal mines, machinery, plant, wagons and stocks of coal and to regulate coal supplies and fix prices.
12. To control gas, water and electricity undertakings.
13. To regulate or prohibit the sale, delivery or use of motor spirit.
14. To restrict the use of the telegraphs.
15. To prohibit dealing in or the carrying of firearms or ammunition.
16. To prohibit public meetings and processions.

Failure to comply with the regulations under these heads, or any attempt to interfere, or to induce others to interfere, with their due fulfillment or enforcement, will constitute an offence for which the maximum penalty will be three months hard labor and a fine of £100.

These regulations have been conferred upon the government by urgency councils, and steps to bring them into force may be taken if, and when, the government deems it necessary.

Road Contracts For 90 Miles Let

Since April 1 the Pennsylvania Highway Department has let highway contracts aggregating $6,000,000 in value. This involves the construction of about 90 miles of roads, including excavation, grading and surfacing, mostly with reinforced concrete and Hillside brick. The monthly total was increased by the letting, during the past week, of three contracts aggregating $880,487 in value.

Cement, Lumber and Steel Before and Since the War

Prices over 9 to 12 Years—Cement the Flattest Curve—Steel Nearest Prewar Level

To show what has happened in the last decade in the basic construction industries, curves are here presented of the base prices of structural steel at Pittsburgh, Southern pine in New York, and cement in Chicago. The characteristics of the three industries during the war period are clearly depicted. The war peak in steel occurred in July, 1917. Government regulation set the curve at $3 per 100 lb. in October, 1917. Since October, 1920, the price has been falling, the present quotation being $2.20 for steel shapes.

The New York lumber market was remarkably steady during the eight years prior to 1917, when the upward war movement began. The average price in 1909 was $25.50 and $31.50 in 1916, with an average of $28 over the eight-year period. The following are the yearly averages to date:

1917	$37.75
1918	$43.25
1919	$50.00
1920	$67.50
1921 (five months)	$51.00
Today	$48.00

The bottom price, August, 1909, was $22.50, the peak $75 in September, 1920. Since the peak, prices have slumped so sharply that the market today is far from being stable.

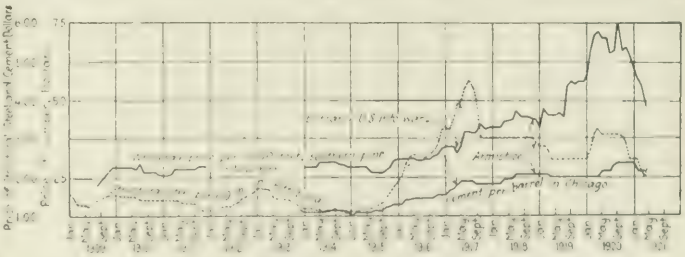


FIG. 1—CEMENT, STEEL AND LUMBER PRICES OVER 12-YEAR PERIOD

From January, 1913, to date there were twenty-five changes in cement prices, of which twenty were advances. The increase over 1913 is 82 per cent.

The cement curve is the flatest of the three. The tremendous upward movement of general prices from 1915 to 1917, inclusive, carried cement with it. The rise, however, was gentle compared with that of steel and lumber, although it has been more persistent.

A better understanding of the agreement between the price trends of steel and cement since 1900 may be had by examining the curves on p. 487 of

Engineering News-Record of Mar. 17. These curves are of prices of structural steel shapes in Pittsburgh and of the average factory prices of cement over the entire country. In the case of both these products, the general movement had been downward from 1910 to 1914, at which time steel started on its rapid journey to the peak of 1917. The rise in cement did not begin until 1915, but it continued long after 1917.

Fig. 2 is a comparison of price trend with production since 1908. Whether production rose or fell the average price of cement increased steadily from

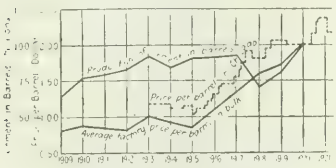


FIG. 2—PRICES AND PRODUCTION OF CEMENT COMPARED

1915 to 1921, owing to advances in the cost of materials and labor. At present, the average factory price is about $2, as against $1 in 1913. On the other hand, the present Chicago price of $2.17 is only 82.4 per cent over the 1913 figures. Structural steel is 47 per cent above 1913; lumber, 68 per cent, while labor, which enters into the costs of all these materials, averages for the seventeen cities covered by *Engineering News-Record's* quotations $4.50 per day now, or 150 per cent above the average rate of 1913, which was $1.80.

Asphalt Association Holds Second Annual Convention

At its second anual convention held in New York April 13 the Asphalt Association adopted resolutions as follows:

Urging Congress to pass the federal-aid appropriation of $100,000,000; urging that highway management be diverced from politics and materials and methods be placed in open competition; declaring that every highway be required to show traffic justification for its construction; memorializing Congress to authorize the United States to join the Permanent International Association of Road Congresses; urging the Interstate Commerce Commission to authorize a reduction in freight rates for road materials; recommending that public officials carry forward road-building programs to the extent permitted by appropriations available, thus giving employment to many hundred thousand men now out of work and utilizing tens of thousands of idle open top freight cars.

The directors elected F. P. Allen of the Standard Oil Co. of Indiana, Chicago, Ill., as vice-president to succeed J. M. Woodruff of the Sinclair Refining Co., Chicago, and re-elected J. E. Pennybacker, secretary.

Indiana Contractor Loses in Suit Over Road-Construction Bond

The Indiana appellate court has just ruled against the Foulkes Contracting Co., Terre Haute, Ind., in a suit regarding a surety bond. The contracting company made an application to the United States Fidelity and Guaranty Company some months ago for a road-construction bond in which it promised to pay $5 for the bond and if the bid was accepted $413.50 additional as the first year's premium, and $418.50 annually thereafter until it furnished evidence of the completion of the work and discharge from future liability.

The insurance company filed suit in the lower courts for two annual premiums. The contracting company filed an answer to the effect that at the time of application, it was agreed between it and the agent of the insurance company that if the contract was awarded the contracting company it should have the right to secure a personal bond for the construction and the $5 should in that event cover the whole obligation.

The trial court found for the insurance company and the appellate court held that any alleged oral agreement between the two prior to the writing of the application for the bond sued on, could not operate as against the terms written in the application, that the statutes do not contemplate the giving of a bond different than that tendered with the bid and that the appellee had a continuing liability on the bond, though the board of county commissioners permitted the contracting company to substitute a personal bond in the place of that tendered with the bid.

Building Contractor's Employees Agree to Increase Output

(London Correspondence)

At a mass meeting of 500 men, the emloyees of Messrs. W. G. Tarrant, London building contractors, recently agreed to increase their ouput by 10 per cent in order that their employers may reduce their building estimates by at least 7½ per cent. This firm holds large Government contracts and employs several thousand men all over the country. W. G. Tarrant, the managing director, says that in the interests of the building trades wages must not increase at all during the next three months. Further, most of the money borrowed by the Government for housing schemes had been already used; evidence of this being supplied by the curtailing of the building schemes now in force, and, in Mr. Tarrant's opinion, these schemes might shortly be closed down altogether, thus precipitating another crisis in the building industry unless costs were considerably reduced. Moreover, private builders could not be expected to build cottages at what they had been costing the Government, about £1,400, and he thinks £600 will be the irreducible minimum next year.

Northwestern Lumber Production 61 Per Cent of Normal

According to a recent bulletin issued by the West Coast Lumbermen's Association, lumber production in western Oregon and western Washington for the week ended April 9 was 39 per cent below normal. The actual production at the 119 representative mills was 52,330,268 ft. b.m., new business 57,306,837 ft. b.m. and shipments 62,674,712 ft. b.m. Local business is active, reads the report, with new work totaling 2,603,585 ft. b.m. and deliveries being 4,530,088 ft. b.m.

Wage Conditions in Britain

(London Correspondence)

It is generally felt that all wages in the engineering trade will fall in June, until which time wages have been stabilized by an agreement arrived at by the empoyers and employees. Orders to engineering firms in this country have fallen off considerably and practically no engineering contracts with Europe are being received. In some cases engineering firms have sacrificed their profits to keep their plants working. Many firms have cut their prices quoted by as much as 20 per cent, but this has proved fruitless.

The impending wage reductions have galvanized the trade unions into activity and efforts are being made to formulate a common policy of resistance to any reductions contemplated by the employers.

The Engineering and National Employers' Federations have issued a statement which deals with the present trade situation. The statement finds the present low state of the engineering trades due chiefly to:

1. Complications of the foreign exchanges.
2. Depreciation of European exchanges due to currency inflation and inability to export on account of low production; i.e., underproduction in Europe means apparent over-production in Britain.
3. Low individual output in Britain leading to prices at which Europe will not or cannot buy.
4. German mark has two values at present, internal and external, the first being two-and-a-half times as great as the latter, which means that the German workman receives a wage which for foreign competition, is only two-fifths of its internal value.
5. The home "consumers' strike."

It is interesting to note that wage standards at the end of last December, compared with pre-war figures, were:

	Per Cent
Railways, some lower grades	270
Railways, foremen, some grades	140
Building trades, hourly rates	225
Building trades, weekly earnings	190
Coal mining	160
Engineering	145
Shipbuilding	144

Road Machinery Exports

Road-making machinery valued at $107,865 was exported during March, 1921, according to the figures compiled by the Bureau of Foreign and Domestic Commerce. This is a slight decrease from March of last year, when the value was $120,331.

Wage Situation in the Building Industry

The wage situation continues acute in the building industry. New cuts have been announced by builders in various cities and in general they are being opposed. The rejection by 70 per cent of the unions in Chicago of the proposed decrease has led the employers to issue a statement that they would stand pat on their proposal to reduce in general from $1.25 an hour to $1 for skilled mechanics and from $1 to 70c. for laborers. Unions are to be given until May 1 to accept that scale; failure to accept which, it is said, may result in a lock-out involving the 60,000 building trade employees in the city of Chicago, and postponing indefinitely approximately $100,000,000 worth of work.

Cleveland has recently announced a cut in the wages of carpenters from $1.25 to 90c. Unions in Portland, Ore., are ballotting on whether they will accept a 10 per cent reduction. The painters of New Britain, Conn., have accepted a 15 per cent reduction, whereas in New Haven, Hartford and Waterbury, other Connecticut towns, general wage reductions in the neighborhood of 20 per cent have been opposed, the proposal of a reduction having been answered in Waterbury by a strike. A general strike has been precipitated in Indianapolis through the proposed reduction of 20 per cent in building-trade labor and it is estimated that around 5,000 men are involved. Though building trade employers of Rockford, Ill., proposed a 20 per cent reduction, which was opposed by all unions, the masons voluntarily made a reduction of 10 per cent.

The Building Trade Employers Association of Boston opened an employment office recently, more than 400 men applying for employment during the first few hours it was opened. Boston builders still continue operations on an open-shop basis.

Commission Government at Buffalo Survives Mysterious Attack

What is described as a bill of mysterious origin, designed to cause the abandonment of the commission government plan at Buffalo, N. Y., was passed by the last legislature, but vetoed by the Mayor of Buffalo and not passed over the veto before the legislature adjourned. Known as the Gibbs-Rowe bill, the proposed act provided for a council of 15 members, six to be elected at large and nine from nine "council zones," and for a Mayor with large powers. The proposal to abandon the commission plan was strongly opposed at a public hearing. At this hearing the sponsors of the bill declined to state who had drafted the measure. Another bill aimed at the commission plan in Buffalo, known as the Swift-Brady bill and described as another variant of the mayor and council plan, did not make much progress.

Large Pittsburgh Building Moved

The widening of Second Avenue in Pittsburgh, made necessary the moving of an eight-story building a distance of 40 ft. The building was a brick and steel structure about 30 x 120 ft. and was loaded with hardware. It was necessary to move it without any disturbance to business. The usual business proceeded during the entire operation, which was carried out last week.

The weight of the structure was more than 5,000 tons and it was necessary to use 880 screw jacks to lift it. It was lifted 16 in. together with the sidewalks at the front and side and slid over by means of ten screw jacks moving at the rate of 1 ft. an hour on steel rollers operating on rails. This work was let to the John Eichelay, Jr., Co. of Pittsburgh, and was done at a saving to the city of over $100,000.

Bricklayers' Output in Britain

(London Correspondence)

Some discussion has arisen in England over the fact that bricklayers employed by the building guilds on contracts under the Ministry of Health are laying 900 bricks per day, while those employed by private contractors are not laying more than 300. The Minister of Health states that if the output could be raised from 300 to 900, two months would be saved on the construction of each house, and the money saving effected would be about £70 per dwelling.

Device for Thawing Fire Hydrants

A portable device for thawing fire hydrants by steam from a steam coil heated by acetylene was demonstrated recently in New York City. The device consists of a steam coil surrounded by a water jacket and a ten-jet acetylene burner beneath the coil. The burner is supplied with dissolved acetylene such as the Prest-O-Lite Co. compresses into cylinders for auto truck and tractor lighting. Water is forced from the water jacket into the steam coil by a hand pump. The superheated steam thus produced is played through a hose upon the frozen hydrant. The device was invented by Louis F. Rose and is made by The American La France Fire Engine Co.

Past Week Second Heaviest of Year in Building

Exceeded by the previous week by the small margin of 1½ per cent, the contracts let during the past week, as reported in *Engineering News-Record*, give the second highest total figure for the year—$30,482,334. Last week's contracts totaled $30,874,237.

This week's total is large mainly because of the increase in the construction of miscellaneous buildings—educational, bank and office, theater, church, etc.—the total for this class being the largest figure of any week this year, $15,550,258, more than 50 per cent of the total. Street and road contracts, though many in number, totaled but approximately $7,000,000. The largest buildings for which contracts were let include a $2,000,000 theater and office building in Detroit, a $1,000,000 church in Lackawanna, N. Y., and a $1,000,000 hotel in New York City. The largest street and road contracts were let by Pennsylvania, Wisconsin and Oregon, these three states letting contracts aggregating $2,114,616.

A marked increase is noticed in the number and value of sewer, waterworks and bridge contracts let during the past week, the total value of this class of work being $3,857,523. Industrial building also shows an increase, a number of small manufacturing plants being contracted for in New England and elsewhere.

Municipal Paving Contract Is 83 Per Cent of Estimate

In a recent letting of municipal paving contracts in Gary, Ind., it was found the total bid of the successful bidder was only 83 per cent of the engineer's estimate. Sheet asphalt of a 1-in. binder and a 1½-in. top was estimated to cost $2 per square, whereas the low bid was $1.67. The accompanying table indicates where the saving of $2,698 on $13,662 worth of work was effected.

ESTIMATE AND SUCCESSFUL BID ON GARY, IND., STREET JOB

	Sheet Asphalt 1-Inch Binder 1½-Inch Top Per Sq Yd	Regrading per Sq Yd	Concrete Header, 1 in Ft	Reset Catch Basin Covers	Curb and Gutter Rebuilt 1 in Ft	New Material in Place (Flume, per Ton	Extra Binder per Ton	
Engineer's estimate	$2 00	$0 20	$1 50	$5 00	$2 00	$5 00	$10 00	$16 360
Low bid	1 67	10	1 50	3 50	1 90	4 00	9 00	13 662
Unit difference	33	10	..	▶ 1 50	10	1 00	1 00	
Quantities	5,065 2	5,065 2	188	7	300	100	380	
Total difference	$1,671 52	$506 52		$10 50	$30	$100	$380	$2,698

Oregon Highway Bids 80 Per Cent of Estimates

On April 22 the Oregon State Highway Commission let contracts for the construction of approximately 73 miles of highway, the total estimate of the engineer on which was $928,286 and

the total contract price $831,172, a difference of $97,114. The successful bid in each case was considerably under the engineer's estimate, there being ten projects involved. Most of the work is only grading, shaping, and in some instances, surfacing. One large paving contract was let, the estimate on it being $415,841 and the contract price, $383,583, or about 8 per cent below the estimate, involving the construction of 12½ miles.

Million-Foot Southern Pine Order Closed

The Marsh & Truman Lumber Co., Chicago, last week sold a million-foot order of Southern pine to the Lackawanna Bridge Co. for that concern's Tonawanda, N. Y., project. It is understood the order consisted mainly of dressed long-leaf timbers from 12 in. to 4 in. and 4 x 6-in. and 3 x 8-in. short-leaf material.

Spokane Forms A. G. C. Branch

Contractors of Spokane have formed a local branch of the Pacific Northwest Chapter of the Associated General Contractors of America. Offices of the branch have been opened and an executive secretary has been engaged, says a recent copy of the A. G. C. *Bulletin*. The new association starts with a membership of more than 40 contractors operating in and near to Spokane.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 7, the next on May 5

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4.00	$3.75	$3.23	$3.51	$4.65	$4.45	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	7.05	4.88	5.30	6.90	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.85	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	49%	50.65–5%	45%	58¼%	51.9–5%	40%	49.80	40%	5%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.20	64.10	67.80	70.00	85.90	73.00	80.00
Concreting Material:									
Cement without bags, bbl.	2.90 (del.)	3.00	2.85	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	1.75	2.75	2.00	2.50	2.50	1.50	1.50
Sand, cu.yd	1.25	1.50	1.75	2.75	1.00	1.10	1.65	1.50	1.50
Crushed stone, ¾ in., cu.yd	2.15	2.50	3.20	2.75	2.25	3.50	2.50	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	38.00	45.00	55.00	38.00	47.00	27.00	48.00	120.00
Lime, finished, hydrated, ton	21.00	18.00	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	2.50	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.00	25.00	12.00	18.00	14.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.21	.12	.06	.09	.12½	.13	.19
Hollow partition tile 4x12x12, block	....	.15	.19½	.096	.104	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.65	.67	.88	.71	.78	.85	.83	.79	.95
Common labor, union, hour	.75@.80	.35	.60@1.00	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non union, hour	.....	.25	.40@.60	.50	.50	.37½@.50	50@.55	.40@.45	.30@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 *and* 5 per cent, 45*@* 50 means a range of 45 *to* 50 per cent. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on 6r instead of pine. Brick is $18 delivered, 16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu. yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir, instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

It is possible this week to give material prices and labor rates in Birmingham, Ala., and such information will hereafter be included in the *Engineering News-Record's* Monthly Prices of Construction Materials and Labor. Standard open-hearth rails in lots of 500 tons and over can be purchased at $47.50 per gross ton, 12- to 45-lb. rails, at $2.20 per 100 lb. Cast-iron pipe costs $60 per ton. For building materials, the prices are: $14 for common brick, f.o.b. kiln, with $2.75 per 1,000 for delivery charges; 55c. per ton for sand, at pit, $1.43 in the city; $26 to $28 for dimension and form lumber on the site. Cement sells for $3.05 net, on sidetracks or in warehouse. Open-shop labor is paid as follows: Bricklayers, 8½c. to $1 per hour; carpenters, 70 to 75c.; hod-carriers, 25 to 40c.; common labor, 20 to 25c.

Cement in New York appears to have reached the bottom. The market is competitive, with $2.90 net the most reliable price to contractors. This quotation allows the dealers a profit of only 4c. per bbl. The wholesale price alongside dock to dealers is $2.40; the unloading charge is 6c.; handling in yard, 10c.; cartage 30c.; profit, 4c.; resulting in a delivered price of $2.90, as stated.

Steel and cast-iron pipe are down in San Francisco, as is also linseed oil. The oil has dropped 1c. in Atlanta and 8c. in Denver. Steel prices have been adjusted in Atlanta warehouses.

Chicago labor unions have declined to accept the 20 per cent cut. Employers have agreed to stop all work on **May 1** unless the new scale is accepted. The matter still awaits final decision.

Although the New Orleans metal workers have not returned to work it is probable that a vote to end the strike will be taken next week. This would allow the men to return to work under protest, the differences to be arbitrated. The workers have signified willingness to accept a reduced wage—85c. for mechanics, 50c. for helpers, with a 48-hour week. The real contention is over the open shop.

The Ottawa branch of the Canadian Building and Construction industries has announced a cut of 10c. per hour in most of the trades, making the rates **90c. for bricklayers, 75c. for carpenters, 50c. for common laborers.**

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren
Editor

Volume 86 NEW YORK, MAY 5, 1921 Number 18

Am. Soc. C. E. Harmony

HARMONY over constitutional changes prevailed last week at the Houston convention of the American Society of Civil Engineers. The armed neutrality of the January meeting had changed to a genuine effort to get together. The Houston convention did not discuss the draft as to essentials. The only change it made of its own motion was to omit a single redundant line. All other changes made were at the instance of the revision committee, the most important one—and one absolutely necessary to meet the demands of the members—having the object of restricting nominating votes for directors to members of the respective districts. The membership may, therefore, take the changes as they appear on the ballot without fear that a handful of members has upset the protracted consideration of the revision committee. As a result of the Houston decision it seems likely that the society will have a new constitution by the fall.

Technical Life Revived

IN ADDITION to the effort to get along at the Houston meeting another hopeful sign was the announcement of the authorization of committees to promote research and technical activities. Especially will the latter benefit the local sections, which have long felt the need of a common bond other than that which develops out of the interest in selecting the society's officers. The applause which greeted the news that the *Proceedings* would henceforth contain all papers and discussions also indicated the desire to restore the society to technical functioning. Hard work and service along solid lines apparently are just ahead. For this there is reason for hearty congratulation.

Log-Flume Engineering

LOG-FLUME construction has in the past been characterized by the lack of sound engineering design. The logger has depended, except in the largest operations, upon his own devices and experience to get the logs out of the woods. The building of the flume has been considered as elementary as the building of a skid road. Consequently, flumes have been built more or less rudely and logs have been floated to the mill with varying degrees of success. What the engineer may contribute to this branch of logging engineering is told in an article on p. 768 of this issue. The author shows that getting the logs to the mill involves many considerations usually neglected. Mr. Woods has reduced to a minimum the snaking of logs coming down side gulches, by carrying the flume to the timber rather than the timber to the flume. Study of operation of flumes has resulted in adopting a vertical curve that reduces clogging of the flume under certain conditions and the throwing out of logs under others. Other important observations having relation to successful operation will be found in the article in question. Not less important are the construction methods which the trained engineering mind has developed. These, while simple, are decidedly novel in character and will be much appreciated by men who have had experience in getting things done in new country.

Zig-Zag Concreting Chutes

DAM construction affords exceptional opportunity for ingenuity in the layout of concreting plants. In the Far West, particularly, where so many masonry dams have been built in the past few years, these plants have been many and varied. The one at the Scott dam on the Eel River, illustrated in this issue, is a case in point. The adoption of the paralleling trestle led to multiplied chuting, with central station hoppers feeding each of the chutes. This is fairly common, but what is not so common, although it is not unique, is the zig-zag wooden chute which connects the hopper to the lower position of the suspended steel chutes. At first glance these have somewhat the appearance of a child's sand toy, and, with their numerous acute-angled turns, would seem to be apt to clog easily. The testimony, however, is to the contrary. Dropping concrete vertically a considerable distance is a necessary operation in many kinds of construction. These zig-zag wooden chutes would seem to be well worth considering as a substitute for the not altogether satisfactory means generally adopted.

Fire Resisting Concrete Buildings

THE Edison fire in 1909 taught us many things about the fire resistance of concrete buildings; first of all that an unburnable—or at least slow burning—envelope does not prevent its contents from burning rapidly and secondarily that there are many precautions in design which serve to reduce the percentage of failure of a concrete structure subjected to severe fire. Since then several other fires have added to our knowledge and the excellent tests by the Bureau of Standards and the Fire Underwriters' Laboratories have supplied confirmatory data. The exceptionally intense fire in the Barrett company's naphthalin drying house, described on another page, is the latest addition to the record. It demonstrates again that unprotected structural steelwork is a dangerous adjunct to a concrete building, that square, rodded columns soon lose section under fire and thereby may readily reach a failing unit stress, that lightly-covered reinforcement is easily overheated and weakened and that gravel aggregate tends to spall under fire. All of these things should be taken care of in proper design and, in addition, the principles of fire protection must be applied in concrete buildings just as they are in buildings of inflammable material.

Integrity of Public Service

RECENTLY we called attention to the political situations now endangering the work of some highway departments. Here is obvious occasion for the activities of engineering societies, as was pointed out in connection with the instances at issue. Would not engineering societies be strengthened in their efforts to preserve the integrity of public engineering services if in every political campaign they would lay before the two principal parties memorials regarding the proper standards in the technical services of government. Candidates would thus learn, before election, that the engineering societies were vigilant in the defense of governmental engineering organizations. They would be less inclined to come into conflict with these engineering societies. The societies themselves would be stronger when action was demanded if they had previously made the acquaintance of officials by laying before them a strong statement of principles. If the presentation be made in person by public-affairs committee of the societies so much the better. On the "check list" of every governing body of an engineering society in this country should go this item: *"Before election.*—Send memorandum of principles governing engineering services to candidates for offices controlling such services."

Water Meters on the Grill

WATER-METER manufacturers were grilled at the Lockwood hearings in New York last week. Probably there were reports in newspapers even at far-distant points, and if the newspapers "ran true to form" they took the Lockwood evidence as complete proof that there is in New York a high-handed meter manufacturers' ring. Engineers will do well, however, to suspend judgment, for the Lockwood hearings continue to be of the *ex parte* type, as was pointed out in our discussion of the hearings on the cement industry. As a matter of fact, the water-meter hearing did not even attempt the introduction of evidence showing that the meter manufacturers used any influence, whether monetary or otherwise. Just because the New York Board of Aldermen refused to admit the Badger meter the conclusion was drawn that the meter manufacturers were responsible for the exclusion. Only four days elapsed, however, before the newspapers which, in news columns and editorials, unmercifully damned the competing meter manufacturers were with equal positiveness reporting that the exclusion of the Badger meter was due to the refusal of the Badger company to bribe the board of aldermen or certain of its members. As evidence of the injustice of not permitting cross-examination in these hearings is the statement of the star witness that his company was selling the small sized water-meters—$\frac{5}{8}$ in.—for one-third less than were his competitors. His own price actually figured to $9.67 while competing manufacturers report recent sales for various figures below $10 and some as low as $9.46. The Lockwood hearings are undoubtedly resulting in good but they are also spreading misinformation on which the public is convicting many who have not only not had a fair trial but are probably far removed from the wrong-doing that the counsel to the committee imputes to them. Eventually the cases will be cleared up, in some instances through court trials, but at present justice demands that judgment be withheld.

The New Federal-Aid Road Bill

RADICAL changes in the administration of federal-aid highway work will be made if the bill introduced in Congress this week by Representative Dowell of Iowa is enacted into law. The measure, the chief provisions of which were given on p. 738 of the news section last week, was drafted by the executive committee of the American Association of State Highway Officials and before its presentation was reviewed by the President and the Secretary of Agriculture. The document has been referred to as a golden mean between inadvisable extremes. It aims, through several far-reaching modifications of the existing federal-aid highway act, passed in 1916 and amended in 1919, to correct certain undesirable features of federal-aid work and to place the future program upon a sounder basis.

One of the chief criticisms of federal-aid work has related to the practice in some states of matching federal appropriations, not exclusively with state funds, but with county or a combination of state and county money. The result has been that great pressure has been brought to bear to select roads for political rather than traffic reasons. This has resulted in the expenditure of funds upon isolated stretches having little relation to a logical state or national system of roads.

This condition will be remedied by the passage of the new bill. It provides that within a period of two years federal government appropriations shall be matched with *state* funds. There will then be no financial backing for local interests in their efforts to secure the expenditure of federal-aid money for highways of only local importance. State highway departments will be able to select for improvement routes which are demanded by the best interests of the whole state. This will be a big step forward.

Of equal importance is the stipulation requiring the designation by each state accepting federal funds of a state highway system, with a mileage not to exceed 7 per cent of the total mileage of the state. The roads in the system would be classified into two groups: First, the primary or interstate roads, which are to comprise three-sevenths of the state system, and second, the secondary or intercounty roads constituting the remaining mileage. The designation of highway systems by the states and the classification of roads is something which the U. S. Bureau of Public Roads has been ardently advocating for some time. Up to the present, however, it has not been vested with the authority to insist upon such principles, even though their soundness has been generally recognized. With state highway systems definitely selected and recorded, and the further important provision that federal-aid shall be specifically limited to such systems, the prospect for a network of highways of interstate and intercounty importance is definitely assured. This feature of the bill should go a long way toward reconciling the national highway system advocates, who until recently failed to support—if they did not actually obstruct—the policy of federal aid.

One other admirable feature of the bill deserves emphasis—the section relating to maintenance of completed work. Briefly, federal aid will be withheld from a state unless adequate state funds for maintenance are provided, and in the event of a state's failure to maintain a project built with the aid of government funds the Secretary of Agriculture must refuse to approve any project for road construction in such state

and is also given authority to put a road in proper condition by using the state's federal-aid allotment. Drastic insistence upon proper maintenance has long been needed and this feature of the bill, if passed, will enable the government to insure satisfactory maintenance on roads which its funds have helped to build.

The bill deserves unqualified support. It represents the best thought of an organization which recognizes that the great roadbuilding program of the future must be carried out on a sound economic basis. Under the existing law certain unsatisfactory practices could not be corrected. The new bill, giving increased control to the federal authorities, puts teeth in the original act and will insure the selection and construction and later the adequate maintenance of a system defensible upon economic lines.

In thus commending the new measure we do not wish to belittle the efforts of those who put through the first large-scale federal-aid appropriations. Imperfections were to be expected. There has been written into the new bill the lessons of experience.

The Need for Statistics About Business

NEVER before has so much attention been given in a public way to the use of statistical aids in the determining of business policy. Open-price associations have been attacked in a suit before the federal courts; they have been painted in the deepest black in the Lockwood building investigation in New York, and have been an important feature of a report to the President by the Federal Trade Commission. Private statistical service bureaus are multiplying rapidly and are strongly presenting in person and in advertising the advantages accruing from statistical guidance of commercial and industrial enterprises. Their growth is evidence of a new appreciation by business men of the value of such statistical service. Finally, Mr. Hoover in his address before the U. S. Chamber of Commerce at Atlantic City proposed the establishment by the government of a statistical service covering every great commodity and the more important industries. The subject is pertinent to the work of engineers and contractors, for the building material industries are involved.

Those who see evil in the collection and exchange of statistics are interested primarily in preventing them from being used to the detriment of the public—a position thoroughly sound. The public interest is paramount. However, in the sweeping condemnations that have been made, as exemplified in the one-sided Lockwood investigation, there is no admission whatever that figures may result in good to the public, much less of the fact that they are necessary for the stable conduct of business, and thus have a positive bearing on the welfare of every citizen.

Of course, eternal vigilance is still the price that the public must pay for protection against a goodly portion of the business community. In other words, most business men are human and when the opportunity is offered, will take advantage of the public. But that does not detract from the fact that some measure of co-operative effort is not only required, but is in the interest of the public. The problem is to devise methods for securing the advantages which should accrue to the public and industry from group effort while erecting safeguards to prevent the exploitation of the public.

Two excellent examples of how the public may benefit from the gathering of industrial and commercial statistics will be found in Mr. Hoover's address in the business news section of this issue. It is pertinent to note, however, that the benefits come not from the mere gathering of these statistics for the industries but *from their dissemination to the public.* Therein is the crux of the situation. There is strong temptation when information is held within the industry to allow it to be used as the starting point of collusive operations. The danger of this temptation would be lessened if the figures were given to the public, for the buyer would thoroughly understand conditions and be in a position to detect collusive effort.

The policy of publicity of figures has been followed to an extent in some industries. The results have been satisfactory, as witness the generally favorable attitude in business circles toward the U. S. Steel Corporation. Even in the steel industry, however, the facts made public—relating chiefly to furnaces in blast, the volume of production and the volume of business being placed—do not go nearly as far as a government statistical department would go. There would be rather full data on production, consumption and stocks, with information regarding capacity of the industry and the percentage of plants in operation. Manufacturers' prices, as a check on profiteering dealers, should also be published, at least for the basic industries.

The object, within industry, to be accomplished by full statistical information is to secure a more intelligent guidance of industry and trade. Every business man makes constant efforts to ascertain what his competitors are doing, and though it may take time he eventually does learn what they are doing and guides himself accordingly. But while getting the data his business may suffer grievously. There may be serious over-production with consequent heavy bank carryings, sharp lay-off of employees, and all the other evils which go with organization disruption, and idle industrial plants. Full information of what is going on in the industry allows tendencies to be sensed at the very start, and the application of remedies that will assure the flattening of the peak. This tends to a healthier industrial condition—which is of universal advantage.

The dissemination, whether through open-price associations or a government agency, of price information, as distinguished from production information, also tends to eliminate the "competition of ignorance." Underselling of fair prices by those with no knowledge of their costs is a common industrial evil. Such practice eventually eliminates the unfortunate individual, but not *until the public has paid the bill* through liquidation.

Without doubt there will be objection to government publication of statistics by those fearful of more government interference in business. The benefits to be derived are too great, however, to allow their fears to prevail. It is commonly conceded that our business men generally guess at the future and decide their courses from day to day, instead of laying down policies based on a thorough understanding of conditions. Anything that will get us away from this policy of "playing hunches" will be of general benefit.

Such sentiment is building up against open-price associations that they are quite likely to be prohibited by law, even if under the present court proceedings they are found not to violate the anti-trust laws. If that should result, some other means to the same end must be found. The government collection and dissemination of data offers a solution.

Concrete Dam on Eel River Built on Shale Foundation

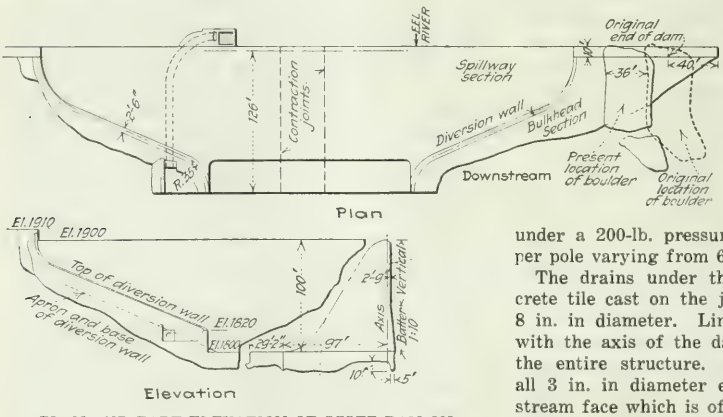
Dam Lengthened After Rock Slipped at Abutments — Extensive System of Sub-Drains Used— Elaborate Chuting Plan From Auxiliary Trestle

There is now under construction on the Eel River, about 150 miles north of San Francisco, a gravity section concrete dam, known as the Scott dam, which is noteworthy both as to design for the provisions against underflow and in construction for the comprehensive chuting plant which has been installed. The structure is furthermore of interest because of a large rock slip which occurred at one abutment and which has necessitated the extension of the dam about 40 ft. beyond its original length. In the first of the following two articles the sub-drainage design and the difficulties due to the slip are discussed. The second article is devoted to the concrete placing operations.

The dam is being built for the Snow Mountain Water & Power Co. The designs were prepared by B. C. Conduit and the work has been carried out under the direction of Edwin H. Warner, engineer in charge of construction. W. A. Kraner, of San Francisco, holds the contract for the work.

Drainage Design and Foundation Difficulties of Dam

THE Eel River dam is a gravity concrete structure originally designed to be 725 ft. long but later extended to a length of 765 ft. and 135 ft. high. Of the dam crest length 485 ft. is treated as spillway and in order to prevent the overflow from cutting around the ends of the structure curved deflector walls were designed on the downstream face of the spillway from crest to toe, these walls converging so that where they terminate at the toe the width of the spillway will be decreased to 185 ft. From the downstream toe an apron extends 30 ft. along the river bed below the dam proper and is extended down to the shale rock below.



PLAN AND PART ELEVATION OF SCOTT DAM ON EEL RIVER, CAL.

Boulder which moved is shown on the right of the plan.

When an examination of foundation conditions was made at the site of the dam, exploration tunnels and shafts disclosed a shale formation with talcose intrusions. The shale was pronounced firm enough to carry the weight of the dam provided water was kept out of the foundation. Accordingly, the axis of the dam was shifted until the structure could rest entirely on shale, and provision was made for grouting below the cut-off wall to make the seal at the upstream face as effective as possible. Furthermore, a network of underdrains was specified to carry off seepage water which might find its way under the structure.

Last season parts of the dam were completed to the full height of 135 ft. The excavation made before the first concrete was poured extended 15 to 25 ft. below the ground surface for the full width of the dam and a cut-off trench on the upstream face, 5 ft. wide, was carried 10 ft. deeper than the adjacent excavation. Before pouring concrete, 3-in. pipes were left in the cut-off wall forms, spaced 5 ft. apart and placed so that their tops would protrude on the upstream face of the concrete just above ground level. Through these pipes 1¾-in. drills were driven to a depth 30 ft. below the bottom of the cut-off wall and when the concrete had hardened, these holes were grouted under a 200-lb. pressure, the amount of cement used per pole varying from 6 to 150 sacks.

The drains under the dam consist of porous concrete tile cast on the job in 18-in. sections, 3, 6, and 8 in. in diameter. Lines of drains were laid parallel with the axis of the dam and on 15-ft. centers under the entire structure. These longitudinal drains are all 3 in. in diameter except the line nearest the upstream face which is of 6-in. tile. By means of risers, each of these lines is connected every 80 ft. to cross lines of 8-in. tile, imbedded in the concrete 5 ft. above the bottom of the excavation. The 8-in. lines in turn are connected by risers to a gutter at one side of a 3 x 5-ft. inspection gallery which is to run entirely through the dam beginning at levels near the top at both ends of the structure and extending thence down to a central level 85 ft. below the crest of the dam. From its lowest point this gutter discharges through a 12-in. pipe leading to the downstream toe.

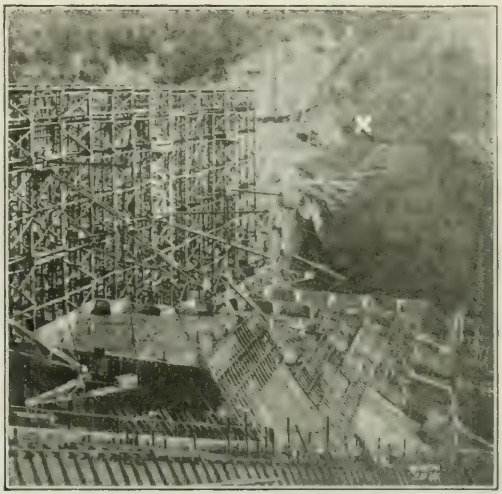
Waterways through the dam left in the concrete include a 3 x 5-ft. sluiceway, controlled by a sliding gate on the upstream face, and a 6-ft. circular outlet-pipe imbedded in the concrete which may later be used for operating a 2,000-hp. waterwheel. It is planned to build a small power house for this waterwheel just below the dam. The pipe is controlled by a butterfly valve and a needle valve at the downstream end, with provision for emergency closure by means of a sliding gate on the upstream face of the dam.

Two sluice-ways through the dam, used as a bypass for stream flow during construction, are to be filled up after completion of the work by concrete delivered through six pipes, three in each sluiceway, left in the dam for this purpose. In effecting closure, which is to be done at low water, stop-logs will first be placed in a double set of grooves at the upstream end of each sluiceway and the space between them will be filled with concrete, thus effecting a permanent seal. A wooden bulkhead will then be built in each sluiceway downstream from the concrete pipe nearest the upper end, and the section thus closed off will be filled with concrete, pouring from the top of the dam through the pipe imbedded in the structure. When this section is full and the concrete has set, the bulkhead will be moved below the second pipe and the process repeated.

As an additional precaution in anchoring the plugs in the sluiceways, a notch in the shape of an inverted V was left in the sluiceway roofs at the lower ends of the concreting pipes, this space to be filled by concrete as the closure is effected. The sluiceways were also tapered to a decreased cross-section at lower end.

After completion of the concrete work on the dam, which is to include a ¾-in. coating of "gunite" on the upstream face, it is planned to place a puddled clay fill on the upstream side, reaching about 12 ft. up on the concrete and extending across the canyon from end to end of the dam.

The dam was well along toward completion when work was shut down for the winter in November, 1920, on account of early rains. After a period of heavy rainfall and high water the ground at the south abutment, against which no concrete had been poured, settled and moved downward toward the uncompleted structure. A hydraulic giant was used to remove the soft material in this slide and decision was then made to increase the length of the dam crest about 40 ft. and, with this exception, to complete the structure on the original plan as early in the present spring as water permits.



POSITION OF BOULDER AT ABUTMENT OF DAM IS INDICATED BY CROSS AT RIGHT

The movement on the south bank did not occur without warning. There were frequent, though slight movements of the surface on this bank of the stream even through the dry season. This was shown by the changes in level of bench marks established there during construction. The November movement that occurred after the high water, however, moved a mass of metamorphic rock which was previously supposed to be in permanent position and against which it had been planned to pour concrete. This movement is attributed by power company engineers to the fact that the flood which swept through the gap between the uncompleted portion of the dam and the south abutment loosened and softened the layer of material between the rock and the shale beneath. At the same

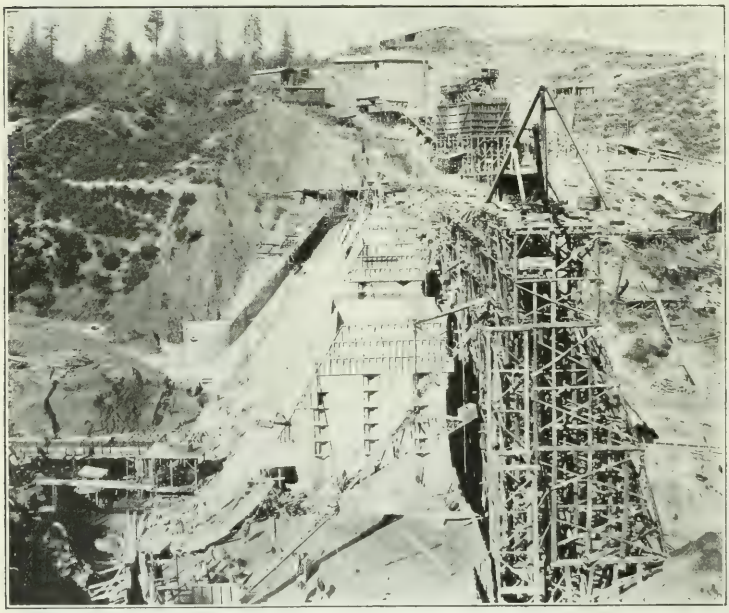
SOUTH ABUTMENT AFTER THE BOULDER HAD MOVED DOWN TOWARD THE DAM

time there was a general movement in the overburden of loose material, and the surface of the south bank was effected for some 500 or 600 ft. up and downstream and about the same distance up the slope of the hill.

After the movement a hydraulic giant was used to remove the material behind this face of rock previously considered as an abutment. When this exposure had been made the rock was pronounced a true boulder because of its conchoidal shape and the striations upon it. It is estimated to contain between 6,000 and 7,000 cu.yd. and is classed as belonging to a later geological age than the underlying shale. This boulder, according to the belief now held, originally came from some point upstream or farther up the hill and is entirely foreign to the shale formation underlying the dam. The November movement in the south abutment carried the boulder 36 ft. toward the dam, and left it at a level 20 ft. below its previous position.

Although the material in the boulder was considered firm enough to warrant its incorporation in the concrete, decision has been made to eliminate it from the structure entirely for two reasons. If the boulder were left in place, tunnels would have to be driven under it in which to replace with concrete the strata of soft shale that overlies the hard shale. Also, after the completion of the concrete dam around the boulder, a portion of it would project on the downstream face, thus affording a lever in the concrete, as it were, which might at some time be a menace to the stability of the structure.

At the same time that the rear part of the boulder was exposed with the hydraulic giant, excavation was made of all material which could be moved with a 2-in. nozzle under a 350-ft. head in the area to be covered by concrete. About 30,000 cu.yd. of material was moved in this way, chiefly soft shale and talcose nodules. The material exposed by this work is reported to be a hard shale, entirely suitable as a support for the concrete of the dam. The plans for the dam were accordingly changed so as to increase its length by about 40 ft., as shown in the accompanying drawing. To complete the structure on the foundation thus exposed, after the boulder has been removed, is estimated to require about 4,000 cu.yd. of concrete more than was contemplated in the original design.



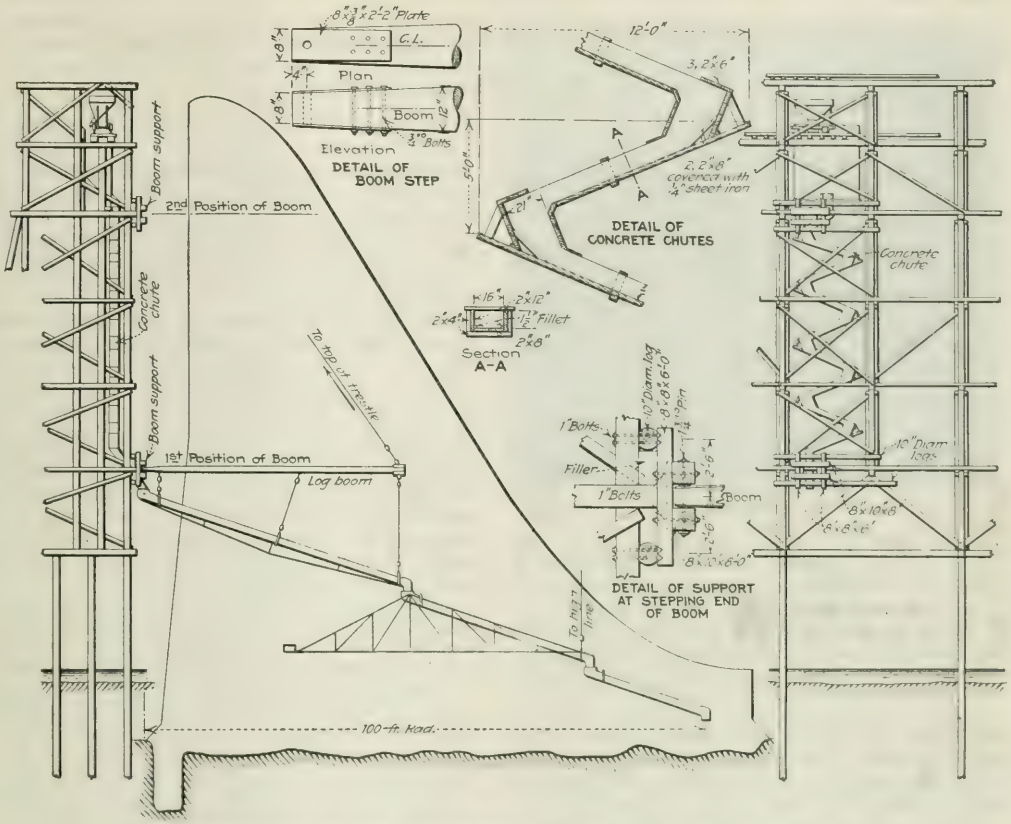
VIEW OF CONSTRUCTION PLANT FROM SOUTH BANK OF THE RIVER

Efficient Plant for Handling Concrete on Dam

THE construction plant for the Eel River Dam was selected and arranged to use local advantages to the utmost and to maintain the maximum speed in placing concrete. Before the construction crews went to the job complete detailed drawings were made for all structures involved in the construction plant and the plans for these were carried out consistently without change. The contractor deemed it economical to build a trestle exceeding the full height of the dam and to use in connection with this suspended chutes for delivering concrete. An exceptionally high degree of flexibility for the spouting system and a reduction to the minimum of mixer shutdowns on account of trouble in the delivery system are advantages claimed for this arrangement. Other features of the contractor's plant were screw conveyors for delivering cement and zig-zag concrete chutes to avoid a straight drop in the delivery of concrete.

Rock and sand for the concrete were obtained from pits in the stream bed above the dam. Two ¾-cu.yd. steam shovels and a 1¼-cu.yd. dragline skip delivered the materials from above and below water respectively to dump cars shunted into the pit. These cars were taken in three-car trains by locomotives, of which three were ordinarily kept at work in the pit, to the base of an incline leading up to the bunkers. The cars were rated at 4 to 4½ cu.yd. capacity but by heaping them up they were made to handle an average of 5 cu.yd. per load. The incline was 600 ft. long, built on a 24-per cent grade, and the cars were hauled up in three-car trains by an electric hoist at the top. With this equipment the materials could be delivered to the bunkers at a maximum rate of about 200 cu.yd. per hour and averaged, during periods of continuous operation, about 150 cu.yd. per hour.

From the hopper beneath the top of the incline the coarser material passed through a rock crusher and thence all of it went by bucket conveyor to the screens over the storage bins. Two screens were provided, each 40 in. in diameter and 20 ft. long. The rock



ARRANGEMENT OF THE TRESTLE AND SPOUTING SYSTEM ON EEL RIVER DAM

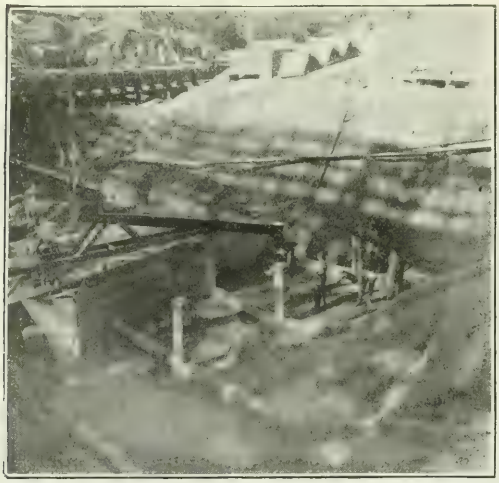
screen was divided into two 10-ft. sections, one having 1¾-in. holes and the other 3¾-in. holes. The sand screen delivered into the sand bin all material that would pass through a ⅛-in. opening. The three bins each had a capacity of 350 cu.yd. This arrangement being in accord with the finding, made before the work started, that concrete of maximum density would result when these materials were mixed in the proportion of 1:3:6, the 6 being divided into equal portions of fine and coarse rock as segregated by the screens. From these storage bins the materials went into the mixer hopper via a combination chute and measuring box.

In order to be at a point convenient for delivery of cement by motor trucks the shed in which the cement sacks were emptied had to be about 50 ft. away from the bunker structure. The plan first tried was to deliver loose cement from shed to measuring box by means of a 10-in. pipe set on a 45-deg. slope. When it was found that the cement would not flow satisfactorily on this grade a screw conveyor 50 ft. long was substituted which discharged into the cement measuring box. A second screw conveyor delivered the cement batches from measuring box to mixer.

The mixing equipment consisted of two 2-cu.yd. batch mixers, this capacity being selected with the idea that when the entire distribution system was in running order they would supply concrete as fast as it could be handled. During the height of the work it was found that as much as 175 cu.yd. of concrete could be placed per hour and that it was possible to average 1,500 cu.yd. per 12-hour day continuously. During the month of October a total of 31,500 cu.yd. of concrete was poured. As originally designed the dam was to have contained 86,400 cu.yd. of concrete. Of this total 79,200 cu.yd. were poured before the work was closed down for the winter.

At the outset of the work observation tests were made on concrete turned in the mixer for periods varying from 22 to 60 seconds, the time being measured from the instant at which the charge started into the mixer to the instant at which it started out. The result of these observations was the decision that a complete admixture of the materials was attained in three-quarters of a minute. As the mixers were operated at 13 r.p.m. a three-quarter-minute mixing period meant 9 turns per batch, and this was adopted as standard throughout the job.

Each mixer discharged into a bin with two outlet gates, the outlets being separated by a central partition of such height that a batch would fill the bin to a level just above the partition. Thus, after both mixers had discharged into their bins, it was possible to load four cars simultaneously. The outer walls of the bins were carried up high enough so that two batches of



DRAINS UNDER DAM BEFORE POURING CONCRETE

concrete could be put into each when desired, thus affording a storage capacity that sometimes avoided the necessity for shutting down the mixers on account of a brief delay somewhere in the delivery system.

Before any concrete was poured a driven-pile trestle was built close to the line which marked the upstream face of the dam. Piles, bracing and caps for this structure were all cut in the woods near by. The trestle was built to a height slightly above the top of the dam, but in order to keep to a minimum the length of the incline from the gravel pit the entire bunker arrangement was worked out so the mixers would deliver by gravity to cars that could run on an approximately level track to a stage of the trestle 12 ft. below its top.

When all the concrete which could be delivered by gravity from this level had been poured the tracks were moved to the top of the trestle. The remaining 10,000 cu.yd. of concrete was discharged from the mixers directly into the cars, the 12 ft. of elevation that made this possible being gained by eliminating the bins between mixers and cars. The cars were of 2-cu.yd. capacity with wedge-shaped bottoms and 12 x 24-in. gates on one side. A single track was provided on the trestle with sidings to enable incoming and outgoing trains to pass.

It was found that the operation of discharging concrete from the cars was delayed by the necessity for using a shovel to loosen concrete which caught in the corners. When this was discovered fillets were welded into the corners of the cars, thereby obviating the delay and saving for each of the two trains one-twentieth of the time consumed in its round trip, thus increasing by 10 per cent the rate at which yardage was placed in the dam.

A feature of the construction program was the use of four 50-ft. booms set about 80 ft. apart on the side of the trestle facing the dam. A hopper of capacity sufficient to hold two train loads of concrete was located alongside the track on the trestle and immediately above each boom. A zig-zag wooden chute connected this hopper with the inner end of the chute suspended from the boom. By means of the counterbalanced arrangement shown in the drawing on p. 753, each chute and boom could be swung so as to deliver concrete anywhere in its half circle of 100 ft. radius. The advantage of using four booms was that while the spouting system on any one of the booms was being changed or adjusted there was no stoppage of the steady flow of concrete, the cars being routed, in the meantime, to the next boom.

Beginning with the full spouting arrangement shown, as the level of the concrete rose, 10-ft. sections of the chute were removed from the outer end one at a time until only the section under the boom remained. The boom was then raised 48 ft. to a level just below the track, and the full length of suspended counterbalanced chutes were replaced.

The concreting crew included 18 men assigned to the following duties: Two men at each mixer, operating gates that admitted material to the charging hopper; one man charging and discharging each mixer (including operation of the water barrel); one gateman at the mixer hopper loading dump cars; two engineers on 3-ton gasoline locomotives that handled cars from mixer to trestle; two men opening gates on concrete cars; one man above the cars at dumping point to insure thorough dumping; one hopper man at head of the zig-zag drop chute; one rigger to swing and adjust booms and spouting system; one foreman and six shovel men in the concrete.

The forms consisted of 5 x 10-ft. wood panels, which were moved upward as the work progressed. These forms were held in place by tie-wires attached to runs of No. 6 anchor wires spaced 4 ft. apart vertically. With these stays on the inside and guy wires on the outside of the forms each panel was held in place without wood bracing.

Pouring was ordinarily continued in alternate, full-width sections of the dam 40 ft. long, a lift of about 5 ft. being made at a pouring. The forms were kept 10 to 15 ft. ahead of the concrete level and were stripped three days after pouring.

Plans for Greater San Francisco

A program of civic and industrial development in San Francisco was outlined by Dr. B. M. Rastall at the annual banquet of the Chamber of Commerce of that city. Dr. Rastall has been engaged for several months in making an industrial survey of the city and the address reviewed the important features of the comprehensive report he is making to the Chamber of Commerce. The first of these recommendations were: (1) Removal of Rincon Hill to permit location of industrial district south of Market Street with easy access to waterfront and access to railroads entering city. (2) Reclaiming and replanning of Islais Creek flats to provide additional industrial sites and elimination of present barrier to through routes from city to natural industrial districts to the south. (3) Construction of great industrial terminals at Hunters Point, which would have deep water dockage and direct connection with railroads. (4) Additional harbor facilities and progressive harbor management to take advantage of proposals 1, 2 and 3. (5) Extension of street car systems under single ownership with adequate financial provisions. (6) Replanning of isolated districts now laid out on checkerboard plan with 25-ft. lots to permit of modern home district development. (7) Development of future water supply, making available large excess amounts to attract certain classes of industry.

Interstate Water Conflicts and Possible Solution

A Discussion by Representative Engineers

SUGGESTIONS by R. I. Meeker, irrigation engineer, Denver, Col., in *Engineering News-Record* Jan. 27, p. 157, for interstate co-operation to avoid conflicts over water rights and also to further the more complete utilization of our water resources have brought words of approval from many engineers, particularly in the West. Some communications on this subject have already appeared under Letters to the Editor. Eight others are given here. The general ideas advanced by Mr. Meeker seem to meet with approval by all who have expressed themselves on the subject.—EDITOR.

By C. E. Grunsky

Consulting Engineer, San Francisco, Cal.

SOME METHOD must be found of apportioning the flow of interstate streams to those in the several states who can make beneficial use thereof. The adjustment of rights among numerous claimants in any one state cannot be satisfactorily made without regard to the beneficial use, present and prospective, of the water of the interstate stream in the other states which have contributing watershed areas or into which the water has been taken or can conveniently be taken by canal. Co-operation of the several interested states is desirable. But there should also be help, in some cases at least, by the Federal government.

It appears almost axiomatic that the state should forever remain in control of storage sites and of the regulation of stream flow by storage. On interstate streams and on projects of great magnitude the Federal government may well take the place of the state or act in co-operation with the state in this matter.

No other natural resource exists which can be developed to greater advantage than the water of the stream. Nature replenishes the supply at its source. There should, therefore, be a sufficient inducement held out to secure its early full utilization. The development of water powers will assist materially in conserving the supply of fuel. But whenever the development of the water resources by private enterprise is permitted care must be taken that the government does not lose control. No grants should be made without limit as to time. Moreover, the control of the reservoir which serves to regulate the stream flow should never be allowed to pass completely into the hands of private interests. The storage reservoir is an aid to economic water-power development. It is needed to augment the supply of irrigation water in certain months of the year when the stream is at low stages and the irrigation demand is large. It is also of service in providing a dependable supply of water for municipal use, and in many cases it can be used effectively in cutting down the peak of the stream's flood discharge. The irrigator's requirements for water do not always coincide with the demand for power, and both the power operator and the irrigator desire to have their reservoirs full at a time when the owner of land, subject to inundation by floods, desires to have the reservoir empty in order that when the flood comes a part of it may find lodgment in and be retarded by the reservoir.

The manipulation of storage facilities by the state would almost automatically put the state into police control of the stream, because delivery would have to be made of the water from storage to those who have established rights and this delivery would be subject to supervision. This control would be of great advantage in some of the states, as in California, where no provision has yet been made by law for water masters to regulate the taking of water from the stream by those who claim or who have definitely established rights to take water therefrom.

Whenever it can be shown that a water power project or an irrigation project, of which water storage is a feature, is economically desirable the state, or the state in co-operation with the United States, should provide the storage facilities and should then deliver the water from storage at such charges as will give the government a proper return. There is nothing novel about this method of procedure. It is on a par with what has been done successfully in several states. Massachusetts, through a water board, has expended more than $40,000,000 for the construction of storage reservoirs and conduits for the wholesaling of water to Boston and twenty-seven or twenty-eight neighboring towns.

On the interstate rivers, such as the Colorado, where the control of the water by storage should, to a large extent, be far down stream, the construction of reservoirs under co-operation of the seven states of which parts are in the watershed of Colorado River cannot be hoped for. The storage work on the Colorado River should be done by the United States and the impounded water should be delivered to those who are ready to generate power with it and to the irrigation canals at fair prices.

Mexico will be a beneficiary from any large properly planned storage project on the main Colorado. The international aspect of the matter, therefore, deserves consideration. If the United States can deliver some of the stored water of the Colorado River without detriment to the developments already under way in this country to Mexico this should be done under treaty arrangement, such that the service will be clearly defined and the compensation to be made by Mexico will be fair and proper. The service which Mexico gets at present from the Imperial canal system is not protected by any treaty arrangement. In this respect Mr. Meeker's suggestion that a treaty prevails is subject to modification. The only treaty which contains any provision relating to the Colorado River is the treaty fixing the boundary between the countries and this merely provides that the interests of the United States in the navigability of the river shall be safeguarded. The canal which conveys water from the Colorado River into the Imperial Valley passes through Mexico and is managed upon Mexican territory by a Mexican corporation which is a subsidiary of the Imperial Irrigation District. The concession which Mexico granted in 1904 to this corporation contains a provision under which the Mexican land owners may use the water of the canal to one-half of its amount. It is under this concession that water diverted from the river on United States territory becomes available for the lands in Lower California. As Mr. Meeker would have it, there should be an agreement reached between the United States and Mexico relating to the irrigation development in Mexico which can be sanctioned by the United States, just as there should be co-operation between states on interstate streams, where a delimitation by artificial state boundaries of territory within which rights are granted and protected results in absurd situations.

By F. E. Weymouth

Chief Engineer, U. S. Reclamation Service, Denver, Col.

THE article by Mr. Meeker leaves one with a pleasant sense of agreement and expresses a trend of thought now developing. At least among engineers we are turning from legal strife as the solution of the question of rights in interstate streams to a more constructive view.

The article shows a viewpoint a long step in advance of the attitude held in the very recent past and still held by some. It shows recognition of the rights of users in the lower states. Interstate conflicts have arisen from just one cause—water which had been used in a lower state was diverted and used in a state higher on the stream. Generally these later diversions have prevailed over priority rights in another state. I do not know that any great actual destruction of property values has been caused by such diversion but it cannot be denied that there is a moral obligation to respect the lower rights.

Divided interests on a stream certainly do not make for the best development of the stream. The officials of the upper state have no jurisdiction to administer the stream within their state for the benefit of a lower state and to the detriment of the lands of their state. Once the development of the upper state has taken place it is idle to talk of an adjudication which may destroy the communities of the upper state in order to re-establish conditions which may have existed years before.

In general the present stage of development on most of our streams is such that the dispute is over the natural flow of the stream. There is generally at the flood period surplus water which can be stored and regulated to supply all rights. Instead of adjudications and legal battles, Mr. Meeker advocates replacement storage as a constructive way of dealing with the situation.

This is the course followed in the highly developed regions of eastern Colorado, all within the state and subject to one control. The Reclamation Service in its developments on a stream of necessity does not recognize state lines and must consider all existing rights. Some of its reservoirs are replacement reservoirs. It is comparatively easy to provide for existing rights by building a reservoir because these rights are already determined, but what of the potential rights which each state has in every stream flowing through it?

Irrigation development is not static; each year new acreage comes under ditch, a growth unnoted and unheralded. Periodically a crop of new and ambitious projects springs up. These possibilities are the potentialities which each state wishes to see developed within its borders whether or not it may jeopardize some older development where some teeming community is thriving. Another feature adds now to the importance of careful consideration of the proper regulation and development of the rivers of the West. Heretofore irrigation has been paramount, and it still is in general, but there are portions of the West where water power is now considered more vital.

Recognition of the necessity of considering potential rights as well as existing rights is the reason for the existence of the League of the Southwest and the Colorado River Commission, which organization consists of representatives from the Reclamation Service and from the seven Western states lying partly or wholly in the basin of the Colorado River. Here the interests of the Republic of Mexico must also be considered. Not so many years ago such an organization could not have functioned, perhaps partially due to mutual misunderstanding but mostly because there would have been nothing definite on which to work. But now the irrigation and power possibilities in the basin have been fairly well outlined and, fully as important, data have been gathered from many sources which enable the prediction with some degree of accuracy of how much water will be consumed in growing crops and how much of that which may be diverted will return to the stream.

All the engineers of this committee are agreed that the best solution of the Colorado River problem is the construction of a large reservoir at Boulder Canyon, or vicinity. It will provide in advance the replacement storage advocated by Mr. Meeker and will in effect separate the Colorado into two rivers, the Upper and the Lower. At present, while widely separated by distance and with entirely different economic conditions, the two parts of the basin are mutually interdependent as to water supply and development in one part may jeopardize the water supply for another.

The result of the work of this league may be virtually an apportionment of the waters of the Colorado to the different states. If it works out satisfactorily, as we now expect, the same basis may be used in solving problems connected with other large interstate streams. While the Colorado is a large problem, yet its relative abundance of water supply does not create, from an engineering viewpoint, so delicate a situation as exists on other streams where land and water are more nearly balanced.

The Reclamation Service has in the last few years investigated projects which involved a detailed study of the entire stream similar to that now being made on the Colorado River. In essence this is what Mr. Meeker advocates and what is being done now co-operatively on the Colorado River. Notable examples are the Rio Grande and the North Platte, the latter in co-operation with the State of Wyoming. A striking feature of both these streams is the large area of seeped land lying in the flood plane of the river. Lateral seepage from the river, aided by irrigation diversion, brought about this condition, which could be remedied easily by drainage. These seeped areas are now in some cases evaporating more water than would be used if they were drained and irrigated. In consequence drainage will release water which may be used at some point downstream. I believe, therefore, that in addition to reservoirs drainage is needed before each state can realize in full its potential rights in the Rio Grande and North Platte and many other streams. While drainage of old lands can be brought about only by awakened public sentiment, yet precautions can be taken to see that new projects provide adequate drainage.

It is certain that far more can be accomplished by a dollar if it is used to drain and rejuvenate old partially abandoned lands, which naturally were the first and easiest irrigated, than if it be used to build ditches to cover new lands. Then, too, it seems not improbable that the water released by drainage may sometimes react favorably to the water supply for canals above. The effect may be the same as replacement storage. It behooves each state to study and aid in the development of its neighboring lower state if it has in mind its own largest potentialities.

By John E. Field
Consulting Engineer, Denver, Col.

IT IS to be hoped that Mr. Meeker's article will bring about a definite attempt on the part of the several states to get together.

Time in interstate water suits, as in many other things, tends to solve questions apparently much involved. It is the opinion of the writer that interstate difficulties are largely imaginary, theoretical or academic, and in time will largely disappear. For instance, the constantly increasing return seepage to the South Platte River is even now furnishing to Nebraska ditches a greater volume than was available during low water before irrigation was commenced in Colorado, and practically all the ditches need. The virtual abandonment of the use of water from the Laramie River on lands on the Laramie plains has left water for lands near Wheatland, Wyo., and for the Greeley-Poudre tunnel, even before the Colorado-Wyoming suit has been decided. The lack of financial success of the canals and lands in western Kansas tends to eliminate the insistence of Kansas on their claimed rights. The rapid development of drainage systems in the San Luis Valley will return much water to the Rio Grande, and by the checking of evaporation from the wet areas will compensate for any additional waters diverted by uses in Colorado. The growing knowledge of the amount of water available for use on the lower reaches of the North Platte and the return seepage indicates that water may be used in Wyoming and Colorado without affecting materially the use in Wyoming and Nebraska, especially under the government projects. The economy of use, better administration and detailed information of the limited areas irrigable on the western slope of the Continental Divide in Colorado, and the almost unlimited supply in the Grand River, show that transmountain diversions can be made without injury to western-slope users.

While it is the firm belief of the writer that physical conditions are such that Colorado cannot be and will not be injured in her ultimate development, interstate suits and prohibitions, uncertainties and possible adverse decisions will delay natural and proper development, in some cases, even beyond the present generation. It is this unnecessary delay to which Colorado objects and against which she must defend herself. The appropriations and large expenditures by the state have been necessary to secure data, to conduct a campaign of education both at home and abroad and to defend herself when attacked.

The time is probably now here when, with the information on hand, two states may sit down and draw a treaty of peace. Colorado fears no development in adjoining states

but she does fear the promulgation of laws or rules academic in character and temporarily detrimental to her present interests.

Mr. Meeker speaks of interstate ditches and mentions the Mitchell canal. As a matter of fact the state engineer of Nebraska has crossed the Wyoming line and has regulated this canal just as though it were all in Nebraska. In the proposed "treaty of peace" such action would undoubtedly be sanctioned.

Other instances of state co-operation are as follows: On the Republican River the Colorado water commissioner and the ditch company co-operate to make the distribution of the water in the Interstate ditch between the users in Colorado and those in Nebraska in accordance with the finding of the court. On the Pathfinder (North Platte Project) the reservoir so nearly regulates the flow of the stream that there is water for everybody, and most if not all ditches have purchased reservoir water from the Reclamation Service. Here, too, anticipated difficulties have vanished by common horse sense, business-like handling of the problem by the parties interested.

The most important item of interstate problems is the economic phase. Modified, perhaps, somewhat by property rights, the highest and best use of the water is in the public interest, and, indeed, in the interest of the users also. Entering into the economics of the problem are (1) losses in a river bed; (2) availability of the return seepage for irrigation; (3) the duty of water, the amount which in addition to the rainfall is necessary for the irrigation of an acre of land, the unit of volume being measured at the source of supply; (4) the crop return per unit of volume of water used, with due regard to whether the product is an essential or merely a desirable "luxury" crop; and (5) whether the area to be irrigated in addition to raising crops is desirable as a place of residence for the land owner.

The higher up on the stream water is used the less is the loss in transit in the river bed, and the oftener are the return waters rediverted and reused. In the semi-arid region the streams lose in volume after leaving the foothills, especially during low flow, when the water is most valuable. The farther we get from the mountains the less the fall and broader and sandier the stream bed. The rainfall decreases from the foothills to a point where the effect of the approach to the humid region is felt. In Colorado the precipitation decreases for about 100 miles from the mountains easterly, and from there it increases gradually until the non-irrigation section is reached at about meridian 100. The water should therefore be used as near the foothills as is practicable.

While fruit and semi-tropical products have come to be a regular part of our daily diet, they still are not as essential as wheat, oats and the cereals generally. Furthermore, the cereal area of the United States is limited and little remains undeveloped, while the unused area suitable for semi-tropic crops is very great. Greater weight should be given, therefore, to the necessities of those regions capable of raising the cereals and such crops as are produced in the colder sections of our country.

The production of crops is desirable and necessary, but more desirable and more necessary to our national welfare is the production of homes, and especially of farm homes. There is no better place for homes than on our high plateau regions.

If state lines are to be eliminated (see *Engineering News-Record*, Feb. 10, p. 274) then let users in Colorado purchase the lands in western Kansas, cease such irrigation as interferes with the irrigation on the higher reaches of the river, and convert the Kansas land to such use as it is better fitted for. Conversely, if Kansas land owners can afford to pay for water rights in Colorado and transfer them to Kansas let them do so. In the end better land will be irrigated, more crops produced, more homes established and the lands less valuable for crop production would revert to some other use. Under such a rule of transfer Colorado feels that no water she needs would pass beyond the borders of the state.

In my opinion, no necessity exists for any general rule or law in regard to insterstate matters. In all the cases in which Colorado is or may be involved, and in all others with which I am familiar, the physical condition and historic facts are such that each case contains within itself the basis of a practical equitable solution. When the Western states sit around a peace table this condition will be apparent to all, and the peace terms can be drawn for each drainage area with justice to all and prejudice to none.

By D. C. Henny

Consulting Engineer, Portland, Ore.

THE existing conflicts between the interests and rights of adjoining states in the matter of economical use of water in interstate streams has been clearly set forth by R. I. Meeker in *Engineering News-Record*, Jan. 27, p. 157. He quotes several interesting instances, some of which are pending in the U. S. Supreme Court, while others must ultimately go there for final decision. The number of quotations can be readily multiplied. On the California-Nevada line state rights are involved in the control of Lake Tahoe, the outflow from which enters Nevada. An opposite question, so far as California is concerned, is likely to arise on the Klamath River, which flows from Oregon into California, and also on the lower Colorado River, where in addition an international question is involved. Another international problem is presented by the St. Mary and Milk Rivers, both flowing from Montana into Canada, the Milk River, however, returning to the United States. This particular subject is covered by a treaty with Canada to which, however, Montana, claiming rights in both rivers, could in the nature of the case not be a party (see *Engineering News-Record*, Dec. 30, 1920, p. 1277).

Mr. Meeker quotes claims made by the State of Washington on behalf of its Columbia Basin project. Storage is required on the Pend Oreille River in Idaho and on the Flathead River in Montana. The United States is directly interested in Flathead storage, which is in an Indian reservation, while an international question is involved, since heavy diversion (20,000 sec.-ft.) from the Pend Oreille River and storage in the upper basin may affect Canadian rights. Use of Columbia River flow for power by the construction of dams across the stream at such points as Priest Rapids and Celilo Falls may also be complicated by an international question, as an existing treaty with Canada provides for an open river from the Canadian line to the sea. Another international question of great importance may arise on the lower Rio Grande, where an area of nearly 200,000 acres has been highly developed by irrigation pumping, all situated on the American side. At times of extremely low stage practically the entire river flow is used. Excellent and easily reached irrigable lands lie on the Mexican side and since the greater part of the flow originates in Mexico claims may be set up by it in the future to part of the water.

The general problem, so far as it is a purely technical and economical one, can undoubtedly be treated satisfactorily by engineering commissions such as Mr. Meeker suggests and one of which relating to the Colorado River has been organized recently. So far as the problem is a legal one the obstacles in the way of early progress seem almost insuperable, partly due to the usual attitude of the legal mind, which worships precedent and is but rarely constructive.

The problem, at least as it presents itself in the West, would be brought somewhat nearer solution if a Federal Department of Public Works were created as provided in the McCormick senate bill. Such a department would have or could most effectively collect the necessary physical and technical data. It would have the advantage of a trained legal staff familiar with engineering problems and imbued with a spirit of overcoming obstacles and suggesting remedies. On the one hand such a department could invite the co-operation of the individual states and on the other it would be in close touch with the State Department for the treatment of international phases of the work.

Whatever means are employed to clarify the present serious, uneconomical and embarrassing muddle, engineers should recognize that at present the most formidable obstacle is not technical but legal and that in the formulation of any program constructive legal advice is indispensable.

By C. J. Ullrich

Deputy State Engineer, Salt Lake City, Utah

QUESTIONS of adjustment of interstate water conflicts, the determination of water rights and the regulation of the flow of interstate streams are becoming of moment to most Western states, not only with respect to the larger interstate streams but also with respect to the smaller ones on most of which the normal flow has been already over-appropriated.

On the smaller interstate streams the interests of only two states are as a rule involved and the interstate problems are not as numerous and conflicting as are those on the larger interstate streams; also the methods applicable to the solution of these problems are not always applicable to the larger interstate streams, and if so they may become cumbersome and unwieldly in application.

The problems involved in working out an economic plan of ultimate utilization of the water in interstate streams are generally peculiar to each stream and no hard and fast rule can be laid down for their solution. However, the basis for adjusting such problems must be co-operative authority. Unless such authority is delegated to some state official in each state there can be no starting point. Realizing this lack the state engineer of Utah has recommended to the legislature the enactment of a law providing for co-operation with Wyoming in the determination of the rights and the regulation of the flow of Utah-Wyoming interstate streams, contingent upon Wyoming passing a similar law. There are several streams, including the Bear River, flowing between these two states.

Under the present irrigation and water rights law of Utah no cognizance is taken of prior rights in an adjoining state on interstate streams nor has the state engineer power to grant applications that contemplate the appropriation of water in Utah from such streams to be used in Wyoming. This condition has resulted in blocking several smaller irrigation projects on these streams because no valid title to the use of the water could be secured from the state. The recommendation of the state engineer is meeting with favor among the legislators and it is hoped that it will be enacted into law.

The writer agrees with Mr. Meeker that the enforcement of interstate priorities is not always practical. The physical conditions of the watershed, location of reservoir sites, replacement storage, return flow and the equitable proportion of state benefits may all mitigate against the enforcement of such priorities. Should interstate priorities be enforced under adverse conditions it means that the ultimate utilization of the water of a river system is an impossibility. The Federal courts in adjudicating rights on interstate streams have in the past adhered rigidly to the enforcement of such priorities. While the theory of Western water rights law upholds this procedure, the writer doubts its efficacy.

Within the states priority of right should be fundamental, but as between states the doctrine of the greatest good to the greatest number should prevail. The foundation of state prosperity is agriculture and to deny the citizens of a state the use of water from an interstate stream merely because citizens of an adjoining state have a prior claim at the lower end of a stream is denying the state the right of developing its agricultural possibilities. The history of irrigation in the West has proved that the use of water on the upper reaches of a river system is of benefit to the users on the lower river as the return flow in the course of time builds up the low water flow to a point where it stabilizes the lower rights as against seasonable low water fluctuations.

Again, the enforcement of interstate priorities upsets intrastate priorities that may have been established through state courts or other state agency and renders uncertain and indefinite what has already been declared as certain and definite. In other words, it makes a title to the use of water granted by the state questionable and may result in upsetting industrial and agricultural development initiated by virtue of the state having granted or decreed the title to the use of water.

The writer does not wish to convey the impression that interstate priorities should not be enforced, for they should be, but only when their enforcement brings about the ultimate utilization of all the water of a river system.

The method now being followed on the Colorado River for the solution of interstate water conflicts, as outlined in Mr. Meeker's article, appeals to the writer as the proper one, for it is based on co-operative authority exercised through a commission.

By J. C. Stevens

Consulting Engineer, Portland, Ore.

THERE is no question in my mind but that the old lower-river vested right must for suitable considerations give way to the growing demand for increased agricultual development. While assistant state engineer of Nebraska in 1902-03, I knew of cases where, in order to supply lower-river vested rights for one acre of land, water enough was lost in transit by evaporation and percolation to have copiously irrigated from five to ten available acres on the upper river. Many such instances can be cited for the Platte, Republican and Arkansas River basins.

Where such conditions exist on interstate streams the control must be vested in an authority not bounded by state lines. Where conditions permit one obvious solution is to pool all water rights, construct impounding reservoirs and have the water distributed by some such unrestricted authority. Where adjoining states have similar irrigation district laws there appears to be no reason why an entire drainage area could not be organized into a single irrigation district regardless of state lines. Many irrigation problems that a few years ago appeared impossible of solution are today being successfully handled by properly officered irrigation districts. Such districts, working in co-operation with federal agencies, will be able not only to make the vitally necessary engineering investigations but also successfully to finance the construction of irrigation works.

It is not likely that a general solution of these problems can ever be made. Instead each interstate stream will probably have to be handled on its own merits.

By J. B. Lippincott

Consulting Engineer, Los Angeles, Cal.

In arid America the question of the division and distribution of water is of intense interest, vital to the life of the communities concerned. Therefore, as R. I. Meeker (*Engineering News-Record*, Jan. 27, p. 157) proposes a plan for dealing with the largest rivers in the western half of the country, his subject becomes correspondingly important. As he states, with many of the largest streams, such as the Platte, Rio Grande and Colorado, there is special necessity for broad and impartial study of the maximum benefits to be obtained. The available water supply is largely the measure and the limit of the ultimate development of the region in which it is used.

Throughout arid America it is recognized, with reference to the ownership of water, lands and minerals, that he who is first in time in his application is the first in right, and as far as the water is concerned that beneficial use is necessary for maintaining ownership. In the regions of Europe practicing irrigation this theory is basically the principle of the Latin law relative to water and is distinct from the riparian law, which is derived from England, a humid country, where water is of value principally because of its bank rights. Right based on priority has been accepted generally throughout their arid regions, in some states being modified by a peculiar blending with the riparian laws. It is recognized as the international basis of settlement of conflicting claims on the Rio Grande where the United States has contracted to deliver fixed amounts annually to the intake of old Mexican canals opposite El Paso. This general theory of recognizing priorities has been recommended for the division of the Nile between Egypt and the Sudan.

Water is "property," and it would be exceedingly difficult if not unconstitutional for any state or other authority

to attempt to take prior vested water rights away from lower areas on a stream for the benefits of districts situated on the headwaters of the rivers, as suggested by Mr. Meeker, irrespective of the relative benefits that might accrue from use in either place. It would be impossible to proceed with the development of great projects on the lower Colorado or Rio Grande that are now under way if there is to be a serious prospect of the water ultimately being withdrawn for use on other areas higher up in the drainage basins.

For years there has been a demand on the part of the Western States and territories to break away from Federal control of national resources. Where the central government has yielded to the state in these demands the results have generally been unsatisfactory. The handling of state school lands and the extravagant if not illegal distribution of the swamp and overflow lands given to the states illustrate this. The attempt on the part of the states to carry out the provision of the Federal Carey irrigation act involving grants of public lands to them is another example. The states are not only jealous of the authority of the United States within their boundaries but they are also exceedingly suspicious and aggressive against each other, as indicated by the strife between Colorado and both Kansas and Nebraska over the Platte and Arkansas.

Federal authority, as represented by the U. S. Reclamation Service, the U. S. Geological Survey and the U. S. Department of Agriculture, has demonstrated its integrity, ability and fairness in its discussions of land and water problems in arid America. The government is the largest owner of land and riparian rights on our interstate streams. As owner of public lands, which when reclaimed must bear largely the cost of construction for their development works, the United States naturally would insist on the control of expenditures and the determination of public policies relative thereto. The accomplishments of the Federal government in reclaiming lands, particularly through the agency of the Reclamation Service, are in vivid contrast to the failures of the states in the handling of such problems. The solution by the government of the Rio Grande problem, involving three states and two nations, has been eminently satisfactory. The same is true of the Colorado River, where projects have been built for the benefit of Colorado, Utah, Arizona and California. Their plans are maturing along rational lines and there is no apparent reason for terminating their authority.

No particular injustice has been observed in interstate irrigation projects that have been operated by the Reclamation Service. States dealing between themselves would have had greater difficulty. Manifestly the states could not properly deal with international adjustments of water problems such as occur with Milk River on the Canadian border, and the Colorado and Rio Grande in Mexico.

Mr. Meeker writes of the saving that would follow the use of water near the headwaters of streams as compared to utilization on the lower reaches where extensive losses by seepage and evaporations occur. It is also true, however, that crop values per acre are often greater in lower, warmer elevations than in higher mountain meadow lands. The adjustment of these problems of vested rights and economic values by the regulation of floods is highly desirable. It is difficult to see how this can be accomplished other than by Federal authority. Surely states such as California and Arizona would have to wait a long time for Colorado and Utah to assist in the extension of their irrigated areas. California and Arizona could not well construct great storage reservoirs outside of their boundaries.

Mr. Meeker refers to the recommendations of the League of the Southwest, as indicated by the resolutions adopted at the last convention at Denver. The policy outlined by these resolutions is not constructive and it is inimical to the broadest developments of arid America. The U. S. Department of the Interior has withdrawn public lands in known reservoir sites; for instance, in the basin of the Colorado River, pending a broad and comprehensive study of the regulation of that stream and its utilization for the development of water power and irrigation. These investigations have proceeded diligently and continuously. The high mountain states resent the withdrawal of these reservoir sites from public entry for the possible benefit of lands on the lower portions of the stream. On the one hand the resolutions of the League of the Southwest insist on the immediate opening of these withdrawn areas for various forms of private use, and at the same time they propose a conference of state and national officials for the purpose of considering a general agreement to be ratified by state legislatures and act of Congress for the division of the waters. It is manifest that this would bring about acrimonious and involved negotiations extending through a term of years. In the meantime these natural opportunities would be largely lost, due to minor private filings. It is contended by the writer that such a policy would be much less to the general public interest than that which now obtains, to wit: the holding of these natural opportunities under Federal control, pending an investigation by a comprehensive and impartial authority.

It is believed by the writer that (1) the work which has been done by the Federal government for the reclamation of arid lands has been satisfactory; (2) that the administration of state land grants has been unsatisfactory, and (3) that it would be a mistake to throw this subject into a conference of partisans. The introduction of a congress of engineers and attorneys representing state rights and ambitions would lead to confusion, strife and delay. It is hoped that the U. S. Reclamation Service, which is an organization free from politics, scientific in its work and efficient in its construction, will be continued unhampered in carrying out the great work which it has demonstrated it has capacity to perform.

By John T. Whistler

Consulting Engineer, Chicago

PROBABLY no more glaring example of injustice arising from *intra*state administration of *inter*state streams can be found than exists on the Bear River, Utah-Idaho.

Bear River rises in Utah, flows into Wyoming, thence into Idaho and finally into Utah and Great Salt Lake. The waters of Bear River in Utah are over appropriated for the period of low discharge, while in Idaho there is practically no shortage. Rights from the river in Utah are all adjudicated and diversions are regulated by the state. Subsequent in time to other decreed rights certain lands in Utah acquired a right in Idaho to divert just above the state line, and since the diversion point is above those of other users in Utah these lands with an Idaho right have in effect a water right superior in fact though inferior in time to other Utah lands.

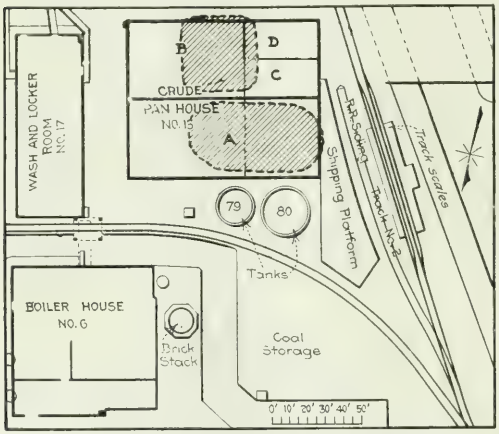
This statement may not be entirely correct in detail, but even if incorrect in all particulars it well illustrates the necessity for some other than the present method of administering interstate streams. What this method must be will be indicated by the outcome of the long pending Laramie River case in the Supreme Court referred to by Mr. Meeker. "Home rule" is certainly desirable in just so far as it can obtain without injustice. Results in other interstate matters would appear to justify the conclusion that a definite and satisfactory solution of the problem by co-operation of the states acting as individuals will at best be a matter of a great many years. On the other hand Federal regulation of interstate transportation matters, for example, has been quite satisfactory.

Our Federal Government was originally organized for the very purpose of administering matters of interstate interest and to avoid a conflict between states. Does not the logical solution of the problem therefore appear to be to await the result of the pending Laramie River case in the Supreme Court, which is expected to determine the constitutional status of rights from interstate streams, then provide for administration by the Federal Government either by appropriate legislation by Congress or by constitutional amendment as the finding of the Supreme Court may indicate to be necessary? In any case the Federal Government must be a party at least to the administration of such international streams as Rio Grande, Colorado River and Milk River.

Effect of High Temperature Fire on Concrete Building

Burning Naphthalin Fuses Concrete and Wrecks Structure of Barrett Mfg. Co. at Frankford, Pa.—Greatest Damage Due to Collapse of Steel Monitors

LAST June a reinforced-concrete building in the chemical plant of the Barrett Manufacturing Co., at Frankford, near Philadelphia, Pa., was wrecked by a high-temperature fire from burning naphthalin, a coal-tar product being stored in the building. Since then the owner has been studying the design of the structure, with a view to its rebuilding, and has preferred to withhold the details of the fire until some decision could be reached as to the proper design for such occupancy It has now, however, released the following information regarding the building and fire. Part of this information was obtained in an inspection of the building last summer and part from papers read before the recent annual meeting of the American Concrete Institute.

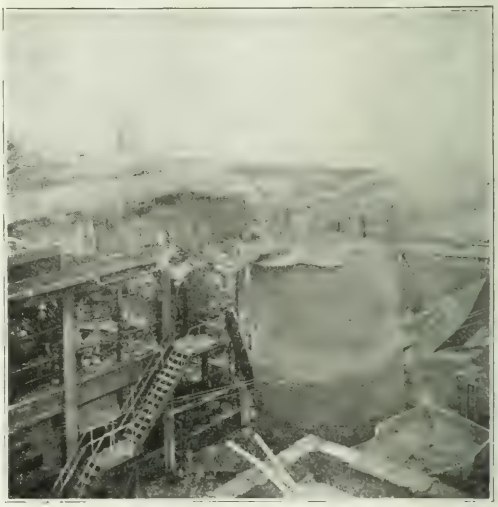


LAYOUT OF PLANT WHERE FIRE OCCURRED

The building in question was a two-story reinforced-concrete structure, 86 x 106 ft. in plan, and divided into two symmetrical parts by a 13-in. brick wall the long way of the building. The first floor was on the ground, and the second consisted merely of beams and girders with no floor slabs. This peculiar construction is due to the occupancy, that is, the cooling of naphthalin. The naphthalin is stored in large, flat pans resting directly on the beams and girders and at intermediate levels at each floor on wooden horses or trestles. The entire structure was of reinforced concrete, except two light monitor roofs, as shown in the cross-section herewith, of unprotected structural steel. The details of the reinforced-concrete design are shown in the accompanying drawings. The columns are square, 18 x 18 in. in the first floor and 12 x 12 in. in the second, and are reinforced with straight rods bound at 12-in. centers by light wire binders. The beams and girders are reinforced by a loose rod system, heavily stirruped and with continuity rods extending well into girders and through the columns. Details of the roof itself are not available, but the structural steelwork is open to the second floor except at the monitors where there was a 3½-in. slab as shown over a part of the sloping roof between the monitors.

On one side of the building about 20 ft. distant from the wire-glass windows were two steel tanks in which naphthalin was stored. The fire started early in the morning and was apparently due to a "boil over" in one of these tanks. The molten material ran out into the yard of the plant and about 150 ft. distant into the boiler room, where it caught on fire and the fire ran back over the surfac of the liberated naphthalin and soon distributed the flames to the naphthalin pans inside the building. The plant watchman was notified of the fire at 5:55 a.m., the naphthalin from the exploded tank being on the ground burning at that time. At 6:30 a.m. the destruction of the building was practically complete; that is, the building was brought to its final failure in about 45 min., which is an indication of the quickness and severity of the fire.

Due to the extreme heat generated by the flames there is very little reputable testimony as to the behavior of the structure during the conflagration. It is to be noted, however, that the steel monitors collapsed almost immediately the fire started inside the building, and, except for a portion of the building as shown on the plan, they carried down with them in their fall the full second story of the building. The fire also attacked the monitor farthest from the tank and that collapsed, causing destruction on the second floor of the section beyond the fire wall. Naturally, the heat was most intense in the section exposed to the tank and here the destruction of the concrete itself was most marked. On the side toward the tank, for instance, there is obvious evidence of fusion of the concrete, as shown in the accompanying view. There can be no



LOOKING OVER TANKS TOWARD WRECKED BUILDING. COLLAPSED MONITOR AND ROOF

question that the temperature at this place reached such a height as to cause fusion. In all previous fires, it may be noted, such an occurrence has been very rare. The steel mullions to the window frames here also melted and ran down the frames in places.

The typical failures are shown in some of the views. The columns spalled off on the corners, the reinforcement softened and bent and the columns cracked as shown. The edges of the beams also spalled, exposing the steel, which softened, bent and in some cases broke, dropping the beams. It is difficult to tell how much of the failure was due to the impact of the falling monitor and how much to direct fire damage.

TYPICAL FAILURE IN SECOND FLOOR

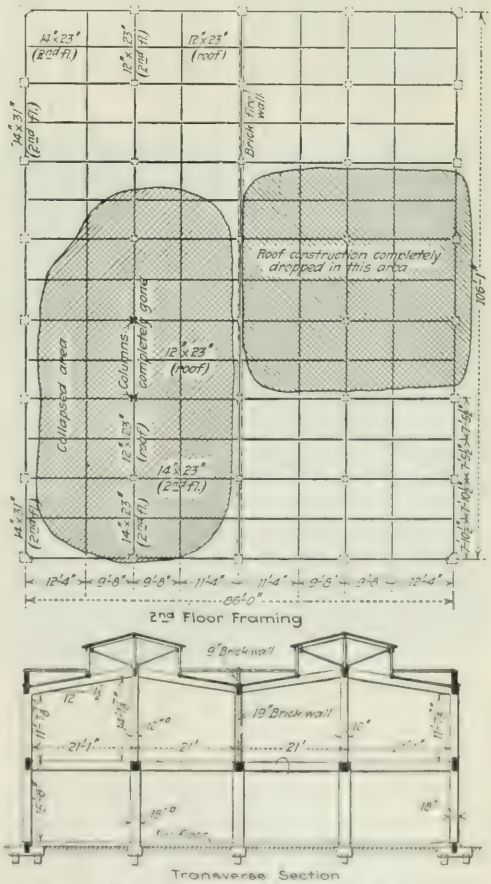
Some of the comments on the design of the building and on the probable design of another building for the same occupancy are taken, as follows, from a paper by W. A. Hull of the U. S. Bureau of Standards:

The building was of modern design and recent construction. It may be regarded as a first-class reinforced-concrete building. However, in connection with the failure of the columns supporting the roof structure, attention should be called to the fact that computation shows that the unit stress on the concrete core of these columns, when a deduction of 2 in. all round is made for fire protection, is somewhat in excess of that ordinarily allowed in engineering practice. Assuming continuous beam action, which probably approximated the true condition, the reactions at the center support are increased by 25 per cent. It should also be taken into consideration that the interior columns presumably expanded more than the wall supports when subjected to fire conditions and that this would still further increase the load sustained by these columns. All of the loads allowed for in computing the stress on the concrete in these columns, with the exception of approximately 15 per cent (the roof live load) were due to the weight of the structure and were actually on the columns at the time of the fire.

The center roof girder was designed with the assumption that it would be fully continuous, which perhaps represented the actual condition except in the end spans for which no details are shown. The roof beams were designed for a bending moment of $\frac{1}{10}$ WL which is ordinary practice for continuous beams of two spans. The maximum diagonal shearing stress in both beams and girders was about 60 lb. per square inch, and what would be considered adequate additional web resistance was provided in the form of bent-up bars and light stirrups.

The coarse aggregate used in the concrete was gravel obtained from the Delaware River near Bridesburg. There was nothing extraordinary about this aggregate; it would properly be classed as a highly siliceous rather than a limestone gravel.

The failure of this building to withstand the attack of the fire presented the engineers of the Barrett company with a new problem, or rather with a series of new problems, for they had to consider not only the reconstruction of this building but also the question of safeguarding other buildings, already in use, in which unusual fire hazards exist. This building had been built according to good practice in design and construction and was regarded as the last word in fire-resistive construction, yet it had failed to resist the attack of a severe fire. It is needless to say that the owners of this building expect to be able to prevent a recurrence of such a fire in the new building but they realize that they have a hazardous occupancy and that there is the possibility of another fire in spite of all precautions. The question of how to build at reasonable cost a building that would be able to withstand such a fire had to be answered.



PLAN AND SECTION THROUGH NAPHTHALIN BUILDING WHICH BURNED

Many things were considered. The advisability of rebuilding in concrete was seriously questioned. Such expedients as substituting brick piers for concrete columns and of protecting the concrete structural members with

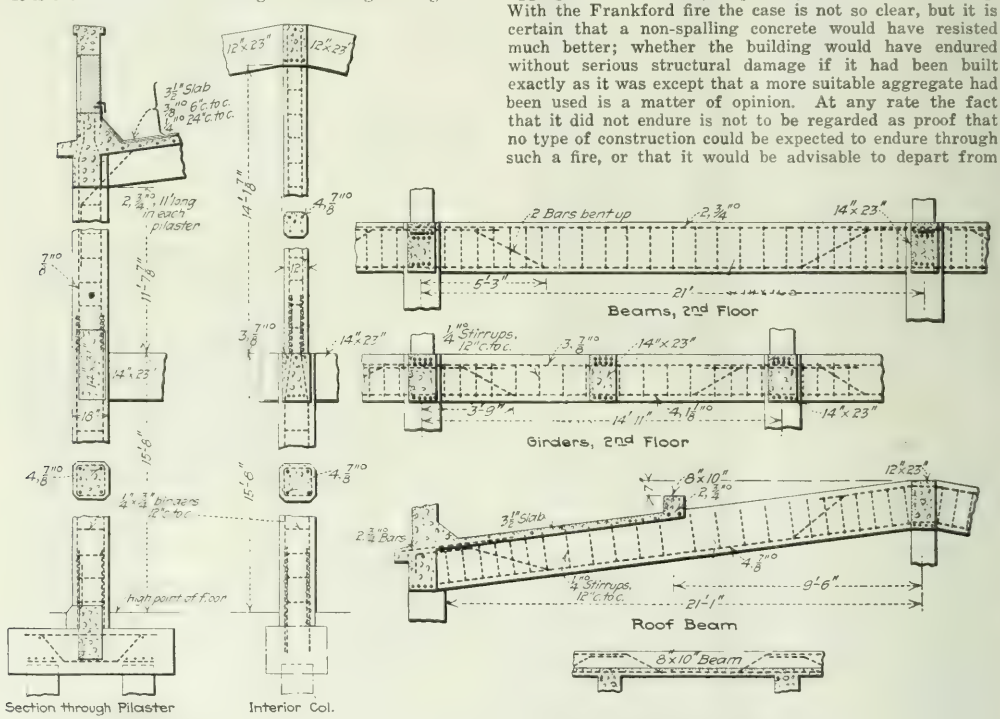
burned clay in some form were considered. It was a case that could not be disposed of by saying that nothing could be expected to withstand such a fire. If the best concrete construction were not going to be suitable it was obviously necessary to try to find something else that would. However, a careful analysis of the matter brought out the fact, very strikingly, that the building that was damaged, although first-class in every other respect, was absolutely unsuited to the resistance of a quick, sharp fire, and that the results did not differ widely from what was to be expected of this type of structure. The fact was also brought out that the failure of this building did not justify the conclusion that concrete construction is not suitable for such an occupancy.

It is the writer's understanding that the engineering staff of the Barrett company decided to rebuild in concrete, although because of prevailing business conditions the structure has not yet been replaced. It may be worth while, however, to review some of the points which led to the conclusion to rebuild in concrete.

As has already been stated, this building, first-class in other respects, was by no means of the best type of fire-resistive construction that can be built, within reasonable cost limits, of reinforced concrete. In the first place, the gravel aggregate used in this building belongs in the class of aggregates that have a strong tendency to spall when exposed to quick fires. The square columns and rectangular girders made spalling relatively easy. There was, of course, nothing provided, in the way of metal mesh or other tie, to prevent the loss of the protective concrete by spalling. It has been demonstrated repeatedly, by actual fires and by fire tests, both in this country and in England, that this type of concrete building does not resist quick, hot fires well. This is the second notable case in which such construction has failed after a comparatively short exposure. There have been a number of other cases which have been less spectacular and have received little if any publicity.

In the case of the Far Rockaway fire and of the one at Frankford the process of destruction was essentially the same. Large portions of the outer protective concrete spalled off, leaving the load bearing concrete and portions of the reinforcement exposed directly to the fire. Neither steel nor load bearing concrete is adapted to withstanding such exposure, and this is particularly true of concrete made from a highly siliceous aggregate. In the case of the Far Rockaway fire it seems reasonably certain that had the building been identical in all respects except aggregate with the building that was so badly demaged it would have come through the fire without structural injury. In this case the same construction would have "got by" if the concrete had been of a non-spalling type made with a coarse aggregate of limestone, trap rock, or blast furnace slag. With the Frankford fire the case is not so clear, but it is certain that a non-spalling concrete would have resisted much better; whether the building would have endured without serious structural damage if it had been built exactly as it was except that a more suitable aggregate had been used is a matter of opinion. At any rate the fact that it did not endure is not to be regarded as proof that no type of construction could be expected to endure through such a fire, or that it would be advisable to depart from reinforced-concrete construction in building to house such an occupancy. The type of construction as well as the aggregate was poorly adapted to resist spalling and other structural damage. The long, slender, square columns and long girders without special ties for the protective concrete made the building particularly liable to such effects.

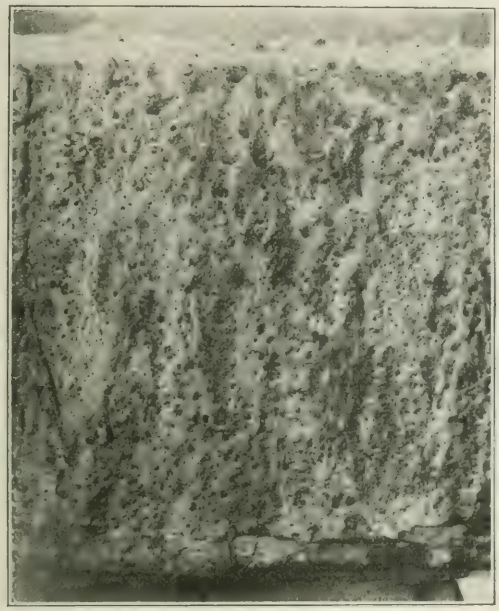
In many localities a non-spalling aggregate can be used without excessively increasing the cost of the building. Limestone, either crushed or in the form of limestone gravel, as well as trap rock and blast furnace slag are all so definitely superior to siliceous gravels, crushed sandstone and crushed granite as to make two distinct classes of aggregates, which for brevity have been called spalling and non-spalling. Where the cost of a non-spalling aggregate is excessive the severe fire hazard can be met by the use of secondary reinforcement in the outer concrete together with a reasonable increase in the thickness of the latter. The effectiveness of secondary reinforcement in the form of a light grade of expanded metal placed in the protective concrete has been tried out in fire tests of full sized building columns with promising results. There appears to be no reason for doubting that the fire-resistance of girders and



DETAILS OF REINFORCED-CONCRETE FRAMING IN WRECKED BUILDING

slabs made from the spalling types of aggregate could be brought up to any reasonable standard by the proper use of secondary reinforcement with protective concrete of suitable thickness.

The lessons to be learned from the Barrett fire seem to be fairly well defined. If we accept the evidence of the column tests that have been conducted within the last three years at Chicago and at Pittsburgh there can be no doubt



A SPECIMEN OF FUSED CONCRETE BEAM

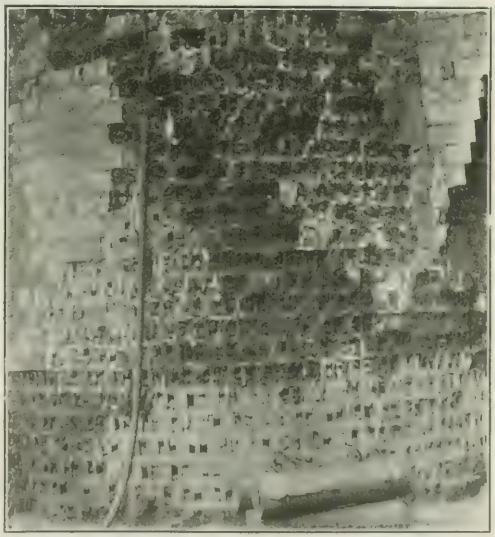
that reinforced-concrete buildings that will be very greatly superior to the Barrett building in point of fire-resistance can be built without too radical departures from established engineering practice.

In the report of the committee on the Far Rockaway fire, of the American Concrete Institute, is the following comment on the Barrett fire.

The progress of the fire was extremely rapid. At the beginning, Tank 79 was burning; Tank 80, having a wooden top, soon caught fire and was entirely consumed. The fire spread to Building No. 15, known as the "Pan House," where the material, in Section A (east of the dotted line, which represents a temporary wooden partition), lay in long cooling pans. West of this partition was the "flake house," where the material existed in a flocculent condition and was spread over the roof, beams and sides of walls. In addition to Tank No. 79, Building No. 17, the coal storage, the roof of Building No. 6 and the awnings on Building No. 5 were ablaze at the start.

In Section B, the second tier columns were all damaged, and will probably have to be removed. Section C is in pretty fair condition. Section D, known as the centrifugal room, was only slightly damaged. The fire wall separating these three sections from Section A probably protected sections B, C and D from damage. The shipping platform was destroyed, as was also the base beam in front of Building No. 2. The hollow radial brick stack of the boiler house was damaged to a height of about 30 ft. Considerable spalling took place and it was necessary to plaster the stack for a distance of 30 ft. from the ground. Building No. 17 was entirely destroyed, and the roof of Building No. 6 was seriously damaged.

The very rapid and intense heat that resulted from the burning of this naphthalin, especially in Building No. 15, which had no floors, but had a double tier of long, cooling pans, containing naphthalin, which burned freely, subjected the concrete to very rapid expansion, and caused the serious spalling of the corners of the columns and edges of beams, exposing the reinforcement in nearly all cases and in one of the columns the exposure was sufficient to cause buckling of the column. The rigidity, however, of the roof construction was sufficient even under this severe treatment to keep it in place, excepting the western end of Section A. Failure was caused by the collapse of the unprotected metal lantern. The north end of the building, facing Tanks No. 79 and 80, was subjected to very unusual heat and the face of the brick walls spalled under the action of this heat for the distance of nearly an inch. The wired glass in the windows melted and even the metal mullions were melted. The flames from the burning naphthalin in the cooling tanks roared through this opening and fused the adjacent concrete faces of the beams and girders even on the exterior of the columns. The columns in this building were square in section and spalling occurred. The round type of column would have materially helped the situation, but in the judgment of the committee would not entirely have prevented spalling.



CONDITION OF BRICKWORK IN STACK LOCATED ABOUT 100 FT. FROM FIRE

From this fire are drawn the following conclusions:

(a) The spalling of the concrete was in a large measure due to the use of a coarse aggregate which contained a large percentage of quartz;

(b) Square columns increased the degree of spalling;

(c) Structural concrete requires protection against fire; the thickness of the protective coating depends on the degree of heat to which the structure is likely to be subjected;

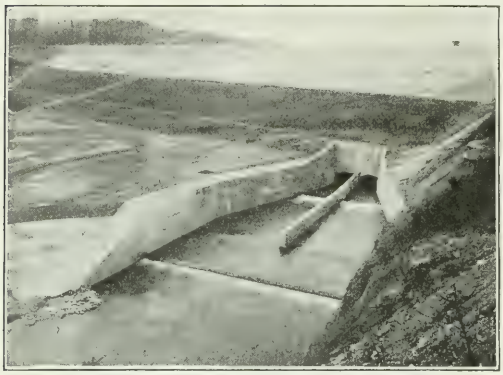
(d) It is probable under these conditions that 3 in. of concrete, made of aggregate of non-spalling charac er and properly reinforced, would afford adequate protection to the structural concrete;

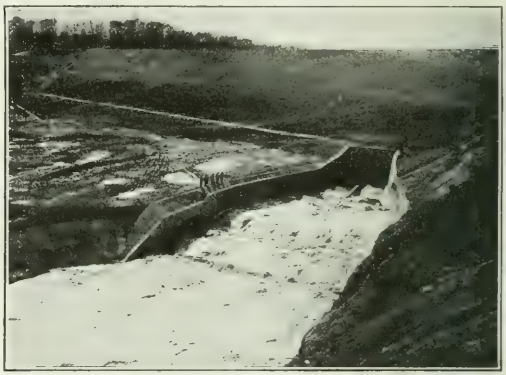
(e) The sprinkler system was rendered ineffectual by the shutting off of the electric current which operated the pumps;

(f) The engineers of the Barrett company are of the opinion that there is no more suitable material for use under such conditions than reinforced concrete, and will, therefore, use this material in reconstruction.

Hydraulic-Jump Pools Effective

RECENT observations of the functioning of the hydraulic-jump stilling works at the outlet of the Germantown dam, near Dayton, Ohio, show that the design of outlet works adopted by the Miami Conservancy District for its detaining dams is entirely effective, the functioning being precisely that expected from the model experiments and intended by the designers. Last season, the dam being then uncompleted, the outlet conduits were of twice their ultimate depth, being so built in order to provide excess discharge capacity as a safety measure against overtopping of the unfinished embankment. Late last year, however, the lower half of the conduits was filled and the permanent conduit floor placed over the filling, thereby increasing the throttling effect of the conduits and allowing the dam to function in full as a detention dam. A test of the design of the outlet works therefore was not available until the present stage.





HYDRAULIC JUMP IN DISCHARGE OF GERMANTOWN DAM OUTLET CONDUITS AT LOW AND HIGH HEADS

Permanent floor of outlet conduits in place. Left-hand view taken March 4, at ordinary low water. Right-hand view taken March 9 during a freshet, when the dam was impounding water; conduits discharging under about 16-ft. head.

In the view at the left herewith is seen the discharge at relatively low flow of the stream (Twin Creek). The view was taken March 5. A distinct hydraulic jump is seen at the entrance to the stilling pool, and the flow over the tail weir is smooth and evenly distributed. The much more pronounced and powerful jump occurring under higher velocity flow is exhibited by the right-hand view, taken on March 9, during a sharp freshet, when the dam ponded the steam flow to a depth of 16 ft. above the crown of the conduits. The view very clearly portrays the effectiveness of the jump pool in transforming the high velocity concentrated flow of the conduits into the slower tailrace flow.

Rule of the Pavement in London

The London traffic committee, appointed by the Ministry of Transport, has been discussing the question of a rule of the pavement and has favored the rule of "Keep to the left" to correspond with the rule of the road. As it is, most pedestrians in London follow an unwritten law of the pavement of "Keep to the right," with the result that pedestrians walk with their backs to approaching traffic; many accidents have resulted from pedestrians stepping off the pavement into the road to allow more room and being run down.

Shield vs. Trench Method for Hudson Vehicle Tubes

Chief Engineer Holland Answers Arguments of Olaf Hoff Regarding Type of Construction Decided Upon

QUOTING from his annual report for 1920, C. M. Holland, chief engineer of the New York-New Jersey Tunnel Commissions, explains below why the shield method has been selected in preference to the trench method for the construction of the Hudson River vehicular tunnels between New York and New Jersey. The reasons which influenced the decision of the commissions are given in reply to a communication received by *Engineering News-Record* from Olaf Hoff, advocate of the trench method and builder of the Detroit and Harlem River tunnels. There are printed below Mr. Hoff's letter and a reply thereto in the form of excerpts from Mr. Holland's latest annual report. Mr. Hoff says:

In your issue of March 31, p. 562, there is an article headed "Hudson River Vehicular Contracts to be Ready May 15." The statement is made in this article that it is definitely announced in Mr. Holland's report, "that the trench method of construction which had been under consideration as an alternative during the past year has been abandoned on the ground of not being adapted to the Hudson River conditions." I do not have the slightest desire to criticise the decision of the board of consulting engineers or the chief engineer, but I feel strongly that this opinion should not go unchallenged. The Hudson River conditions in my judgment are, if anything, more favorable to the construction of a trench tunnel than to a compressed air, shield-driven tunnel of the proposed dimensions.

Arguments for Trench Tunnel

My reasons for this statement are as follows:

1. The dredging of a trench in the bottom of the river is a simple, direct and common operation. The side slopes of the trench will probably stand at 1¾ to 1, and quite possibly at 1 to 1, for the length of time required for construction purposes.

2. The preconstructed steel section used in the Hoff method, say 300 ft. in length, can be spotted, sunk and aligned in correct position in four hours or less and encased in concrete in not to exceed three weeks.

3. If piles be desired underneath the tunnel to give it an assured stability, rather than depending on the bearing capacity of the silt, they can readily be driven to an approx-

imately correct level and would not need to be cut off. The load being light, on account of the buoyancy of the tunnel, a relatively small amount of piling would be required.

4. In doing this work it would never be necessary to occupy a river space more than 600 ft. in length, along the axis of the tunnel; this certainly should not materially interfere with the traffic of the port. At Detroit we had ore steamers in the height of the summer season passing by as often as every 10 min. and this traffic was never interfered with in the slightest. The Detroit River is much narrower than the Hudson.

5. On the other hand, the driving of the proposed two river tubes of the unprecedented diameter of 29 ft. in the Hudson River silt by shield and compressed air will unquestionably present the gravest difficulties with a constant menace of accidents.

My opinion in this matter is based on my practical experience in carrying to successful completion, under the Hoff method, two of such trench tunnels. The Detroit River tunnel and the Harlem River tunnel of the Lexington Ave. subway are the most notable examples of successful trench tunnel work, and both of these were built under contract by the writer and his associates. A trench built tunnel has the following advantages over a shield driven tunnel for this project:

1. It can be built far more economically; a saving of several million dollars would not appear unreasonable.

2. It can be built with greater confidence and less risk of accidents.

3. It can be placed at a considerably higher level, thus saving in grades and energy.

4. It will, at less cost, produce a stronger and more substantial tunnel construction, because of the fact that the cost of the materials entering into the construction roughly amounts to about two-thirds of the total, the labor being one-third, while in the shield-driven tunnel it is just the opposite, two-thirds of the cost being represented by labor and one-third by the material.

5. It can be built with auxiliary and separate tubes for the purposes of ventilation, without great additional cost. These could be placed one above the other between the main tubes and used, one for exhausting foul air and the other for forcing in fresh. They could be of a diameter to give about twice the area of the available space left for ventilation in the present plan; this would reduce the velocity of the air in proportion and the cost of ventilation to a still greater degree.

This last item (5) is perhaps the most important, because the problem of an effective ventilation is, after all, the most difficult one to solve in connection with the vehicular tunnel. What will happen if the tunnel is filled with automobiles and trucks and one of them takes fire, say in the middle of the tunnel? That is the outstanding problem that stares the commissioners and the engineers in the face.

The writer has given this matter a great deal of thought and would suggest for consideration that series of segmental bulkheads or partitions be placed crosswise of the tunnel a suitable distance apart (perhaps about 200 ft.) and extending from the roof down to the clearance line. These bulkheads will, if not confine the smoke, at least greatly interfere with its spread throughout the length of the tunnel. An asbestos curtain, either wound up on a roller or placed horizontally and passed over a roller, could be placed along the lower edge of these partitions and lowered to the roadway, shutting off a limited space in front and rear of the burning vehicle from the remainder of the tunnel.

It seems to the writer that such an arrangement at least might afford sufficient time to get the tunnel cleared of vehicles and passengers and thus minimize the chance of a holocaust. Separate tubes for ventilation, however, would appear to be necessary.

In answer to the foregoing, the following excerpt has reprinted from the 1920 annual report of C. M. Holland, chief engineer, New York-New Jersey Tunnel Commissions:

In adopting any type of construction it is necessary to give consideration to the physical features not only of the under-river portion of the work but also of the tunnel approaches. On the New York side of the river the line of the tunnel passes under the slip between Piers 34 and 35, and on the New Jersey side it passes under the slip between Piers 8 and 9 of the Erie Railroad Co. The damages would be excessive if the trench method were used, due to the interference with the waterfront.

In Jersey City, the approach to the waterfront lies under the property of the Erie Railroad Co. which insists that the work must be conducted so as not to interfere with the operation of the railroad yard, and in New York City every effort must be made to avoid interference with the use of the streets by the public. Accordingly, the shield method was adopted as the most practicable, insuring the least inconvenience and the greatest safety to the public.

With the adoption of the shield method of construction from the land shafts to the river bulkhead, the adoption of the trench method as an alternative type of construction under the river was given most careful consideration. Noteworthy examples of the trench tunnel are those constructed under the Detroit and the Harlem Rivers. In studying the trench method of construction under the Hudson River, consideration was given to the wide variance in conditions in the Detroit and Harlem Rivers, on the one hand, and the Hudson River on the other. Attention is called to the decision of the Public Service Commission as to the method of construction used in building the recent subway tunnels under the East River. The commission had already adopted the trench method of construction for the Harlem River tunnel and the same method was considered for the East River crossings, but conditions were so essentially different in the East River from those in the Harlem River that shields were favored for the East River work. In comparing tunneling conditions in the Harlem River, the East River and the Hudson River, it is evident from the width of the River, the great volume of river traffic, waterfront conditions, and conditions of the river bed that, of these rivers, the Hudson River is most suited to shield tunneling. Consequently, if shield tunnels were chosen for the East River in preference to the trench tunnel, as built in the Harlem River, so much greater reason would there be for using the shield tunnel in the Hudson River.

The waterfront conditions in the Detroit and Harlem Rivers are favorable to the trench method of construction in that there are no valuable piers serving large shipping interests; whereas, on both sides of the Hudson River there are valuable piers and waterfront property, interference with the use of which would be an important element of cost which is not nearly so important in the case of shield tunneling, as the work is conducted in such manner as to offer the least interference with waterfront conditions.

Waterway conditions on the Detroit and Harlem Rivers, both as to channel and cross-river traffic, are not comparable with Hudson River conditions, and if a tunnel construction unit of sufficient length for proper prosecution of the work were used in the excavation of a trench across the Hudson River there would be an unavoidable interference with a great volume of river traffic. A count of river traffic shows that 1,500 boats cross the line of the tunnel daily. Congested river conditions, while serious to the river traffic, are also of importance in estimating the cost of the trench method because of the hazards to the equipment of construction as well as to shipping itself.

The records of the U. S. Engineer Office for the Port of New York, during the years 1918 and 1919, show that two dredging outfits, working under the direction of that office in the East River where conditions are not as bad as in the Hudson River, suffered 62 accidents, 5 of which caused delays varying from 5 to 45 days. Col. Edward Burr, U. S. Engineer Officer in charge of the New York district, in discussing Hudson River conditions before the American Society of Civil Engineers in October of this year, made a statement which bears directly upon waterway conditions which would have to be met during the construction of the tunnel by the trench method. He stated: "Every dredge on this reaches nothing at a fixed position in a channel [illegible] in traffic, which is greatly increased [illegible]

moorings are necessary, as in swift tidal currents, and the congestion existing in the main channels of New York Harbor, complicated by tidal conditions, creates a most serious problem in the prosecution of operations requiring the use of such machines. Collisions are frequent under these conditions, with resulting increases in the time and cost of prosecuting the work."

From the preceding it would appear that there is a real hazard involved in carrying on operations from plant anchored in mid-stream. Any collision resulting in the sinking of a tunnel section during the operation of placing it in position would be a very serious matter. The shield method of construction will not interfere with river traffic, and therefore no element of cost or damage from that source need be considered. Further, the U. S. Government has placed very rigorous limitations upon the occupancy of the waters of the Hudson River which require the States to bear the cost of dredging a 1,000 ft. channel in the middle of the stream before the trench tunnel could be constructed in the present channel near the New York pierhead line.

The character of the river bed is an important element in the consideration of the practicability of the trench tunnel. The material in the Detroit River is a clay of a consistency that is particularly suited to trench excavation, while in the Harlem River the material is sand and gravel. In the Hudson River the material is a soft silt and rock, the character of the former being such that the volume of excavation that would have to be handled would be unduly large. As to the rock excavation, it would be necessary to blast and remove the debris at a great depth, which condition was not found in either the Detroit tunnel or Harlem River tunnel. This element of rock, in itself unprecedented, is a serious obstacle. This point was given the most careful consideration at the time the decision in favor of the shield method was made for the construction of the East River tunnels through rock and quicksand. Silt conditions in the Hudson River are extremely favorable to the shield method of tunneling in that if the silt cannot be shoved aside by the shields it is easily excavated and disposed of through the tunnel. The very condition of the river bed which constitutes a serious difficulty in the trench tunnel is the one most favorable to the shield tunnel.

It has been claimed that the trench tunnel would effect a substantial saving in cost over the shield method of construction, based largely upon what has been accomplished in other places or upon proposed innovations in this method of construction. It is to be noted, however, that on account of the uncertainty in regard to dredging the Hudson River silt and the removal of the rock in an open trench the general attitude of men familiar with dredging conditions has been that this work should be done under some form of cost-plus or by the rental of dredging equipment rather than upon a straight bid price for yardage in place. The uncertainties of this work, which is of such great magnitude, might involve the contractor in financial difficulties if he bid anywhere near what would ordinarily be considered a fair unit price.

The estimates which have been made do not support the contention that the trench tunnel is the cheaper of the two methods, and attention is called to the actual bid figures on two recent tunnels representing the two types of construction. In 1912 the Public Service Commission accepted bids for the trench tunnel in the Harlem River amounting to $375 per lineal foot of track as compared with bids in 1914 for shield driven tunnels in the East River varying from $388 to $425 per lineal foot. The later prices were submitted when the cost of materials was slightly greater than in the former case, and furthermore, the latter tunnels were about one-third in rock, while very little rock was encountered in the Harlem River tunnel. If this comparison were carried farther to the tunnel under the Hudson River, where conditions for shield tunneling are more advantageous than under the East River, a still lower price for the shield tunnel under the same market conditions can be reasonably expected, due allowance being made for the difference in size of tunnel. The above comparison shows that the claims made by the advocates of the trench tunnel are not consistent with the actual cost of work done heretofore.

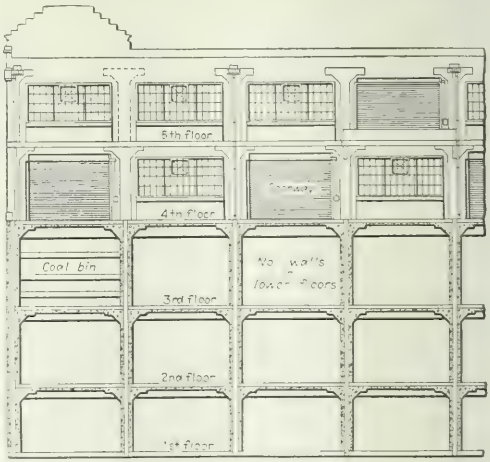
In making a recommendation on these premises important elements must be considered. Counsel has advised that definite plans and specifications must be prepared so that bids will be on a comparative basis and that it is not permissible to ask for bids on general specifications with the privilege of modifying or departing from the engineer's designs.

It is considered that it would be impossible to place a method so untried, so full of possibilities for delays and unusual situations, on a parity with the recommendation which has already been made of the shield-driven tunnel, a type which has been developed along scientific lines through a considerable period of years and which has proved feasible and successful under the very conditions under which this project will be undertaken.

Rail and Water Terminal for Nashville, Tenn.

Lower Floors of River Dock for Wharf or Storage According to Stage of River—Tracks and Mechanical Equipment

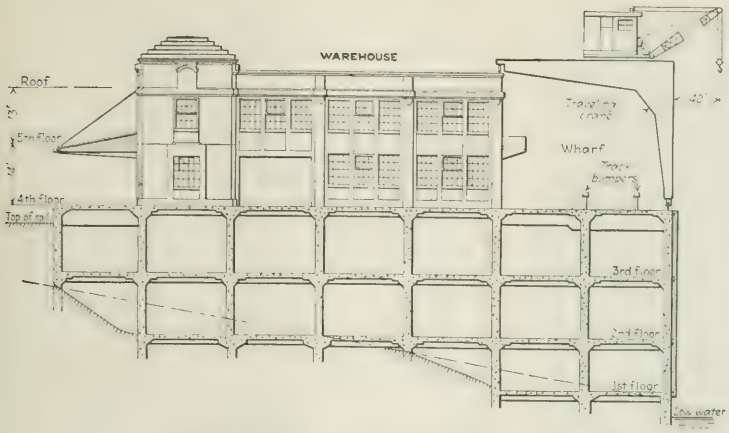
PLANS for a municipal waterfront terminal on the Cumberland River at Nashville, Tenn., for the accommodation of railway and boat traffic and the interchange of freight have been adopted by the Board of Transportation Trustees, which has sold a municipal bond issue of $300,000 for this project. The plans have



PART OF THE RIVER ELEVATION OF DOCK

been approved by the U. S. Engineers for the War Department and it is hoped to put the work under contract this year.

River traffic at Nashville averages two boats daily during the navigation season, but at present the only accommodation consists of the usual levee or paved slope, from which gangways are laid to the steamers or barges. As no wharf boats or floating landings are provided freight cannot be stored in readiness for loading. Therefore when a boat arrives there is frequently a line of trucks and wagons extending for two or three blocks from the levee, the later arrivals sometimes having to stand in line all day before getting a chance to unload. There are few tracks along the bank to permit of handling freight directly between cars and boats. With a maximum variation of 45 ft. in the



SOUTH ELEVATION OF DOCK; NASHVILLE, TENN.

river level, the provision of wharf or dock accommodations available at all stages of the river has been a difficult problem.

A four-story dock so located on the channel as to be accessible for boats at the lowest stage of river and having its first floor 6 ft. above the zero pool level is the solution of the problem as provided in the present plans. The fourth floor is about 4 ft. above the level of the waterfront street, and will have a two-story warehouse. A peculiarity of the structure is that it will have no inclosing walls below the fourth floor, these being prohibited by the government engineers as constituting a serious obstruction to the current during high water. During the greater part of the year these lower floors will be utilized for storage for short periods, protection against theft being provided by city watchmen. A reinforced-concrete coal bin of 100 tons capacity at the outer upstream corner will act as a brace to the columns at the river front.

In plan the dock will be 300 ft. long, with a width of 140 ft. at the third and fourth floors. The other floors decrease in width with the slope of the bank, being 120 ft. and 40 ft. for the second and first floors. The warehouse will be 300 x 80 ft., with a 20-ft. loading platform on the west or land side and the 40-ft. wharf on the river side. A double-track line connecting with the neighboring freight terminal of the Tennessee Central R.R. will be laid in the stret in front of the dock.

On the open part of the river side of the fourth floor will be two stub tracks, with a driveway between them and the warehouse. Along this open part or wharf will travel an electric gantry crane of the semi-portal type, one end of the crane girder or bridge being carried by a leg having wheels traveling on a rail on the floor level, while the other end of the girder is carried by wheels traveling on a rail on the wall of the warehouse. On the crane girder will be a revolving electric hoist with 50-ft. boom and capable of handling a 5-ton load at full reach. The hoisting and traveling speeds will be 100 ft. per minute and the rotating speed 1 r.p.m.

In addition there will be three 5-ton automatic electric platform elevators 10 x 18 ft., each large enough to handle four of the storage battery trucks which will be used for handling freight. These elevators will serve the five floors and will be of the automatic type, with push-button control and micro-leveling device to bring them flush with the floors when stopping. At one end of the building will be an inclined chain conveyor for handling sacked cement or grain between boats and the warehouse or cars. An inclined driveway at one end will give direct access to all floors by trucks and wagons, so that freight can be unloaded in readiness for the boats. Reinforced-concrete construction is to be used throughout, with cylindrical columns supporting a flat slab floor system with four-way reinforcing and having spans 20 x 20 ft. c. to c. of columns. All floors are designed for a live load of 500 lb. per square foot, the wharf or track deck having heavier girders and being designed for Cooper's E-50 loading for the railway tracks. All columns are carried down to footings on solid rock at depths of 8 to 50 ft. below street grade. No special structural features are included. Concrete walls with steel sash and steel rolling doors in alternate bays are used for the warehouse.

The Board of Transportation Trustees is a municipal body which was created in 1917 for the purpose of developing railway terminals and other transportation facilities, with power to build or lease railways and to issue municipal bonds up to $5,000,000. The only issue thus far made consists of the $300,000 bonds sold for the river and rail terminal. Freeland, Roberts & Co., are the consulting engineers for this work, with Russell S. Hart and George Nevins as consulting architects. The cost of the structure and equipment complete is estimated at $350,000.

Tests Disprove Old Theory That Charring Stops Decay

The old theory that charring the butts of fence posts and telephone poles preserves the wood has been disproved by a series of tests recently conducted by the Forest Products Laboratory of the Forest Service, U. S. Department of Agriculture, on fences with charred and untreated posts of varied species. The charred posts proved in these tests to be even less durable than the untreated ones. Theoretically, an area of charred wood around a post should prevent decay, because charcoal does not decay or encourage the growth of fungi. But the charred area around a post is not usually a solid covering. It is checked through in many places. If posts are seasoned before they are charred, the charring does not reach to the bottom of the season checks which are always present. If green unchecked posts are charred, checks will open through the charred part as the wood seasons. In either case the uncharred center of the post is exposed to fungus infection and will decay as rapidly as untreated wood. Charring deep enough to resist decay would undoubtedly weaken a post of ordinary size.

Good Practice and Some Features in Log-Flume Construction

Sound Engineering Often Lacking—"Baby" Flume and Moving Platform Cut Labor Costs—Novel Headgate Gives Even Water Flow

By V. K. Woods
Palmer, Pearson and Woods, Inc., Salt Crescent, Wash.

As a rule the building and operation of log flumes is not considered an engineering occupation. The requirements and conditions are apparently so simple that they can be entrusted to practical men. Engineers have at times located flume lines, but have left the building and operation to others. Consequently they have not profited by the errors disclosed in both operation and construction. Flume design, therefore, has shown but little advancement in recent years, while the least contact with operation shows features that would have been changed long since had they come to the attention of engineers.

To those accustomed to the care exercised in the design and location of railroad lines, irrigation canals, etc., the roughness of the location and leveling of the average flume line will prove a surprise. Of course, there is not the reason for the accuracy necessary on railroad or even on ditch work. The traffic is all downhill, the grade of the stream must be approximated and the consequences of frequent and sharp changes in grade theoretically do not appear to be serious. As a matter of fact, however, carelessness in location and design is followed with irregular operation of the flume, the piling up of logs at some points, the throwing of logs out of the flume, and not infrequently, the destruction of considerable trestle.

Fundamental Principles

As to location, it should be a principle to keep the flume as close to the ground as possible. This not only cuts the cost of construction by lessening the amount of trestle work, but makes for greater stability and lessens the cost of rollways (the platforms over which the logs are delivered to the flume). Another error in flume location is a failure to visualize clearly the purpose of flume construction—getting the logs out. As a rule, the flume is built on one side of the valley, near the creek. The gulches coming into the valley terminate in flats, which may be as far as 1,000 ft. from the flume line. Wherever this condition exists it is necessary to put in a trail flume, and, with horses, to haul the logs across the flat to the main flume. To cut down this trail fluming and consequently the cost of operation, it is the writer's practice to swing the flume back and forth across the valley to the mouths of these gulches. In other words, it is better to take the flume to the timber than haul the timber to the flume.

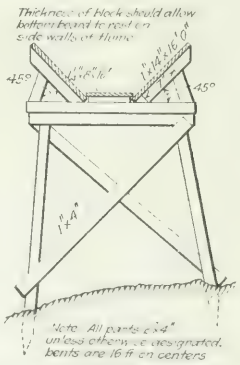


FIG. 1. END SECTION OF AUXILIARY FLUME

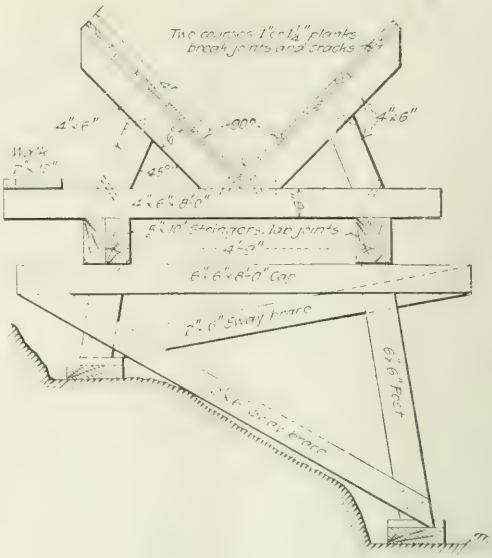


FIG. 2. END SECTION OF FLUME OF HEAVY TYPE

As a consequence of leaving construction entirely to practical men, the grade of the flume is likely to break sharply. As a rule, stakes are put in only at the point of break, the carpenter-foreman then using his eye to "fudge in" the bents so as to secure a vertical curve rather than an angle. Experience shows that these curves are usually too sharp and result in logs sticking at the top in downward breaks, and water piling up or logs being thrown out on upward breaks. Better practice is to put in a grade stake for each bent on vertical curves. The writer's practice is to use a rate of change of 0.01 per cent per 15-ft. bent where the difference in connecting grades is less than 2 per cent. For a difference of from 2 per cent to 5 per cent, the rate of change is 0.02 per cent per bent. Where the grades to be joined differ by more than 5 per cent, the rate of change will be much greater and can be put in safely with the eye. In other words, gradual reversed curves are important chiefly on the flatter stretches of the flume.

In order to secure close adherence to the located alignment and grade, a hub is placed every 15 ft., tacked for center line, marked for the cap cut-off. These hubs are not disturbed, the bents being placed one foot back of them.

For fire protection, as well as to prevent damage to the flume from dead-falls, it is good practice as well as economy in the long run, to clear a 100-ft. right of way.

As to desirable gradients, from 2 to 3½ per cent seems to give best results. Grades as high as 7½ per cent have been used with success. Experience shows that the water in the flume should run within 8 in. of the top.

The maximum curvature depends to some extent on the size of logs to be flumed. For the 5 ft. side flume, the logs should be about from 2 to 4 ft. in diameter and 16 to 24 ft. in length. A maximum curvature of 24 deg. for a 5-ft. side-flume is considered good practice.

The type of flume for heavy work (a flume with 4- or

5-ft. sides) that has proved most satisfactory in the writer's experience is carried on trestle bents 15 ft. on centers. These support stringers 16 ft. long, which in turn carry the V-shaped saddles or brackets, as they are called in flume work. These are spaced on 4-ft. centers on grades under 5 per cent, on 3-ft. centers on grades over 5 per cent and on 2-ft. centers at rollways. Sketches of the standard type of trestle and brackets for a 5-ft. side-flume are shown herewith. Where the flume is at ground elevation the stringers are carried on mudsills. The bents shown in the drawing and the photographs are of sawn lumber. Round timbers cut at the site are frequently used, but prove more economical only on flat ground. On sidehill work sawn lumber flumed down to the site, makes a cheaper job since the round stuff is too heavy to handle economically.

For the flume itself, the most approved type of construction consists of two courses of 1¼-in. stuff. Sixteen-foot lengths are easy to handle and give good results. The widest boards used are 12 in. and those are put in the first course. The limit of 12 in. is fixed because wider boards are difficult to warp on curves. The narrower widths are used in the inner course and care is taken to see that the joints break between the two courses so as to get a watertight job.

Construction Aids

A description of a 5-ft. side flume along Marble Creek. Northern Idaho, presents certain features of flume work that have been the development of a number of jobs. This flume was 18.7 miles long. This work was stopped by the war. The job completed just before this was started was a 10½ in., 4-ft. side flume on Mica Creek, Idaho, designed to carry 1,000,000 ft. of timber in 10 hours, the logs averaging 14 to the 1,000 ft.

In flume construction the standard practice heretofore has been to pack in on horses a saw-mill outfit, taking it to the very head of the proposed flume and then to saw and flume down as needed the necessary lumber for building the trestles, brackets and flume itself. Under this plan of using the main flume for carrying the lumber, it is necessary to carry forward from the end of the completed flume all the trestle, bracket and flume lumber.

An improvement on this method is the use of a "baby" flume, built solely for the transportation of lumber. It has the advantage of delivering material to the spot where it is to be used, thus eliminating the carrying of lumber except for the baby flume itself. Reference to the drawing of the latter will show that the amount of material used in its construction is negligible as compared with that in the main structure. The baby flume is always placed on the uphill side of the main structure, and adjacent to the located line of the latter, for convenience.

FIG. 3. FLUME CLOSELY FOLLOWS TOPOGRAPHY

Satisfactory shipment of lumber through the baby flume is accomplished through telephonic communication between the man at the receiving end and the shipping clerk at the mill. Thus he is enabled to lay down at each point the exact sticks needed and avoid all handling other than the piling of delivered material. The lumber is removed from the flume by a wooden fork which can be laid on the bottom of the flume to force the lumber up and over the side. The fork has a handle on it so that it can be shifted with ease. While the design of the baby flume is simple, the shape should be noted. A square flume was experimented with, but proved unsatisfactory in operation and was more costly than the section selected.

It is apparent that it is more economical to put the brackets together before mounting them on the string-

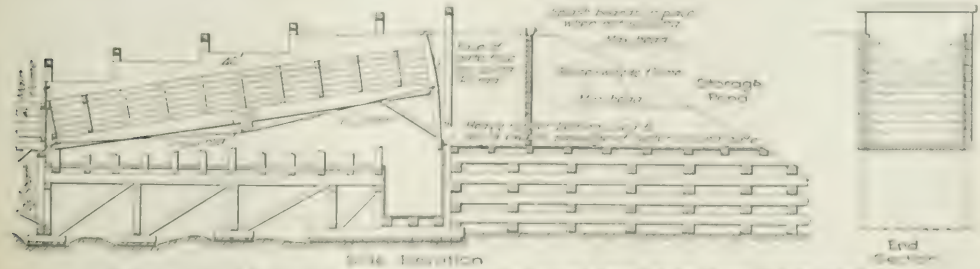


FIG. 4. DETAILS OF SLIDING HEADGATE THAT GIVES EVEN FLOW FROM POND TO FLUME

ers than attempt to assemble them in place. For this reason it has been the custom to carry a work table supported on carpenter's horses along the line. This had to be moved forward at intervals while the lumber had to be carried to it and the assembled brackets carried to the line. On the Marble Creek work an innovation was introduced—a bracket table rolling on the stringers of the completed trestle. Its advantages are obvious. Being located on the flume line, and therefore adjacent to the baby flume, there is no carriage of lumber to it, while carrying of the assembled brackets is also avoided. Moreover, the carrying of the old style table and horses ahead is eliminated. The table is fitted with wooden rollers and is pulled forward by a windlass operated by the two carpenters who assemble and place the brackets. Side rollers under the platform bear against the stringers and guide the table. Mounted on the table is a work bench, on which there is a templet so that each stick of the bracket falls into its proper place without measuring, thus insuring speedy assembling.

FIG. 5. DIVERTING FLUME FOLLOWS RAILROAD SWITCH PRINCIPLE

As a rule, flumes are built near the heads of streams where the water flow is small. In order to get sufficient water to float the logs, a dam is built and the flow stored up for a period of hours, then the gate is opened and a large flow is had for a short time.

In order to maintain an even flow as the water was taken from the pond the writer constructed a gate through which passed a section of the flume. This gate was lowered as the water lowered in the pond, thus making it possible to sluice logs continuously on an even head of water. The gate was constructed with the idea of raising it with a capstan but when operated it was found to raise alone, so the gear was shifted and placed on the lower side of the gate for lowering.

Where local conditions make the sorting or landing of logs necessary, a diverting switch is put in. In operation it is similar to the railroad switch. A hinged lead, or gate, is set at the dividing point of the flumes. This is from 60 ft. to 80 ft. long and is hinged along the line of intersection of the two inside sides of the flumes. By pulleys and windlass it is thrown from side to side.

Am. Soc. C. E. Membership

The membership of the American Society of Civil Engineers on Feb. 10, according to the 1921 Year Book, just published, totalled 9,884, distributed as follows among the several grades: Honorary members, 3; members, 4,243; associate members, 5,025; associates, 174; juniors, 429; fellows, 10.

An Economic Study—

Justifiable Highway Costs

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DETERMINATION of justifiable outlay for a proposed highway improvement from anticipated service should call for at least as careful survey and estimate as the engineer now provides for the engineering features preliminary to the construction of the highway. Millions of miles of earth roads and thousands of miles of lightly surfaced and poorly designed gravel and macadam roads impose upon the highway engineers of the nation the task of so parceling out insufficient highway revenue that it will be applied to the highways in proportion as they show traffic justification for improvement.

To incorporate this requirement into highway engineering practice is to make the traffic unit as widely used as the customary units of physical measurement. This measurement of justifiable outlay by the yardstick of traffic does not disregard the profound beneficial influence of the highway upon social life and educational development in rural districts but inasmuch as they go hand in hand with traffic development the latter may in general be regarded as an index of both the direct and indirect value of the improvement.

Motor vehicle traffic predominates to such an extent as to make logical the adoption of a system of measuring costs and justifiable outlay primarily in units derived from this class of traffic. Thus while the unit commonly used for horse drawn traffic is the ton-mile and applies to loads rather than to vehicle it is necessary to adopt a unit which will take into account the eight and quarter million passenger automobiles now registered and the millions to come and which will allow credit to the highway for the saving in their operating costs. To substitute "vehicle-mile" would not fully meet this need as the million trucks in use and those yet to come must be rated as deriving greater benefit individually than the passenger car. A simple plan sufficiently comprehensive to meet most needs is to retain the ton-mile as the unit of measurement, but to regard each passenger car and each one- and two-horse vehicle as the equivalent of 1 ton, while the motor truck and the heavy team outfits would be regarded as the equivalent of the vehicle weight plus the load in tons. This plan would permit of a rapid traffic enumeration without complexity. Subdivision of the investigation to determine whether the route is to be for heavy truck traffic or for light traffic would require segregation of the heavy and light truck records respectively, but this would not affect the main purpose of the investigation, to ascertain justifiable outlay.

Counting the traffic on the old road is manifestly an inadequate method of ascertaining total ton-miles. After the highway is improved it will divert traffic from other highways, will stimulate local traffic so that more miles will be traveled in a given period, increase deliveries from and to market points, develop resources and finally, if it is on a trunk line or a route to scenic and recretational regions, it will draw increased tourist travel. These various classes of anticipated travel may be termed "potential" and however difficult of exact estimate the investigator should give weight to them in his recommendation as to justifiable outlay. It is suggested that for the potential local traffic a zone be

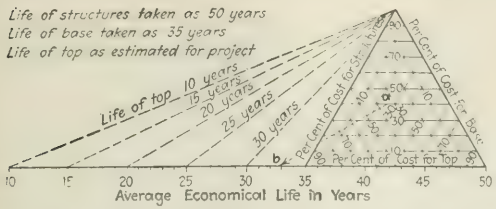


FIG. 1. AVERAGE ECONOMICAL LIFE OF HIGHWAY GOVERNING TERM OF BOND ISSUE OR INVESTMENT

plotted to include the territory which might logically be served by the highway after improvement. Within this zone the investigator could make an approximate automobile census and so acquaint himself with the business, industrial and social factors and possibilities of the zone as to establish a basis for estimating both the saturation point in motor vehicle ownership and the average mileage per car. In short, without attempting to present here the exact detail of a traffic survey, I do mean to urge the necessity and practicability of a traffic census which covers both existing and potential traffic.

Operating costs of motor vehicles are ascertainable and may be expressed in ton-mile units. Costs of gasoline, oil, tires, repairs and depreciation, garage, chauffeur, taxes, etc., make a substantial total. The average cost per car, if we use 9,250,000 as the number of cars and $5,000,000,000 as the annual cost, would be $540. If the average mileage is 5,000 the cost per car-mile is 10.8 cents. Applied to ton-miles the average would be somewhat lower as the trucks loaded would average 3 tons, thus making it probably 8.9 cents. Whether such a rate per mile is too high or too low on a given highway should be ascertained by the investigator. When he has determined upon the rate, however, and applied it to the potential ton-miles, he has established the gross traffic cost on the highway for potential traffic if no saving were effected.

The cost of operation per ton-mile on the old road should be ascertained and from this should be subtracted the estimated cost of operation per ton-mile on the improved highway established by comparative data of operating costs on highways similar to the type or types under consideration for the improvement. As the traffic cost per ton-mile would be affected by the character of the highway improvement to be adopted it is assumed that the engineer will base his comparison upon a type or types of improvement which appear to him practicable if they can be financed out of the traffic saving. In other words, this method leaves to the engineer the same discretion as he now customarily exercises in selection of design but subjects it to the test of financial justification. This saving in cost of traffic operation per ton-mile, when applied to the total existing and potential increase in ton-miles, gives the *gross annual saving* in traffic operation attributable to the improvement.

The *net annual saving* in traffic operating costs is arrived at by deducting from the *gross annual saving* the increase in the annual highway budget for interest, maintenance and depreciation of the improvement. In order to obtain the annual cost chargeable to interest and depreciation it is necessary to estimate the economical life of the improvement contemplated and take that amount which at the end of the period will have discharged all interest and retired the principal.

Considerations which determine the economical life of the improvement, or the period beyond which it may no longer be maintained as such without prohibitive cost, involve not only a study of the durability of pavements of the various types but also the durability of the foundation and of such improvements as acquirement of right of way, reduction of grades, elimination of curves and grade crossings and installation of permanent structures, etc. If these latter features form a considerable portion of the first cost the term in which traffic saving is expected to pay for the project should be correspondingly lengthened. If, moreover, a pavement such as sheet asphalt or asphaltic concrete is used, it may be renewed at the end of its economical life without, as a rule, incurring any additional expense for foundation. To compare one type of pavement with another as to their durability the important point must not be overlooked that renewal may be extensive or merely the renewal of the surface. The most rational

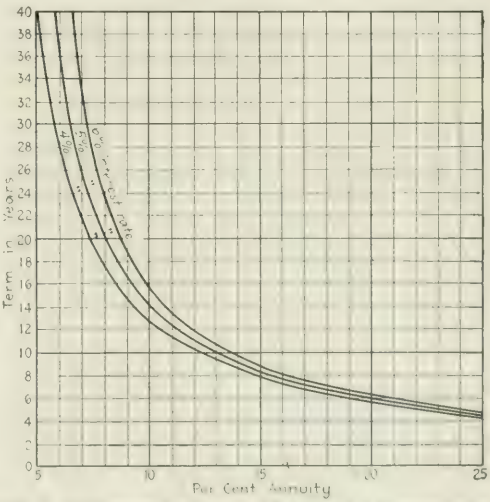


FIG. 2. PER CENT ANNUITY TO RETIRE AN INVESTMENT WITH INTEREST AT VARIOUS RATES

plan is to estimate first the durability and cost of structure etc., as Class 1, foundation as Class 2, and surface or wearing course as Class 3 and obtain a weighted average of durability for the entire project in which the factors would consist of the life and the per cent of cost of each class of improvement. Fig. 1 may be used in determining the economical life of the improvement.

In this chart a life of 50 years is assumed for Class 1, 35 years for Class 2 and from 10 to 30 years for Class 3 improvements. From the point at which the per cent of total cost lines for surface, base, and structure intersect for a given project, an imaginary line is projected paralleling the 10-year line, if the surface is estimated at 10 years; the 20-year line if 20 years, or the 30-year line if 30 years. Intermediate ages can be plotted between these limits. The intersection of the projected line with the base gives the average economical life of the road or investment.

As an example it is ascertained that Class 1 improvements represent 25 per cent, Class 2, 35 per cent and Class 3 40 per cent of the total cost of improvement,

This point is located on the triaxial diagram at *a*. If the estimated life of the wearing course is 20 years a line *a-b* should be drawn parallel with the 20-year line intersecting the base line at *b* which shows an average economical life of 32½ years for the road and also the period in which the investment should be paid off.

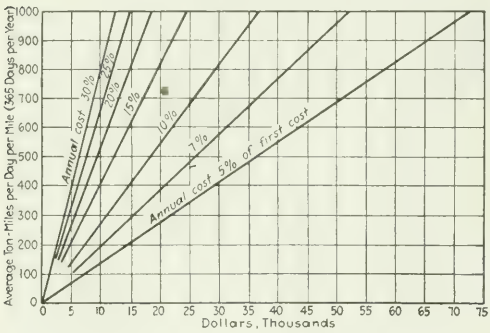


FIG. 3. JUSTIFIABLE FIRST COST OF ROAD PER MILE WITH SAVING OF 1 CENT PER TON-MILE

As the cost of the improvement is logically expressed in the form of annual outlay for interest, depreciation and maintenance, Fig. 2 may conveniently be used to ascertain the annual per cent of first cost required for interest and depreciation over the period covering the economical life of the improvement. The curves are plotted to show interest rates of 4, 5 and 6 per cent; ordinates show terms of years and the abscissæ show per cents of total cost for combined annual interest and depreciation.

Maintenance costs may increase or decrease by reason of the improvement. Whatever the difference between the old and the new costs may be, it should be taken into account by adding to or subtracting from the annuity determined by use of Fig. 2 as illustrated in the example which is given later.

Fig. 3 shows the justifiable first cost at a saving of 1 cent per ton-mile for any number of ton-miles per day up to 1,000 for improvements estimated to require for interest, depreciation and maintenance 5, 7, 10, 15, 20, and 25 per cent respectively of first cost.

To apply the chart assume as an example an 800 average daily ton-mile traffic with a prospective saving of one cent per ton-mile and that the engineer desires that the project be completely paid for in 32½ years. Reference to Fig. 2 shows that with interest at 5 per cent the annual cost is 6.2 per cent of the first cost for interest and retirement. The point in Fig. 3 for this latter per cent with a daily traffic of 800 ton-miles would give $47,000 as justifiable first cost. An adjustment may then be made for maintenance by turning to cost records of the old highway and ascertaining if the annual cost of maintenance is greater or less than that indicated by the estimated annual cost of maintenance for the improved highway. If, for example, the annual cost of maintaing the existing road is $800 per mile and the estimated cost for the new road $300 per mile an annual saving of $500 per mile is indicated. Next should be ascertained what investment is justifiable on account of this saving for the same period and rate of interest previously decided upon. In other words $500 is equal to 6.2 per cent of what sum? This is found to be about $8,000 which added to the $47,000 previously derived gives a total of $55,000 as justifiable first cost.

It may not be amiss to emphasize here the far reaching importance of saving in maintenance cost as justification for improvement in the highway. It is too generally the practice to charge to the improvement the full maintenance cost as well as the full interest on initial cost throughout the entire period.

The practice of proportioning outlay to traffic value of the project will become systematized in time Preparation and design and selection of type in the light of obtainable traffic data can be made more definite and practical without curtailing the exercise of engineering construction judgment. Rather it will broaden the scope of the engineer. What is apparently needed is a blending of traffic and construction surveys to form a coordinated whole.

Water Purification Plant at Highland Park, Michigan

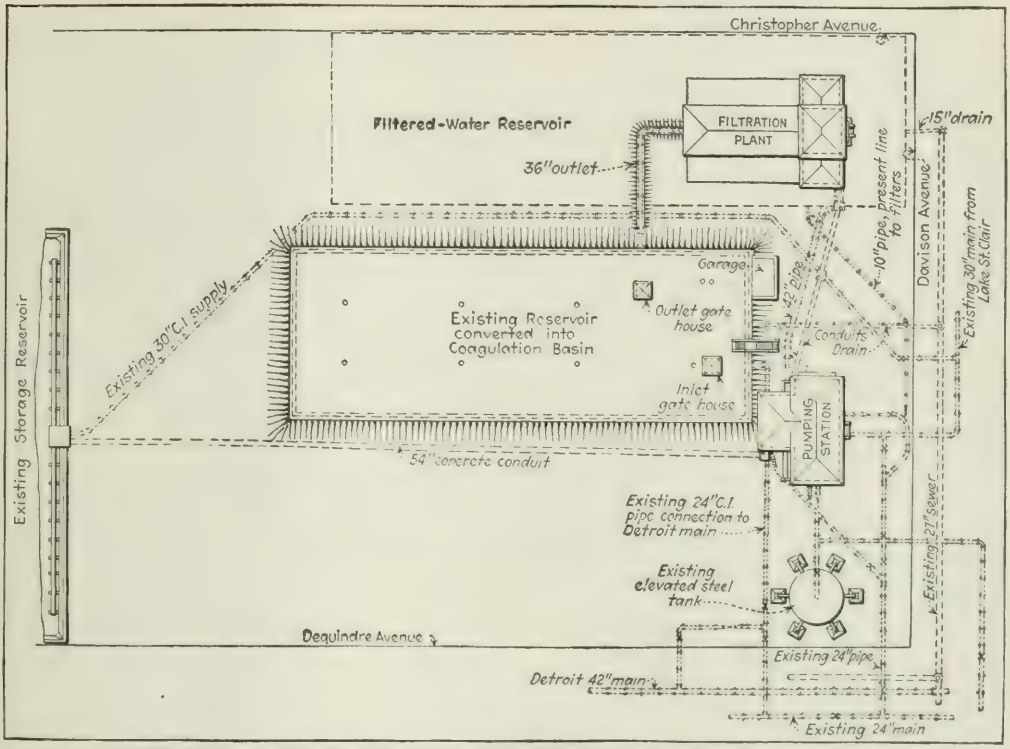
Closely Baffled Coagulation Basin Permits Varying Detention From 20 Minutes to 4 Hours—Perforated Pipe Underdrains

A WATER purification plant has recently been completed for Highland Park, Mich., consisting of a 48,000,000-gal. concrete storage reservoir, a 2,750,000-gal. covered coagulation basin converted from an existing open reservoir, a 12,000,000-gal. daily filtration plant and an electrically operated pumping station. Extreme flexibility is available in the closely baffled coagulant basin. Perforated pipe underdrains in the filters and all of the piping is arranged for rates much in excess of the normal. Pending a reduction in the cost of materials no wash water tank has been installed, a force main being bled to wash the filters. Special arrangements have been made for experimental work with two of the filters.

Water from Lake St. Clair, 11 miles away, is forced by an electric-driven centrifugal pump through a 30-in. main laid around the City of Detroit. The water is delivered into one end of the storage reservoir and taken out of the other, giving a detention period of from three to six days before passing to the coagulation basin. This reservoir was completed in 1917 and described in *Engineering News-Record*, April 11, 1918.

Coagulation Basin—Existing on the site was a storage reservoir 114 ft. wide and 324 ft. long by 13 ft. deep, with side slopes to the earth embankment of 1½ to 1. The bottom is about 5 ft. below the natural ground surface. To convert the reservoir into a coagulation basin a plain concrete groined arch roof was supported on 15-in. square columns and covered with 18 in. of earth. The arches have a span of 14 ft. c. to c. both ways and a rise from spring line to crown of intrados of 3 ft. The heavily reinforced footings are 6 ft. square and rest on the old 4-in. reinforced-concrete floor. The groined arches terminate at the ends and sides in a barrel arch which rests on the old concrete side walls.

A horizontal mixing chamber 14 ft. wide and 64 ft. long, with wooden baffles 3½ ft. apart, was constructed across one end of the basin. At the head of this mixing chamber is a gate house equipped with an automatic float valve to control the flow into the basin and



GENERAL PLAN OF PUMPING STATION AND PURIFICATION WORKS FOR HIGHLAND PARK

to hold the elevation of the water surface constant. A concrete bypass conduit leads from this gate house across the floor of the basin to the outer gate house, so that water can be carried directly to the filtration plant while the coagulation basin is being cleaned.

The basin has numerous baffle walls constructed of one width of common brick so that the water is kept in motion as it passes through the basin. Numerous gates are provided both in the mixing chamber and coagulation basin proper so that the utmost flexibility in the coagulation process can be obtained. A detention period of from 20 min. to 4 hours can be obtained in the basin by the manipulation of the gates when operating at a daily rate of 12,000,000 gallons.

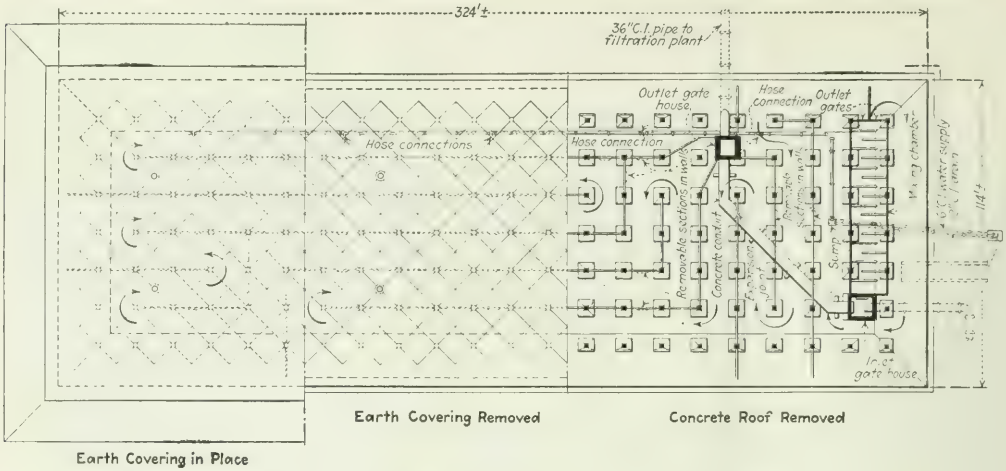
In operation the basin will be supplied from the 48,000,000-gal. storage reservoir, either directly by gravity or through low-lift electrically-driven centrifugal pumps when the reservoir is low. Since the maximum elevation of the water in the storage reservoir is 3½ ft. above that of the coagulation basin a gravity flow can only be obtained when the storage reservoir is kept nearly full of water.

The coagulant used, which is sulphate of alumina, is applied at the entrance to the basin from a hose line run from the head house of the filtration plant. Proportioning is by means of automatically controlled dry chemical feed machines located on the second floor of the head house.

Filtration Plant and Filtered Water Reservoir—The filtration plant consists of twelve filters with a daily capacity of 1,000,000 gal., with a head house, built over and at one end of a 4,000,000-gal. filtered water reservoir. The substructure of the filtration plant is built in such a way that four additional filter units can be added easily when the need arises. While the filter plant is similar to a number of others of this size there are certain features which are distinctive.

The pipe gallery has a clear width of 14 ft. and is so arranged that there is ample room to walk through without climbing over pipes, valves or other equipment. The filtered water conduit consists of a rectangular concrete box supported on piers at such an elevation that its top forms a 5-ft. walkway the entire length of the gallery. The other conduits are cast-iron pipe. All pipes, valves, rate controllers and other equipment are so arranged in the gallery as to give ample head room and working space. A 6-in. cast-iron pipe to carry filtered water to waste when a filter is first started after washing is provided and connects both with the sewer and with a reservoir under the head house, so that it is possible either to run the filtered waste water into the sewer or to store it for use later in washing filters. The rate controllers are of the venturi type and are arranged along the sides of the filtered water conduit into which they discharge. The filtered water conduit is turned up at the outlet end, where it runs into the filtered water reservoir, so that the conduit and rate controllors will at all times be submerged.

The filtering material consists of 30 in. of sand and 18 in. of graded gravel. Part of the sand is from Cape



BAFFLED COAGULATION BASIN MADE FROM EXISTING OPEN RESERVOIR

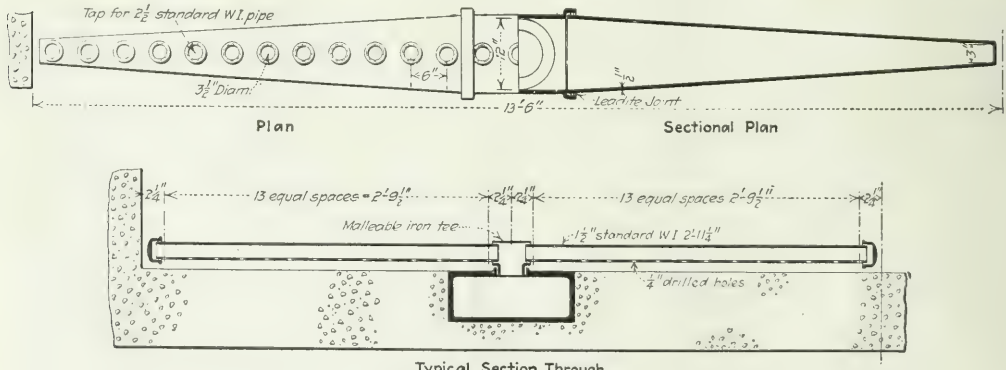
May and part from Red Wing. It has an effective size of from 0.43 to 0.48 mm. and a uniformity coefficient of not more than 1.5. The gravel is from a local bank and was washed, screened and hand picked and then carefully deposited in six layers.

The laterals of the underdrainage system consist of 1½-in. wrought-iron pipes, about 3 ft. long, with ¼-in. holes in the bottom about 2½ in. apart. These pipes are spaced 6 in. c. to c. and at their inner ends are screwed into tees which in turn are screwed into the flat tops of cast-iron manifolds. Each manifold, with its tributary lateral, serves one-quarter of a filter unit. While the filters each have a nominal capacity of 1,000,000 gal. per day, based upon a rating of 125,000,000 gal. per acre per day, it is expected that considerably higher rates may be attained, and piping, underdrain systems and other elements of the plant have been planned accordingly.

installed. In its place a 10-in. connection has been made in a 30-in. force main from the pumping station to the city, and water from this source after passing through a pressure reducing valve is to be used.

Two of the filters have been equipped with special pipes and connections for experimental work, so that large-scale investigations into rates of filtration, methods of control and size and character of filter sand may be undertaken. The experiments are expected to prove of great value in the operation of the plant.

The filtered water reservoir is 121 ft. wide, 415 ft. long and 13 ft. deep from top of floor to crown of groined arch roof. It is built entirely of plain concrete masonry, except that the portion which lies under the filtration plant is reinforced. The groined arches have a span of 14 ft. c. to c. of columns, the same as in the coagulation basin. The same forms were used for both structures. The reservoir has a capacity of 4,000,000



DETAILS OF PERFORATED PIPE UNDERDRAINS

The plant has been designed with the idea of using a motor-driven centrifugal wash-water pump of large enough capacity to wash one filter at a time, no wash-water tank being provided, but on account of the present high cost of pumping machinery this pump has not been

gal. It is built below the level of the ground and is covered by a 24-in. earth fill.

The red brick head house of the plant is three stories high, including the basement, and contains a place for the wash-water pump and other machinery, a large

entrance hall, office, laboratory, toilet rooms with shower bath, chemical storage and feeding rooms and liquid chlorine room. Considerable money has been spent in beautifying the interior of the building in order to make a pleasing impression on visitors to the plant. The entrance hall is trimmed in gum wood, with mahogany finish, has tile floor trimmed with polished marble, ornamental iron stair railings, bubbling fountain, ornamental light fixtures and other features. Broad marble stairs lead up a height of nearly 4 ft. from this entrance hall to the filter gallery, which is furnished with polished marble operating stands and has a background formed by the white enameled brick walls of the filter house. The floor and filter walls are painted concrete.

Pump Capacities

Pumping Station—A small electrically-operated pumping station built in recent years existed on the site of the water-works plant. The superstructure of this building was torn down and a larger red brick building erected. The pumping equipment consists of six 5,000,000-gal. per day motor-driven centrifugal high-pressure pumping units, four of which were in the old station, and two motor-driven centrifugal low-pressure pumping units, one of 8,000,000- and one of 5,000,000-gal. per day capacity for supplying water to the coagulation basin. The pumps and connections are arranged in a manner which gives flexibility in operation, so that in case of accident to any pump or motor some other unit may be thrown into service to take its place.

All the structures above described have been built by the construction organization of Highland Park under the supervision of L. C. Whitsit, city engineer. Rate controllers and venturi meters were furnished by the Simplex Valve & Meter Co. and operating stands and gages by the Pittsburgh Filter & Engineering Co. The improvements were designed by Hoad & Decker, consulting engineers, Ann Arbor, Mich., who also acted in an advisory capacity during construction.

Definition of a Publicity Man

When newly elected officers of an engineering society gather around the table for the cabinet-making process the personnel of a publicity committee often is one of the hardest to name. Charles R. Thomas, in charge of publication of results, Forest Products Laboratory, Madison, gave the following definition to the delegates to the national engineering conference on public information held by the American Association of Engineers, Feb. 25. "It is almost impossible for one man to have a comprehensive knowledge of all the different work that has to be done, but wide experience in many lines of work and a broad sympathy probably constitute the best training for this work. A publicity man must have, in addition, keen judgment, a pleasing personality, a nose for news, the ability to write. He must know what people want and what they are interested in. It is work for a man of buoyant, well-poised temperament and a thorough education. He must have the poise of an editor, the vision of a promoter, the aggressiveness of an advertising man, the accuracy of a scientist engaged in research work, the suaveness of a diplomat, and he must be thoroughly imbued with the idea of developing the interests of other people rather than his own. He must be content to be a Boswell to many Johnsons."

Occupancy and Standardization of Buildings

Subjects Discussed at the Recent Annual Meeting of the Building Officials' Conference at Cleveland

BUILDING-LAW standardization, classification of building occupancy, and methods of construction, including tile, hollow brick walls and pressed steel joists, were discussed by the Building Officials' Conference at its seventh annual meeting last week at Cleveland. The conference declared by resolution that "every effort should be made to standardize the basic principles of building laws," and that the Department of Commerce be supported in its recently initiated attempt to carry out this work. In order to increase the value of the conference it was voted that special committees be appointed to investigate special subjects on which an expression of opinion might be desirable. Participation in joint committees with other societies was authorized, and extension of work on sectional committees of the American Engineering Standards Committee was approved. The conference is already represented in the sectional committee on elevator standardization.

The problem of securing an effective classification of building occupancies, for both regulatory and statistical purposes, was considered in a discussion opened by R. P. Miller, of New York. He mentioned the three classes used in New York—public, business and residence occupancy—and stated that these are too few, although it is necessary to hold down the number of classes to a minimum if effective administration is to be secured. Other members agreed with him in the opinion that a workable classification should be secured as soon as possible so that safe occupancy conditions may be maintained during city growth and attendant local changes. The principle was formulated that all occupancies in any one class should be interchangeable without issuance of a new certificate. W. C. Robinson, of the Underwriters' Laboratories, Chicago, asserted that occupancy determines the fire hazard, and that the classification must therefore be correlated primarily with fire protection. Classification for statistical purposes is being studied by the Chamber of Commerce of the United States, which has a group of twelve classes under consideration. Joint committee work with that body is planned by the officials of the conference.

A paper on "Building Zones," by R. H. Whitten, of the Cleveland city plan commission, made special mention of the importance of providing a board of appeals to handle special cases arising under a zoning ordinance. J. P. Healy, of Washington, and W. P. O'Rourke, of Newark, N. J., supported the author in this argument by experience with zoning in their cities.

Active discussion developed on the subject of projecting signs and marquises. M. S. Shinnick told of the extreme conditions existing in Kansas City and the efforts now being made by the city plan commission to have all street obstructions and projections prohibited. F. W. Lumis reported partial success in this direction in Springfield, Mass.; similar reports for Cincinnati and Newark, N. J., were made by G. R. Hansen and W. P. O'Rourke.

In a discussion of methods of building inspection G. S. Summerell and J. G. Houghton described the practice in Cleveland and Minneapolis of requiring the owner to employ a licensed inspector at his own cost. In

dealing with elevator inspection Mr. Summerell told of a recent census of elevators in Cleveland, when some 500 elevators were found for which no permit had ever been issued, but said that the situation is now in hand.

Papers were read by C. C. Crockatt on hollow tile and William Carver on thickness of brick walls for dwellings, the latter describing the "Ideal" wall construction, comprising inner and outer shells of brick set on edge, tied together by headers alternating with the stretchers. This construction was referred to a committee for investigation during the coming year.

Pressed-steel joists ("steel lumber") were discussed at a session at Massillon during an all-day visit to the plant of the National Pressed Steel Co. Buildings of three to ten stories in which such joists have been in service for periods up to 14 years were inspected, as was also the process of manufacturing the joists. The discussion centered on the inherent suitability of the construction for light-load service, and on the desirability of determining more definitely the degree of fire resisance obtained in relation to the fire resistance required for various occupancies. It was reported that action has been taken recently or is about to be taken by several large cities, among them Cincinnati, where steel lumber floor construction has not hitherto been used, to permit its use in schools, apartment houses and office buildings. The makers predicted that within a year or less the cost of the material might be reduced to equality with the cost of ordinary lumber as used in dwelling-house framing.

The meeting re-elected the retiring officers (R. P. Miller, New York, chairman; F. W. Lumis, Springfield, Mass., secretary-treasurer). The annual dues were increased from $5 to $10 for active members and $10 to $25 for subscribing members, to cover publication of the proceedings and circulation of a news letter at intervals during the year.

Publicity a Necessity to Stabilize Utilities as a Business

In an explanation of the predicament in which many water companies in Illinois find themselves by reason of the present agitation for abolition of the State Public Utility Commission, C. M. Roos, secretary, Cairo Water Co., holds that the entire situation is due to the attitude of aloofness which the utilities have taken toward the public. His views were given recently at a joint meeting of the Iowa and Illinois sections of the American Water-Works Association. Utilities have not talked to the people as freely as they should, and further he says that if the public really knew conditions as they exist today, there would be little difficulty. The utilities would be in a position to do financing to better advantage, confidence in their securities would not be shaken and extensions could be made, all of which would be of advantage to the consumer and tend toward the re-establishment of general business confidence. He suggested that the educational campaign should include the following points: (1) Visits by organizations to the works where instructors would explain details of operation, maintenance and costs; (2) investment by local people; (3) study of plant by school children, instructions being furnished by utility; (4) newspaper advertising and inclosure slips in local mail; (5) solicitation instead of discouragement of questions about service and complaints.

Ohio State Department Reorganized

AN ADMINISTRATIVE code for the State of Ohio, effective immediately, creating the following eight administrative departments was enacted early in April by the State Legislature: (1) Finance; (2) Commerce; (3) Highways and Public Works; (4) Agriculture; (5) Health; (6) Industrial Relations; (7) Education; (8) Public Welfare. Each department is headed by a director. Each department director may, with the approval of the Governor, create unpaid and purely advisory boards to aid in the conduct of the work of his department.

Eight Departments Created

The directors of the eight departments, under the direction of the Governor, "shall devise a practical and working basis for co-operation and co-ordination of work and for the elimination of duplication and overlapping functions."

The salary of each of the eight department heads is fixed at $6,500 a year. The state architect and engineer will be paid $4,000 and the state highway engineer, $5,000, these two offices being the only ones established by the act under the Department of Highways and Public Works. The act provides that the superintendent of highways "shall be a competent civil engineer with at least five years' experience in the construction or maintenance of highways"; that the director of health "shall be a physician skilled in sanitary science"; and that the chief of the Division of Vital Statistics in the Department of Health "shall be a registered physician and a competent vital statistician." Heretofore the Bureau of Vital Statistics has been under the Secretary of State.

Except for department directors and division heads, other officials and employees in the eight new divisions are under civil service—many of them being transferred from the departments previously existing.

The old Public Health Council is continued in office, but no longer appoints the commissioner of health. The director of health, who succeeds the commissioner as a matter of title, is chairman of the Public Health Council and the latter body, like various other boards under the new régime, has advisory powers only.

Budget System Adopted

Among the duties of the Department of Finance one is to submit a budget to the Governor biennially and another is to "investigate duplication of work of the department and the efficiency of the organization and administration of department, and formulate plans for the further co-ordination of department." The Public Utilities Commission of Ohio, under the new code, becomes a part of the Department of Commerce for certain administrative purposes and the director of commerce becomes ex officio secretary of the commission, with the power to designate some employee of the department to serve as acting secretary and to "exercise the powers of the secretary of the commission."

The new Department of Highways and Public Works is given all the powers and is to perform all the duties previously vested in the superintendent of public works, the state highway commissioner, the chief highway engineer, and the State Building Commission. The Department of Education will perform all the duties previously vested in the office of the state geologist.

Controversy Over Use of Water of National Parks

Views Given of Western Engineer and Head of an Eastern Civic Association—Non-Partisan Commission Suggested

PROPAGANDA against the utilization of water in the national parks by storage mainly for irrigation purposes undoubtedly resulted in the favorable adoption by the last Congress of an amendment to the provision of the water-power act exempting the national parks from the jurisdiction of the Federal Water Power Commission. Following the publication of an editorial is *Engineering News-Record* Jan. 13, 1921, p. 49, in which a middle course was advocated between the radical nature-lovers and the ultra-utilitarians further inquiry has been instigated. Many letters have been received, typical of which are two below giving opposite viewpoints. They are presented because the fight, having been removed from the Water Power Commission, reverts to Congress.

J. Horace McFarland, the president of the American Civic Association, an organization responsible for much of the park-preserving propaganda in the general magazines, gives the whole subject consideration. Frank C. Emerson, state engineer of Wyoming, gives a Western engineer's viewpoint on a definite project with which there is large agreement by a representative of *Engineering News-Record,* who spent several weeks in 1919 in the Snake River Valley and also some time examining reservoir sites on the headwaters of the Snake in and out of Yellowstone Park.

The pertinent points in Mr. McFarland's letters, written in January, follow:

In *Engineering News-Record,* Jan. 13, p. 49, is an editorial headed "Parks and Water Power," in which you say in respect to the Esch bill removing the national parks from the provisions of the water-power act in Congress, that it "is supported by the usual hysterical nature-lover propaganda, which in its most rabid form—and in this form it has wide circulation—quite frankly would prefer a wilderness where two dozen men may hunt bear to a scenic reservior which supplies water, light and power to half a million people.

I do not think you wish knowingly to make any misstatements, wherefore I am providing you with the facts. The Federal Water Power Commission itself earnestly desires, on what Judge Payne calls "fundamental grounds of procedure," to be relieved of the continual pressure that will be made upon it if the Esch bill (H. R. 14,469) is not passed by those whom you describe as including "the ultra-utilitarian who would dry up Niagara or pipe the Yosemite." He insists that inasmuch as Congress has once set aside these parks Congress ought to determine on interferences with them. He is presumably a good lawyer, and he can hardly be called a "hysterical nature-lover." [This bill was passed. EDITOR.]

Further on in the editorial another misconception is apparent. You say, "Much of the most necessary and valuable power in the country is within the limits of national parks." Inasmuch as the national parks as now constituted include in whole a total of but 1.11 per cent of the total public lands of the United States available to those who desire to develop water powers and irrigation projects it would seem that this statement was hardly based on the facts.

I am quite sure that if you had heard the evidence brought out incidentally at a hearing in connection with one of the irrigation projects that has desired to avail itself of what was proved by photographs and engineering data to be the most beautiful valley in the Yellowstone National Park, and affording within 20 miles of Old Faithful geyser a much needed automobile camping place for the thousands of tourists who use the Yellowstone National Park, you would have joined with the rest of us "hysterical nature-lovers."

I am equally confident that if you had heard at Des Moines, Iowa, a few days later, the statement of the agent of the promoters who are desirous of damming the Yellowstone River in the Yellowstone National Park, and had realized the engineering absurdity of the proposition, you would likewise have felt as we do with respect to that particular proposition.

I do not seem to know of any of the national parks which exists as "a wilderness where two dozen men may hunt bear." I do know that in 1920, according to the report of the director of the National Park Service, 1,158,445 visitors went into the national parks and monuments, this number excluding two parks, the one in Hawaii and the other in Alaska, and thirteen national monuments. It is on record that the use of the national parks *increased in 1920 117 per cent over 1917.* It is shown that in 1920 *128,074* motor cars, largely those of the farmers and business men within easy reach of the parks, used these wonderful recreation grounds, these museums of the great in scenery and the unique in nature's vagaries.

There exists an almost perfect example of "a scenic reservoir" which does *not* supply "power," light and water to a half million people, but does supply irrigation water to probably two or three thousand people, counting men, women, children and possibly domestic animals. Jackson Lake, south of the Yellowstone Park, has been made from what was admittedly one of the most beautiful lakes in the world into "a scenic reservoir." Inasmuch as the water impounded in it must be used when crops are growing it is drawn down during the summer. The result as shown by many photographs is the killing of all the flooded vegetation about the lake and the substitution for a lovely natural body of water of a slimy pond with a half-mile beach of mud and silt. This is the sort of "scenic reservoir" which seems to be somewhat in the mind of your writer, but which I think scarcely ever exists unless it has been built for that purpose and does not result from the flooding of gradually sloping land.

With the great respect I have for the engineering profession and for *Engineering News-Record* as its exponent, I cannot but regret the statement above referred to, which seems to miss both the facts and the spirit of the situation. Surely you would be willing to correct the obvious and direct misstatements made and to set the parks in the truthful light of the evidence submitted and masses of similar and indisputable evidence which can be provided.

In a later letter Mr. McFarland states that he is in favor of an inquiry by an impartial and non-partisan commission which would inquire into the water-power and irrigation possibilities of all the national parks, setting forth the information thus obtained in a report which would end the cross-fire of statement with respect to the necessity or non-necessity of using the parks at all for anything other than their stated purposes. Further he says:

I have not held and expect never to hold that anything in the nation belonging to the nation is sacred from actually needed use for the public benefit. If it is necessary to grow potatoes around the Washington Monument there ought to be no obection to thus providing food when that necessity is shown. If the whole nation, which owns the national parks, can advantage more by the use of the water in those parks for power production or for irrigation, or for both, than in the keeping of the parks as memorials of great scenery, as nature preserves the wild life of the land, as recreation grounds, then I would favor such necessitous use in the public interest. I should hope that *Engineering News-Record* would be willing to believe that for this bare 1 per cent of all the public lands private use should be avoided and public use promoted. Now if this is hysterical then I am rather glad to be so called.

The following statement of the issue in the matter of the proposed Yellowstone reservoir is made by Frank C. Emerson, state engineer of Wyoming, who is peculiarly qualified by his position to discuss it in an unbiased manner:

A vast deal of nonsense has appeared in the public print during the past few months in relation to what has been termed the "proposed exploitation" of our national parks, and particularly of the great Yellowstone Park in Wyoming. It seems that the questions involved, by plans to make a limited use of two certain reservoir sites within the limits of Yellowstone Park for the purpose of conserving waters to be used for irrigation purposes, are likely to go to judgment with only one side of the case heard.

As a result of applications for a permit to use Yellowstone Lake as a reservoir to store flood waters a special trip of inspection to the lake was made by myself in my capacity as state engineer for the purpose of obtaining first-hand information concerning the proposed development. From my observations on the ground, and a study of the situation generally, it was my definite conclusion that a limited use could be made of Yellowstone Lake as a reservoir, and, without any material detriment to the park, provide a great public benefit to the State of Montana.

The storage of water on Yellowstone Lake would be accomplished by the construction of a low masonry dam across Yellowstone River near the outlet of the lake. This dam could well be of artistic design, carrying a substantial roadway, and would undoubtedly present a feature of much interest to visitors in the park. According to the plan proposed water would be held in the lake at a point no higher than the present high-water level of the lake during the spring-flood period. The difference between normal low-water and high-water level in the lake, under conditions that now exist, is about 6 ft., the high-water level being reached during the quick run off of snow water in the months of May and June. The reservoir proposal is simply to hold in storage water at the high-water level for a period of about two months, allowing the normal discharge of the river to pass through at all times and controlling the water held in storage for gradual release during July and August. The beauty of the falls of the Yellowstone might well be enhanced if the proposed plans were adopted, as the water held back in the lake would be regulated and allowed to go over the falls in greater volume than is now possible during the low water period. As water would be held no higher at any time in the lake than is now in effect at the natural flood height during the spring floods it is evident that, despite the assertions of certain writers to the contrary, no vegetation in the park would be destroyed, no feeding grounds for animals would be disturbed, nor would any of the other natural wonders of the park be threatened.

The West recognizes our national park playgrounds as great assets and wishes to see them well protected. But there seems danger of extending the playground theory too far, and, by reason of fears unfounded in fact, interests that are vital to the West may be denied the privilege of making proper use of water which nature has provided. Montana has suffered greatly from drought conditions during the past few years. This was especially true in the year 1919. It is almost a tragedy when the farmer plants his crop in the spring, cares for it until the heat of summer and then must see it wither away for lack of proper irrigation during July and August. To thousands of Montana farms relief from such a condition can be brought by the storage of water at Yellowstone Lake. Good reservoir sites for the storage and conservation of our water supply are indeed rare. Yellowstone Lake would afford a wonderful reservoir, and it is doubtful if its equal can be found in the West. By reason of its immense area the storage of only 6 ft. of water over the lake would supply a necessary supplemental water supply for nearly 500,000 acres of land. Writers in no position to know the facts have asserted that necessary water should be stored without the park. From such information as I have been able to secure there are no feasible available sites without the confines of the park that will adequately serve the purpose.

The writer has not had an opportunity to visit the site of the proposed Fall River reservoir in the southwestern corner of the park. From information at hand, received from competent judges, it is believed that this development could also take place without any material detriment.

The struggle of man to convert the arid wastes of the West into productive farm lands is a hard one at the best. The interests that have been referred to variously as "water grabbers," "despoilers of our parks," etc., are universally concerns or public organizations that have for their aim the creation of valuable farm lands where only desert wastes now exist. The projects generally promise little monetary return, but are rather undertaken as great public benefits. Anyone familiar with the history of irrigation development will recognize the truth of these statements.

If the people enjoying our national parks realized the true situation in regard to the plans that are proposed in connection with the storage of water in Yellowstone Park their verdict would undoubtedly be in favor of allowing development that, without injury to the wonders of our national playground, would bring great public benefits.

In the interest of fair play the projects that are proposed for development in Yellowstone Park should at least have a fair hearing and be decided upon the merits of each case to be considered. We can depend upon Congress to take such action as well as to guard properly the public interest, and the argument of the opening wedge can have but little consideration from people who know the facts and are willing to give the matter fair thought. To have wide pressure brought to bear upon Congress by the public through a sentiment created by clever writers, taking needless alarm at what they believe might work injury to our national playgrounds, is an injustice not only to the people of the West but to the entire nation.

A final comment on the situation is made, as follows, by the *Engineering News-Record* representative who visited this country in 1919:

(1) Every case should be considered on its merits by itself. (2) Mr. McFarland's suggestion of a non-partisan commission to get at the facts is good. (3) Few Eastern people realize the bigness of the park, with its vast stretches of uninteresting area and the welcome with which one greets a few man-made structures after hours of traversing jack-pine forest. (4) The value of automobile parking space in the wilds surrounding Old Faithful Inn are not to be confused with the parking problem in the loop district of Chicago. Robbing the deer of their grazing grounds has little point, for the real problem for the deer is winter, not summer, feed. (5) Doubtless there are stretches of wooded Yellowstone Lake shore that would be destroyed, but by a comparatively small expenditure this timber could be logged off. The shores visited were all comparatively steep, with shingle beaches. (6) Jackson Lake, seen at its lowest in history, produced even over the mud flats the prize picture of the summer's trip. (7) Since there is great agitation to include the Jackson Lake region in the Yellowstone Park why not effect a transfer, the park giving up the Fall River reservoir site for an equal amount of accessible and even more beautiful area in the Jackson Lake region? (8) Lastly, let us never forget that the irrigated land is so far in excess of the water available eventual utilization is as certain as existence. The Minidoka project of the U. S. Reclamation Service has actually created values in excess of $30,000,000 since 1904 and the water impounded in Jackson Lake played a most important part in the production of that added wealth of the country. Mr. McFarland's estimate of the benefit reaching to two or three thousand people only is therefore too ridiculous for answer.

Traffic Records Made at St. Marys Falls and Panama Canals

COMPARISONS of certain traffic records made at the Panama Canal and the St. Marys Falls Canal, Sault Ste. Marie, Mich., indicate in several instances that facilities on the ocean for handling bulk freight are not yet as efficient as those on the Great Lakes, according to information furnished by L. C. Sabin, general superintendent, St. Marys Falls Canal. Records of size and tonnage of ships and of coaling and discharging coal are cited, the figures from the Isthmus being taken from the *Panama Canal Record*.

The steamship "Friesland," with a cargo of 15,138 short tons of wheat passed through the Panama Canal Nov. 8, 1920, the largest cargo of wheat that had been carried through the canal. The "Friesland" is a vessel of 12,321 tons gross and 8,690 net tons, 520.7 ft. in length by 64.2 ft. beam, drawing 30.4 ft. in salt water at the time of transit. The steamer "W. Grant Morden," with a cargo of 15,149 short tons of wheat passed through the St. Marys Falls Canal, Oct. 9, 1919. The "Morden" has a tonnage register of 8,973 gross, 6,086 net tons, and is 625 ft. long with 59-ft. beam, and was drawing 20 ft. 10 in. in fresh water at time of passing.

The collier "Ulysses," discharged 12,030 tons of coal in 14 hr. 25 min., Nov. 12-13, 1920, which is equivalent to 834 tons per hour, allowing 1 hr. for clean up, etc. This was cited as a new record at the Cristobal coaling plant. On the Great Lakes this rate has often been exceeded. In 1918 the "G. G. Barnum" discharged 10,610 net tons of soft coal in 10 hr. 30 min., or at the rate of 1,010 net tons per hour. In 1919 the "Wm. A. McGonagle" made a record of 1,149 tons per hour.

On Nov. 25, 1920, the Cristobal coaling plant established a new record in delivering 1,102 tons of coal to the steamship "Wiltshire" in 1 hr. 35 min., or at the rate of 696 tons per hour, equivalent to 780 net tons per hour. This coaling record is often exceeded on the Great Lakes. In 1920 the "H. G. Dalton" loaded 13,880 net tons in 10 hr. 30 min., or at the rate of 1,322 net tons per hour, while in 1919 the "J. Pierpont Morgan" loaded 13,534 tons in 6 hr. 59 min., or at the rate of 1,933 tons per hour.

Motor Boulevard in Seattle

An ordinance providing for the opening of a new motor and street car street or boulevard is soon to be introduced into the council of the city of Seattle, Wash. This boulevard will extend south from a plaza in the vicinity of the railway station and will be 150 ft. wide. This width will have a middle section for street cars, two side roadways 20 to 24 ft. wide for motor travel, and a sidewalk on each side. At first it is intended to provide for only an occasional crossing which will be either overhead or under the boulevard with a fenced right-of-way and signs directing traffic to the crossing. As traffic increases additional crossovers or underways will be provided. The amount of motor travel now coming into the city of Seattle is so great that the city engineer, A. H. Dimock, who is recommending the scheme to the council, feels that it is necessary to provide some direct means of entering the city which will not add to the great congestion in the downtown district. While the boulevard may not be built immediately, the condemnation proceedings should start as soon as possible in order to get the advantage of the cheap land.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Credit Due Dean Schneider

Sir—In my recent article on Antioch College I omitted to give credit to Dean Herman Schneider of the University of Cincinnati for the origin and development of co-operative college courses. It is generally known among American educators that the work of Dean Schneider at Cincinnati has brought so-called co-operative college education, that is, the plan of part time study and part time work, from the condition of a theory to a state where the experimental element has to a very considerable extent been eliminated and where others can follow him and take advantage of the very great contribution he has made in this field.

The co-operative plan is only one element in the Antioch College program, but it is an important element. The substantial success that Dean Schneider has attained has placed it and other similar undertakings under deep obligation to him.

ARTHUR E. MORGAN,
President, Antioch College.

Yellow Springs, Ohio, April 28.

Automatic Stream Discharge Recorders and the Parabolic Weir

Sir—The discussion of automatic recorders in *Engineering News-Record*, Dec. 9 and 30, pp. 1124 and 1297, and March 24, 1921, p. 521, has been very interesting, but I do not believe it is complete without mention of the parabolic weir, which is more readily adaptable to an automatic recorder, or meter, than any other form of notch.

The results of an investigation in the hydraulic laboratory of Purdue university on seven parabolic weirs were set forth in Paper 21-B, published by the American Society of Civil Engineers in January, 1921. The side of the notch in each instance was cut to fit the equation $x^2 = 2py$, the value of p ranging from 0.1 to 2.0 in. The results of these experiments may be summed up as follows:

(1) The parabolic weir is one of the best types developed and is adaptable to a wide range of conditions. (2) The actual rate of discharge can be computed by the very simple formula $q = kh^2$, where q is the actual rate of discharge in sec.-ft.; k is a constant for any given weir with beveled edge; and h is the observed head in feet. (3) The value of k can be accurately predicted for any given value of p. (4) The parabolic weir is adaptable to a simple and accurate automatic recorder.

Triangular weirs have been used more extensively than other types in connection with automatic recorders, especially with feed water heaters. Meters for recording the flow through this type of notch are expensive and complicated in design. Furthermore, their accuracy is impaired at low heads because of the manner in which motion is communicated from the water surface in the channel of approach to the meter. Part of this investigation on parabolic weirs consisted in testing a recorder that was attached to the side of the channel up stream from the notch. The mechanism was actuated by a float attached to a slender shaft by a rod. Fastened to the other end of the shaft was a pointer that was caused to move outward from the center of a dial. The distance traveled by the pointer can be made proportional to that through which the float moves by a properly designed link. The squares of the distances moved by the float and by the pointer are directly proportional to each other. The tests also included a calibration of an automatic integrator that eliminated the use of a planimeter on the charts of the recorder. The recorder allows observations of the rate of flow while the total amount for any period of time can be observed directly on the inte-

grator. The tests showed the accuracy of the recorder to be 0.993 and that of the integrator, 0.996. The entire mechanism is simple in construction with but few parts, responds immediately to the slightest change in head and is accurate throughout the entire capacity of the weir.

Lafayette, Ind., April 9. F. W. GREVE,
Assistant Professor of Hydraulics, Purdue University.

Guessing at the Traffic Problem

Sir—Before me is the editorial "Guessing at the Traffic Problem," which appeared in your issue of April 7, p. 577. The proposal to which you refer was made seriously. However, I did not consider that all of the improvements which I discussed would be carried out within the next 200 years; something should be done every little while to alleviate the traffic congestion. May I call your attention to my notes on the paper in question, in which I advocate as follows the immediate construction of the expressway between Fifth and Sixth Aves.

"The expressway from 14th to 59th Sts., between Fifth and Sixth Aves., is of immedate importance and something which should be put through at once. Later, should motive power be developed doing away with noxious waste gases, this expressway should be projected under Central Park to the Bronx, thus giving to the city a most desirable traffic route.

"There is every reason why satisfactory results, from a financial standpoint as well as from utilitarian and aesthetic points of view, should be realized by the city in the creation of expressways. The great improvement at the Grand Central has given to the railroads a terminal the cost of which is carried by returns from the improvement."

Also, may I call your attention to the fact that Mr. Schaeffer, while figuring the cost, did not allow for profits to the city from the sales of property under excess condemnation, or for advance in ratables. Ample provision for the work could be obtained in this way.

In partial answer to the questions in the last paragraph of your editorial, I suggest that this whole problem be viewed from the standpoint, not of tempting traffic away from heavily congested routes, but of providing pleasant and attractive ways and means for traffic to be accommodated on just those routes most heavily congested. To my mind, congestion is not a condition to be eliminated. Alleviation, perhaps, if it results through accommodation, is good, but suppression is not.

New York City, April 22. CHARLES W. LEAVITT,
Civil and Landscape Engineer.

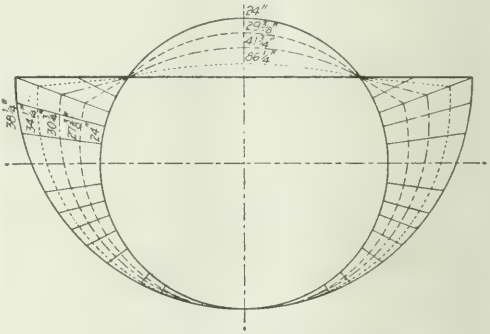
Accompanying the foregoing letter is a quotation from a communication to Mr. Leavitt from Col. W. J. Wilgus, consulting engineer and president of the New York Section, Am. Soc. C. E., which is reproduced below:

"If a double-track railroad is congested with a combination of through and local traffic there is not the slightest hesitation in increasing the number of tracks to four in order that the two kinds of traffis may be segregated. Why is not the same thing true with street traffic when the existing avenues have become so congested that vehicles in both local and express service, so to speak, are so inextricably mixed as to bring both to a standstill. In the case of the railroad there is no debate as to the necessity of increasing the number of tracks to meet the changed conditions. In the case of the street traffic, however, there seems to be a complete absence of fearlessness in meeting the situation boldly and solving the problem in a broad way.

"In the case of the Grand Central Terminal had we not shown temerity the public today would not be reaping the enormous benefits that have come from the tearing down of obsolete structures and the substitution of new ones. The same vision and courage must be shown in the case of the thoroughfares on Manhattan, and I for one believe that this should be immediately undertaken midway between Fifth and Sixth Aves., from Washington Square to the Bronx. I cannot avoid the conclusion that, properly done, this great improvement, through enhanced property values and reduced delays to the public, would be self-supporting, in addition to which the community as a whole would be permitted to expand. As in the instance of the vehicular tunnels, tolls might be charged for a sufficient period to amortize the cost."

A Graphical Solution of the Conduit Transition Problem

Sir—I submit herewith sketches and description of a method for developing intermediary sections in a transition for the benefit of some of the younger engineers, such as myself, who do not know the method suggested by Thomas H. Means in his contribution, "Inverted Siphon Terminates in Riser on Bridge Pier," *Engineering News-Record,* March 31, p. 562. I developed this method, which possibly is an old one, in connection with a similar problem several years ago. I am inclosing one of those old sketches [not reproduced—Editor] and a sketch showing the solution of T. H. Means' problem. I used a small scale in this latter problem and do not claim great accuracy for it. In the Jones Island, Milwankee, Wis., problem, the scale was



END VIEW OF PROJECTED CONDUIT

large enough to indicate ⅛ in., which was accurate enough. I also wish to point out that owing to the peculiarity of Mr. Means' problem, his transition coming at a bend, my sections are not exactly his but they will give the same shaped transition if used at their proper relative positions, which are the ¼, ½ and ¾ distances between the two end sections. This point will be evident in the description which follows.

Project one end section of the transition upon the other end section, getting a vertical projection of the surface between them; select a convenient axis and draw radii to the limiting curves indicating the sections made by a plane revolving upon the given axis with the developed surface of the transitions. Then, if n number of sections are desired, divide the projected lengths of these sections into $n + 1$ parts and connect the loci, which will give the different sections.

A few practical points in connection with the building of the transition: Templets of stiff paper for one-half of a symmetrical section will be sufficient for making the bents. In assembling the latter keep them in their true relative positions and the lagging, preferably of narrow strips, in the directions of the radii in the sketch. It will be found convenient to start the lagging at the critical points and fill in between, using straight and wedge shaped pieces as necessary. Whenever one end shape intersects that of the other end the surface developed around these points will look like a corkscrew. I made twenty-five of these odd looking shapes in connection with the Jones Island project. ED. H. TASHJIAN,

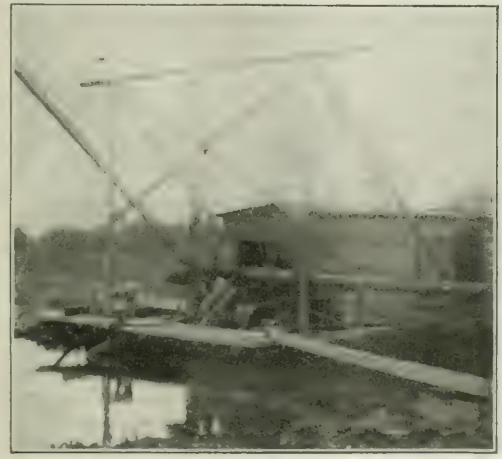
Steubenville, Ohio, April 11. Superintendent for Walker & Weeks, Architects, Cleveland, Ohio.

HINTS FOR THE CONTRACTOR

Submerged Gravel Pumped to Screens for Road Work

By George E. Johnson
Engineer, Department of Public Works, Lincoln, Neb.

During 1920 the construction division of the Department of Public Works of Nebraska maintained two camps with pumping outfits, which were used for procuring gravel for road surfacing. One camp, located near Grand Island, is equipped with a pumping outfit consisting of a 6-in. gravel pump, belt connected to a 50-hp. gasoline engine, with a speed of 1,200 r.p.m., reducing the speed of the pump to 550 r.p.m. The engine was placed upon five pontoons, 5 x 18 x 3 ft.,



PONTOON-MOUNTED CENTRIFUGAL PUMP EXCAVATING RIVER BED GRAVEL

which were bolted together by timbers. A 1½-in. centrifugal pump discharges water continually into the shell of the gravel pump. In this way the solid material is kept in motion, and less trouble is had with pump clogging. This small pump was also used as a priming pump with which to start the larger pump.

Two men operate the plant. One man handles the suction pipe, lowering and raising it when necessary; the second man keeps the machinery in order and attends to the screen and bin. The dredge sucks the water and gravel from the lake bottom and carries it through a pipe 200 ft. in length to a 3 x 6-ft. No. 8 screen.

An average of 125 cu.yd. per day is delivered against a head of approximately 35 ft. By lowering the head 50 per cent, it was found that the production might be doubled. A 50-cu.yd. bin retains the gravel until it is dumped into trucks or trailers, the latter being pulled by a 120-hp. tractor. The finer sand, when separated from the gravel, is carried by a chute to a supply pile, where it is stored until sold for plastering sand.

The plant depreciation runs fairly high, as the pump will only pump approximately 50,000 cu.yd. of material. The original cost of the pump outfit is $1,000, and it is estimated that it will depreciate nearly 25 per cent per year, if used continually. The engine consumes approximately 40 gal. of gasoline a day, and 2 gal. of lubricating oil. Thus the costs of the operation may be given as follows:

Labor, 10 hours a day	$15
Gasoline, 40 gal. at 35c	14
Lubricating oil, 2 gal. at $1	2
Depreciation based upon 200 working days, or per day	5
Total	$36

In 1921 it is expected to reduce these costs 20 per cent, due to the lower prices of labor and materials.

Bucket-Loader Converted Into Crane

Using a crane fashioned from a bucket-loader, nine bays of a factory building, having one apex truss and two lean-to trusses as indicated by the illustration, was erected in less than a week. The erection was done by workmen of the Mosley Construction Co., for the Barber-Greene Co., of Aurora, Ill.

Previous to the arrival of the structural iron workers, the owners rigged one of their self-feeding bucket loaders, in the fashion shown, as a stiff-leg crane. The bucket elevator was removed and a power winch installed on the frame which houses the gasoline engine.

FIELD-MADE TRAVELING CRANE ERECTING ROOF TRUSS

At one side of the motor frame an A-frame was attached with a platform at the opposite side weighted with sacks of sand to form a counter balance. This A-frame reached 32 ft. from the ground, high enough to erect the lean-to trusses. In order to use it on the apex trusses, the A-frame was extended by lashing to it a small telephone pole. This gave the boom a height of 50 ft. For additional safety at this height, ropes were strung from the boom to the steel work on each side. The original drive of the machine was not altered. Power was furnished by a 25-hp. gasoline engine. Six men comprised the crew.

NEWS OF THE WEEK

New York, May 5, 1921

Revised Belle Isle Bridge Plans Bring Lower Bids

Only Two Contractors Submit Prices for Complete Structure—Arundel Corp. Figure is $2,619,000

The two bids for the construction, according to recently revised plans, of the Belle Isle bridge at Detroit, submitted by contracting firms April 23, both exceed the amount remaining in the bridge fund. The Detroit Department of Public Works submitted a bid which was within the available funds and below the engineers' estimate. Only two complete bids were submitted by contractors, although a large number of notices of the proposed letting were sent out and about twenty firms requested copies of the revised plans.

The Great Lakes Dredge & Dock Co., Cleveland, O., submitted a bid of $2,943,541 for the complete work, as included in the last advertisement, or $2,920,261 for the work not including the waterproofing. There is approximately 194,000 sq.ft. of fabric waterproofing.

The bid of the Arundel Corp., Philadelphia, for the complete work was $2,618,922, or $2,599,522 with the waterproofing omitted, allowing $19,400 for the average cost of five types of waterproofing.

A bid for the structural steel work was submitted by the Whitehead & Kales Co., Detroit. The figures submitted were: For fabricating and erecting the structural steel, $144 per ton; for furnishing and erecting bronze bearings, 55c. per pound; metal roadway and sidewalk expansion joints, 6¾c. per pound; metal hand railing and lamp posts, lump sum, $94,940.

The low bid is approximately $1,600,000 below the low bid received for the complete work when the proposed letting was advertised in December of last year. About $1,000,000 of this difference represents the decrease in quantities provided for by the revision of the original plans, and the remaining $600,000 represents the decline in unit costs.

Among the differences between the present design and the original design as submitted for bidding at the two prior lettings are: Reduction of the carrying ribs from nine to eight, the sidewalks now being cantilevered half their width beyond the outer rib; elimination of the pier extensions and the concrete lamp-standard bases supported on them; reduction of 17½ ft. in length of piers, reduction of pier bases and pile foundations, and rearrangement of the piling; revision of the pier footing design by the introduction of an unreinforced concrete seal course over the pile tops; simplification of spandrel details and pier shafts, and substitution of a single sway frame for two at each pier; substitution of plain earth embankments for retained approaches with stairways; omission of concrete dock construction at the north abutment; reduction in field riveting by allowing bolted bracing connections; and omission of the work of removing certain of the old bridge piers. These changes reduced the quantities sufficiently to reduce the cost, when computed at the minimum unit-prices of the prior bids, from $4,000,000 to $3,100,000.

While no definite action has yet been taken by the City Council, the contract will probably be awarded to the Arundel Corp. Steps are being taken to bring the company's bid within the amount available, which is approximately $2,441,500, by omitting certain items such as paving, cinder concrete paving base and sidewalks, which can be supplied later.

The Department of Public Works bid was $2,389,957 and without waterproofing, $2,366,677. The department's bid was low on 16 of the 25 items bid on, but was high on the steel.

Am. Soc. C. E. Convention at Houston Approves Constitutional Amendments

With Minor Changes Committee Draft Stands—140 Present—President Webster Defines Municipal Engineering

The net result of the business session of the annual convention of the American Society of Civil Engineers at Houston, Tex., April 27 was a unanimous acceptance of the constitutional amendments presented by the committee on referred amendments. Automatically the amended instrument goes to letter ballot. The society's action was preceded by a three-hour discussion and futile attempts to make amendments, only one of which was of vital import. The discussion showed that influential adherents of both sides of former controversies were a unit in the determination not to tamper with the six month's work of the committee. This was all the more evident after a spirited address by Arthur P. Davis, punctuated by applause and one by Francis Lee Stuart, received with equal enthusiasm. George G. Anderson tested the temper of the convention shortly after the matter was open for discussion by a motion to amend the "objects," mainly by the addition of a clause on co-operation with other organizations. An extremely weak "aye" vote followed a lively discussion and thereafter none but minor changes were attempted and they failed. The committee brought in seven minor and explanatory changes, noted below, which were accepted without dissenting vote.

No other business was considered at the meeting, but announcement was made (1) of the decision of the publication committee to resume the publication of all paper and discussions in the *Proceedings;* (2) of the authorization of a committee to promote the technical interests and activities of the society, said committee to appoint sub-committees in each district to stimulate interest and activity along technical lines; (3) of the authorization of a research committee "to organize, stimulate and supervise the research work of the society, as conducted by its committees or through co-operation with other societies and individuals"; also a personnel of not more than 15 representatives, including the research committee, of the American Society of Civil Engineers on the advisory committee on civil engineering of the division of engineering of the National Research Council "whose duties it shall be to represent the society in its responsibilities therein as sponsor society in research work in civil engineering."

Constitution Discussed

The report of the committee on the Alfred Noble memorial indicated no progress, largely because of the failure to obtain designs within reasonable cost. Samuel Rea replaces Onward Bates as chairman although Mr. Bates remains on the committee. Robert Ridgway has been appointed secretary-treasurer of the committee.

J. H. Brillhart, chairman of the Texas Section, presided at the opening session when nearly 300 were present, although but 140 members and 72 guests had registered by evening. Governor P. M. Neff eulogized the engineer and his work and Mayor O. T. Holcomb welcomed the delegates to Houston. E. E. Sands, consulting engineer, described local and state engineering works. Mr. Webster followed with the annual address of the president on "The Municipal Engineer," whose wide province he defined largely from his own 40 years' experience in Philadelphia.

Under new business Peter Junkersfeld, chairman of the committee on referred amendments, read the brief report and the seven changes the committee desired to make to the amended constitution, as sent out to the members

March 19, and endorsed by local sections in Illinois, Louisiana, Spokane and San Francisco and a large number of individuals. Many changes had been suggested but the committee felt that it was inexpedient to act favorably on them. It recommended that all such changes be referred to the board or a special committee. Mr. Junkersfeld moved the adoption of the report and the discharge of the committee.

H. S. Crocker, acting secretary, read the communications of endorsement from the sections. Information was solicited as to the members present at the various meetings. It was learned that 10 attended the Louisiana meeting, 25 to 30 the Illinois section, 13 the one in Spokane, and 17 the session in San Francisco.

George G. Anderson offered the substitute amendment on "objects," as noted above, prefacing the introduction with the statement that he believed the spirit of all members was now progressive and that all were earnestly striving to build up the organization. Much discussion followed, with the members of the committee answering all questions, the main one being that the objects must conform to the articles of incorporation. L. L. Hidinger stated that this very point had been taken up with the society's attorneys, who advised the use only of the exact words in the charter which gave full authority for the cooperation demanded by Mr. Anderson.

Mr. Davis added that the attorneys had advised that the society could, if it desired, join the Federated American Engineering Societies and that the powers are not bounded by the constitution but by the articles of incorporation. The real question, he pointed out, was how to get rid of an antiquated constitution. He felt that it was impossible to make acceptable amendments by debate, for any such amendments would create suspicion and antagonism enough to prevent their passage.

Mr. Stuart found the amendments disappointing, but that they represented the judgment of eight men and he believed their work should be accepted, deferring further change to a later date. Mr. Anderson's motion was lost on a *viva voce* vote.

Prof. A. N. Talbot called attention to an obvious typographical error in the constitution, article VII, section 3 last line, the whole line of which was finally stricken out as of no import.

J. N. Chester then attempted to eliminate a sentence in section 1 of the same article allocating foreign members (560) outside of North America to District 1. He failed.

Gardner S. Williams made an equally unsuccessful attempt to eliminate a clause in section 9, same article, prohibiting listing or counting of votes. He desired to return to the present method of making the list available to members desiring it. Mr. Junkersfeld stated that the proposed secret method was that used satisfactorily by the other founder societies. At this point several members, including Mr. Sands of Houston and A. D. Butler of Spokane, spoke decisively against any further amendments. With Mr. Williams' motion lost overwhelmingly, the committee's report as a whole was adopted.

The seven changes proposed by the committee are as follows:

(1) In article VII section 1 of constitution relating to nominations make District 1 as at present include the territory within 50 miles of the New York post office.

(2) In article VII section 4, constitution, add a clause to the effect that no vote for a nominee for vice-president outside of a zone, or director outside of a district, in which the voter resides shall be counted.

(3), (4) In article X section 2 and 3, constitution, eliminate the word "several" before words "corporate member."

(5) In article V, bylaws, relating to student chapters substitute the regulations adopted by the Board of Direction Jan. 17.

(6) In article VI section 2, bylaws, relating to order of business omit the line "Announcement of members of nominating committee."

(7) Add a new transitory article VII to bylaws by which the ballot to be canvassed at the [illegible] annual meeting shall contain the names of all persons nominated by the nominating committee in accordance with the existing constitution as well as nominations by declaration. In other respects the election is to be according to the amended constitution.

It was announced at Houston that Elbert M. Chandler, of Olympia, Wash., chief engineer, Washington State Reclamation service, had been appointed by the board of direction acting secretary of the society. An account of Mr. Chandler's professional experience appears elsewhere in these pages.

Minnesota Enacts Weak License Law

Any One May Practice as Engineer or Architect Provided Term "Registered" is Not Used

(Special Correspondence)

The bill providing for the registration of architects, engineers and land surveyors in Minnesota, has become law. It was modified by the Senate committee so as to make it the least effective, perhaps, of the numerous registration laws in the country. As prepared by the Minnesota joint engineering board, the bill followed very closely the model bill of Engineering Council. As passed, the act allows anyone to practice architecture, engineering or land surveying, provided that use is not made of the term "registered" in the title of those so practicing.

The new law specifically exempts from its provisions those employed by the state and political subdivisions thereof, instead of making registration by public employees compulsory. Provisions for reciprocity with other states and provinces of Canada are made. Partnerships and corporations are permitted to practice as if registered, as provided in Council's model bill. The architects and engineers of Minnesota had a hard task to secure the passage of any legislation affecting professions of architecture and engineering, and it is felt that it is now the duty of every architect and engineer to register, so that when the next legislature meets a solid front can be shown, and the amendment of the law secured.

Revised Townsend Road Bill Introduced

Provides for Federal Highway Commission, Federal Aid and $200,000,000 for 2-Year Program

Senator Townsend's revised road bill, in which the principle of federal aid is accepted, was introduced in the Senate April 29. It provides for the establishment, construction and maintenance of an "interstate highway system" and the creation of a "post roads and federal highway commission."

The highway commission is to be composed of five members who are to be selected with recognition of the geographical divisions of the country; each of the political parties is to be recognized. The commissioners are to be chosen by the President by and with the advice and consent of the Senate. Each commissioner is to receive a salary of $10,000. One of the commissioners selected is to continue in office five years, another four, another three, another two and the other for one year, but their successors are to be appointed for a five-year term. The commission is authorized to appoint and fix the salary of a chief engineer.

The commission is charged with the establishing of an interstate system of highways composed of primary interstate roads, which are to follow the most practicable routes. In the selection of the routes the agricultural, commercial, postal and military needs of the Nation are to be considered. The Federal Government may join with the state in improving connecting roads, but "no project shall be approved by the commission in any state until the state has made adequate provision for the maintenance of all highways selected by the commission in that state."

Basis of Approval

No project is to be approved until the state provides funds at least equal to the amount allotted by the Federal Government and until the state makes adequate provision for maintenance. On 100 days' notice the state is to put any road in a condition of proper maintenance or the work will be done by the commission and charged against federal funds allotted to the state.

The bill provides $200,000,000 for a two years program.

Only such durable types of surface and kinds of material are to be used as will adequately meet the existing or probable future traffic needs of the locality. The right-of-way is to be at least 26 feet wide and the wearing surface of the road is to be not less than 20 ft. wide, unless the commission should provide exceptions.

Federal funds are to be apportioned among the states as follows: One-third in the ratio which the area of each state bears to the total area of all the states; one-third in the ratio which the population of each state bears to the population of all the states; one-third in the ratio which the

mileage of rural delivery routes and star routes in each state bears to the total mileage of such routes in all the states. No state is to receive less than one-half of 1 per cent of one year's allotment. Any unexpended amounts at the end of the period during which they are to be available are to be reapportioned in the same way among all states.

The bill takes care of roads in public forests and in the public-land states. In states containing unapportioned public lands exceeding five percent of the total area of the state the share of the United States is not to exceed fifty per cent of the cost of the road plus a percentage which the area of unappropriated public lands bears to the total area of the State. The bill provides an appropriation of $15,000,000 for forest roads in 1922 and $10,000,000 in 1923. Roads in Indian reservations also are cared for.

Embodied in the bill is a provision authorizing the Secretary of War to transfer surplus material suitable for road building purposes to the Commission for distribution to the everal States.

Engineers Report on Sewage Disposal for Los Angeles

An increase from $12,850,000 to $14,000,000 in the proposed bond issue for trunk sewers and sewage disposal at Los Angeles, Cal., has been recommended by the recently appointed special sewage disposal commission, consisting of George W. Fuller, consulting engineer, New York City; Prof. George C. Whipple, Harvard University, Cambridge, Mass.; and William Mulholland of Los Angeles. The general scheme (see *Engineering News-Record*, Feb. 24, p. 331) for a new outfall sewer and various trunk branches and for fine screening before the discharge of the sewage into the Pacific Ocean is, in effect, endorsed, but in addition it is recommended that in place of a single outlet into the ocean deep multiple outlets be provided in order to get better dispersion, that the outfall sewer be so built "as to resist disintegration from sewer gases, so far as this is practicable," and that an activated-sludge plant having a capacity of at least 2,500,000 m.g.d. be built in order to test the possibilities of recovering fertilizer values from the sewage and of providing an effluent that might be used for irrigation.

The report makes clear, however, that the sewage could not be used for irrigation during a considerable part of the year when there is surplus water from the Los Angeles aqueduct for irrigation. The report also makes clear that there is some doubt as to whether the activated-sludge process would yield any net return on sludge dried and prepared for sale as fertilizer. The capacity proposed for the ocean outfall is "at least 210,000,000 m.g.d." The commission will meet in New York, probably some time late in May, to elaborate and complete its report.

Am. Soc. C. E. Appoints Chandler as New Acting Secretary

Elbert M. Chandler, chief engineer of the State Reclamation Service, Olympia, Wash., was elected acting secretary of the American Society of Civil Engineers at the annual convention at Houston, Tex., April 27, by a vote of 13 to 5 in the board of direction. A permanent secretary requires a vote in the board of at least 18 out of the 30 members. Mr. Chandler will take office May 11 and will hold office until the January meeting.

Mr. Chandler was born in Santa Cruz, Cal., in 1886. His professional work started in 1906 when he was hydrographer and engineer assistant on hydraulic reconnaissance of the Oregon Railway & Navigation Co. From that time to the present he has been actively engaged in irrigation work in the west, being connected with the San Joaquin irrigation project, the Tuolumne Water Power Co., the Pasco Power & Water Co., the Burbank Power & Water Co., and the Naches-Selah Irrigation District in Washington. He resigned as chief engineer of that district in 1919 to become the first chief engineer of the Washington State Reclamation Service. Mr. Chandler was granted the degree of B. S. in civil engineering by the University of California in 1912.

A. A. E. Convention Plans Announced

The seventh annual convention of the American Association of Engineers will be held at the Hotel LaFayette, Buffalo, New York, May 9, 10 and 11. The program for the first day includes the appointment of special committees, reports of officers and standing committees, and the report of judges of the election of officers. A discussion of chapter activities in practice by F. H. Newell, director of field forces of the association, will be followed by committee and council reports on employment, railroads, industries, federal, building and insurance trustees, salaries of engineers in public service and teaching service, education, services and fees of practicing engineers, legislative, chapter activities, municipal problems, water power and conservation, relation to foreign engineers, balloting, and organization. A smoker and entertainment will be held in the evening.

On May 10 the report of the committee on revision of the constitution and by-laws will be received and discussed. In the afternoon a trip to Niagara Falls will be made.

The discussion and voting on amendments to the constitution and by-laws on the morning of May 11, will be followed by a preferential voting to determine the next convention city, and a report of the resolutions committee, and the convention will adjourn. In the evening will be held the annual dinner and installation of officers.

Lockwood Committee Takes Up Water-Meters

Intimation that Exclusion of Badger Meter was Due to Efforts of Competitors, not Substantiated

The Lockwood Committee which, after several months' recess, has resumed investigation of the building situation at New York City, touched last week upon the refusal of the New York Board of Aldermen to permit the use in the city of water-meters manufactured by the Badger Meter Manufacturing Co., of Milwaukee. The counsel of the committee, Samuel Untermyer, tried to make it appear that the action of the aldermen was due to a desire to keep out of New York City the meters of those manufacturers who are not members of the Meter Manufacturers' Exchange. No evidence, however, was introduced to show that members of the exchange had actually brought influence to bear upon the board of aldermen; inferences that there was such influence were drawn merely from the board's refusal of permission.

While it was stated that only the meters manufactured by the members of the exchange could be used in New York City it is a fact that the meters of one non-member of the exchange, the National Meter Co., may be used. The Badger meter has been approvad by the chief engineer and by the commissioner of the Department of Water Supply, Gas and Electricity. A bill passed by the New York Legislature at this year's session, which would have made the approval of the chief engineer final and would have taken authority to approve from the board of aldermen was vetoed by Mayor Hylan. The insinuation was plain at the hearing that this was a further step in the procedure to keep the Badger meters out of the city.

As usual in the Lockwood hearings, no rebuttal testimony was offered.

Since the hearing, the witness who gave most of the details regarding the exclusion of the Badger meter has stated that he had been approached for a bribe, the solicitor of the bribe saying that unless it were paid favorable action could not be expected from the board of aldermen.

Activities of Exchange

The members of the Meter Manufacturers' Exchange are: The Worthington Pump and Machinery Co., Harrison, N. J.; Union Meter Co., Worcester, Mass.; Neptune Meter Co., New York City; Thomson Meter Co., New York City; Pittsburgh Meter Co., Pittsburgh, Pa.; the Hersey Co., South Boston, Mass.; American Meter Co., Buffalo, N. Y. The Badger, the National and the Gamon companies are not members of the exchange.

The exchange was established in 1916 and, in addition to the interchange of information regarding prices at which meters are sold, has standardized meter

couplings and nomenclature and has adopted a business policy aiming to put the selling of meters on a business-like basis. This policy includes standards relating to guarantees. The most important activity of the exchange, however, has been its effort to work out standard specifications and guarantees for water meters, the purpose being to do away with the costly results due to special designs required to meet the odd specifications and guarantees constantly being written by municipal engineers. As a result of its efforts a joint committee on a standard meter specification was appointed by the American and the New England water works associations.

Information on prices, along the usual lines of open-price associations, has been exchanged, but only after the business has been closed. Information on bids has been exchanged only after the bids have been opened. The Federal Trade Commission has been apprised of the activities of the exchange and the books and minutes have constantly been available to members of the commission.

Waddell Named on Commission for $10,000,000 Bridge in China

Dr. J. A. L. Waddell, consulting bridge engineer, of New York City, has been appointed by the Chinese Government as the American member of an international commission to examine and report upon the bids submitted for the new bridge which the Peking-Hankow Railway expects to build over the Yellow River. The commission will be composed of four engineers — one American, one British, one French, and one Belgian.

The new Yellow River bridge will be about 9,000 ft. long, and will be located about half a mile from the site of the present structure. The bed of the river consists of soft silts and mixed sands and clays to a depth of at least 150 ft. or more, as borings have not been carried any deeper. The river channel at low water is comparatively small, but is likely to occupy any portion of the 9,000 ft.; at high water the river frequently spreads out to the full width of 9,000 ft., and may scour quickly to a considerable depth at any point and silt up again as rapidly.

The old bridge consists of short spans of about 70 and 100 ft. length, carried on screw piles. Owing to the extreme softness of the materials the old bridge has never been very stable. It has been stated that at some points the bridge settles several inches as each train passes over, recovering after the load has been relieved. The new structure is required to have massive masonry piers carried to such a depth as to insure a solid substantial foundation.

It is expected that there will be one or more bids from each of the four countries represented on the commission. The cost of the structure is likely to be in excess of $10,000,000. Bids will be received in Peking on June 30.

Dr. Waddell will sail shortly, and the commission will assemble in Peking the latter part of June. The Chinese Government will consult with him concerning several other large railway and bridge projects which they are contemplating.

Passaic Valley Sewage May Enter New York Bay, Court Rules

The United States Supreme Court on May 2 refused to enjoin the Passaic Valley Sewerage District from discharging the screened and settled sewage of Paterson, Passaic, Newark and other communities into upper New York Bay through a multiple outlet at Robins Reef, not far from the Statue of Liberty. The suit was brought many years ago by the State and City of New York to prevent alleged dangerous pollution.

The court holds that the evidence fails to show that a public nuisance would result or that there would be a serious addition to the existing pollution of the harbor, even if the sewage were not treated to a degree beyond the stipulations under which the Federal government withdrew its suit against the Passaic Valley District. The court points out that the district is required, by the stipulations, to carry the treatment of the sewage further than the present plans provide, if the Federal government so demands. The court also states that the whole problem of harbor pollution is one for co-operative study and action rather than litigation. The suit is dismissed without prejudice to the renewal of an application for an injunction if the New York authorities think such action warranted after the sewage-works and outfall are put in operation.

Injunction Refused—Port of New York Pact Signed

On April 29 New York State Supreme Court Justice Francis B. Delehanty refused to continue a temporary injunction obtained by the City of New York to restrain New York commissioners from signing the Port of New York Treaty with commissioners from New Jersey. The treaty was signed on the following day. In the meantime the Port Authority had organized informally with Eugenius H. Outerbridge, of New York, as chairman and J. Spencer Smith, of New Jersey, as vice-chairman. B. F. Gresson, Jr., previously chief engineer New York, New Jersey Port and Harbor Development Commission, was appointed chief engineer.

With the Port Authority formally organized application can be made to Congress to sanction the functioning of the body. Public hearings will be held preliminary to formulating a "comprehensive plan" for the port that must be submitted to the legislatures of the two states before Jan. 1, 1922.

Public Works Department Coming, Says Hays

Discussing probable plans of the Administration at Washington, in a speech delivered last week before the annual convention of the American Newspaper Publishers Association, Postmaster General Will H. Hays, former chairman of the Republican National Committee, indicated that among the changes to be expected would be the substitution of the name "Department of Public Works" for the present Department of the Interior and the transfer of all non-military work from the War and Navy Departments to civilian departments of the government.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

The Western Society of Engineers' coming election will provide members an opportunity to exercise a choice between two tickets. In addition to the nominating committee's selections, as given in this journal April 14, p. 658, the following ticket by petition has been filed: President, W. W. DeBerard; first vice-president, Fred J. Postel; treasurer, Robert I. Randolph; trustee, A. W. Dilling.

The Corporation of Professional Engineers of Quebec, at a meeting held recently in Montreal, elected the following officers: President, A. R. Decary; vice-president, K. B. Thornton; secretary, Frederick B. Brown.

The Engineers' Society of Western Pennsylvania, civil section, at its bi-monthly meeting, May 3, at Pittsburgh, Pa., will be addressed by F. W. Mohlman, chief chemist, the Sanitary District of Chicago, Ill., on "The Milo Acid Process of Sewage Treatment."

The National Highway Traffic Association, at its annual meeting to be held at the Automobile Club of America in New York City, May 13, will be addressed by J. E. Pennybacker, secretary, the Asphalt Associa-

tion, on "Relation of Methods of Financing Highway Improvements to Present and Future Traffic" and by Arthur H. Blanchard, professor of highway engineering, University of Michigan, on "Highway Improvements Should be Based on Transportation Surveys." The reports of the following committees will be presented: Sign Posting for Detours, chairman, Elmer Thompson; Overloading of Motor Trucks, chairman, David C. Fenner; Regulations Covering Speeds, Weights and Dimensions of Motor Trucks and Trailers, chairman, George H. Pride. There will be an informal dinner at 7 p.m.

Personal Notes

Dean A. E. Burton of Massachusetts Institute of Technology has resigned effective at the end of the present school year. Dean Burton is a graduate of Bowdoin College, S.B. 1878; C.E. 1881. He has been connected with the Massachusetts Institute of Technology since 1882 when he became instructor in civil engineering. In 1884 he became professor of topographical engineering, and when the office of dean was created in 1902, he was appointed to the position. In 1896 he was in charge of a scientific expedition to Umanak, North Greenland, having for its object the establishment of new magnetic and pendulum stations.

W. L. MacKenzie, formerly of the engineering staff of the Riordan Co., Ltd., Kipawa, is now with the engineering staff of the Welland Ship Canal at St. Catharines, Ont.

E. H. Barkman, for several years located at Sacramento, Cal., as Western representative for the Missouri Valley Bridge & Iron Co., has been transferred to Little Rock, Ark., in charge of the substructure of two bridges to be constructed by the company.

George Coutts, formerly good roads engineer at Bertile, Man., has been appointed assistant engineer, Trent Canal, Department of Railways and Canals, Peterboro, Ont.

Clarence M. Brooks has resigned as division engineer of the New Hampshire State Highway Department to become highway commissioner of Vermont.

I. Verschelden has been appointed master of bridges and buildings, Farnham division, Quebec district, Canadian Pacific Ry. Co.

Fielder & Burlingame is a firm of engineers recently organized by Frank M. Burlingame and Richard L. Fielder with offices in Buffalo, N. Y., to specialize in making reports and appraisals.

W. E. Moss has been appointed city engineer of Mt. Vernon, Wash.

David H. Fleming, formerly town engineer, Owen Sound, Ont., has been appointed city engineer of Niagara Falls, Ont.

A. L. Grandy, assistant general manager of the Pere Marquette Ry., located at Detroit, Mich., has been appointed chief engineer.

John A. Baird, formerly city engineer of Sarnia, Ont., has entered private engineering practice as consulting engineer and Ontario land surveyor, specializing in surveys, drainage, sewerage, water works and pavements.

Crecelius & Phillips, a firm of consulting, constructing and operating engineers, has been organized by Lawrence P. Crecelius and Victor B Phillips, with offices in Cleveland, Ohio.

H. P. Shoemaker, for eleven years city engineer of Lock Haven, Pa., has resigned to enter private engineering practice.

Bruce Aldrich has resigned as district engineer of the Asphalt Association in charge of the Canadian district offices, Toronto, Ont., to become associated with Kilmer M. Barber, Ltd., Toronto, Ont. He was formerly chief inspector of asphalt with the municipal laboratory at Baltimore, Md.

Merton R. Sumner, until recently chief industrial engineer of the Fuller Industrial Engineering Corp., a subsidiary of the George A. Fuller Co., New York City, is now chief engineer with Arthur D. Little, Inc., Chemists, engineers and managers, Cambridge, Mass.

Henry C. Nutt, for a number of years with the Burlington system engaged principally in construction and maintenance work and as superintendent of various divisions, and later with the Michigan Central, the Northern Pacific, and the Los Angeles & Salt Lake R.R., has been elected president and general manager of the Monongahela Ry. He served in France during the world war in the railroad transportation corps, First Army, at Souilly. He was commissioned colonel in 1919 and upon receiving his discharge was appointed president of the coal commission for Central Europe at Mahrisch Ostrau, Czecho-Slovakia.

Monsarrat & Pratley is a firm of consulting engineers organized by Lieutenant-Colonel C. N. Monsarrat and P. L. Pratley, with offices in Montreal, Que., to engage in the design and supervision of bridge work of all types, in concrete or steel, and for railway or highway purposes. The firm will also provide similar services in connection with foundations, piers, dams, and structural steel work for industrial and other buildings, and will undertake the preparation of reports and estimates, the making of inspections and appraisals and the furnishing of professional advisory services. Colonel Monsarrat was chairman and chief engineer of the Board of Engineers appointed to control and supervise the building of the Quebec Bridge, and since its completion, has been general consulting engineer to the Dominion Government. Mr. Pratley has had a wide experience in the construction of bridges and other structures throughout the Dominion.

R. D. Stewart has been appointed chief engineer of the Denver & Salt Lake R.R., with headquarters at Denver, Colo.

John A. McGrew, formerly superintendent of the Saratoga and Champlain divisions of the Delaware & Hudson Co., has been appointed superintendent of maintenance.

B. E. Clark, recently acting state engineer of Oklahoma, has been appointed by Governor Robertson as acting state highway commissioner.

Bayard A. Long, formerly assistant sanitary engineer, has been appointed sanitary engineer of Johnstown, Pa., succeeding H. J. Baum, resigned.

Obituary

Preston K. Yates, consulting engineer, New York City, died in Albany, N. Y., April 22. He was born in Canajoharie, N. Y., in 1856 and was graduated from Rensselaer Polytechnic Institute in 1880. He was for many years associated with Alfred P. Boller on the construction of some of the important bridges in New York City and vicinity. From 1896 to 1900 he had charge of some of the large contracts on the metropolitan water-supply and sewerage systems in Massachusetts. He was for four years manager of a large Cleveland contracting firm engaged in building docks, breakwaters, dredging, etc. He had for a number of years specialized in the design and construction of crushed stone and gravel plants.

Joseph W. Moore, assistant engineer, valuation department, Illinois Central and Yazoo & Mississippi Valley System, died April 13. He was born in Louisville, Ky., in 1874. He took a special three-year course in engineering at the University of Kentucky. From 1898 to 1907 he was in the employ of the engineering department of the Louisville & Nashville R.R. in both maintenance and construction. He also served as assistant in the valuation department of the Central of Georgia R.R. and later as roadmaster of the International & Great Northern Ry. at Navasota, Tex. From 1919 to the time of his death he was with the Illinois Central R.R. During the world war he was commissioned captain and assigned to Co. B, 35th Engineers. While in France he was in charge of maintenance of way and structures on the standard gage lines in the region of Verdun.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Base-Plus Price Involved in Case Against Steel Corporation

Upon the application of the Western Association of Rolled Steel Consumers and other users of steel products, a complaint was issued April 30 by the Federal Trade Commission against the United States Steel Corporation and eleven subsidiary companies. Issuance of the complaint means that a majority of the commission has reason to believe that the respondents are using an unfair method in competition in violation of Section 5 of the commission's organic act and Section 2 of the Clayton Act, the specific charges involving the use of a device known as the "Pittsburgh plus" price, wherein all steel except rails, wherever made, and whether made by U. S. Steel Corporation plants or by independents, is sold at the f.o.b. Pittsburgh price plus an amount equivalent to the freight to destination.

The case is an outgrowth of conditions complained of by more than 2,700 fabricators of steel in the Chicago, Duluth, and Birmingham districts by legislatures of three states, by several municipalities, and by chambers of commerce and many business organizations throughout the United States, according to the Federal Trade Commission's statement. Through the operation of the "Pittsburgh plus" price, purchasers outside of Pittsburgh must pay for all rolled steel except rails a price arbitrarily fixed by adding to the Pittsburgh base price the freight rate on such steel from Pittsburgh even though the said product is not purchased at or shipped from Pittsburgh. For instance, the complaint cites that with the Pittsburgh base price on rolled steel in Pittsburgh at $50, the Pittsburgh plus price at Duluth, Minn., for rolled steel manufactured in Duluth and delivered to the purchaser in Duluth is $63.20, the added $13.20 being the imaginary freight charge from Pittsburgh to Duluth though the steel in such cases is not shipped from Pittsburgh, but is manufactured and delivered in Duluth.

The complaint further charges that the system complained of "enables Pittsburgh steel manufacturers to secure substantially 50 per cent of the steel manufacturing business of the United States," and that it "retards the natural steel-manufacturing growth of other sections of the country"; that it also "enables the steel manufacturers to maintain substantially uniform prices" as well as "sufficiently high prices for their product to operate at a profit without having their business jeopardized by the lower cost of steel manufactured in other sections."

The respondents are given 30 days within which to make formal answer to the complaint.

Report of Housing Given by U. S. Chamber

In a report recently made public and prepared by the civic development department of the Chamber of Commerce of the United States, the conclusion is reached that "until cost of house construction raches a basic level, it is not believed that there will be an adequate amount of building." The report indicates that one of the big problems to be solved in housing is how to raise the necessary capital. After studying fifty-seven housing and financing companies, the civic development department found that forty-six secured their capital from local subscriptions from individuals, four in part from banks, insurance companies, etc., and one from the parent company. Second only to the high cost of building as a deterrent to investment in new housing is the general belief that houses erected since the war are not as well constructed as older houses, continues the report. The report recommends the giving of prizes for best buildings and adherence to professional codes of ethics and building and housing codes to improve the character of building construction. The report lays special emphasis upon the high cost of building and efforts made aiming at a reduction thereof.

What Business Is Doing To Reduce Cost

American business men are cutting down their overhead expenses to meet the public demand for lower prices, by (1) calling for more work from fewer men, (2) demanding greater efficiency per inch of advertising, (3) depending more on budget and accounting systems and (4) scrutinizing credits more closely, according to a recent survey made by the department of domestic distribution of the Chamber of Commerce of the United States. Answers were received from some 2,000 business men, retailers, wholesalers and manufacturers and the questions asked had to do only with distribution costs. Answers which dealt solely with production problems were omitted.

The greatest variety of answers was received in response to the question: "What are you doing to reduce your personnel cost to a normal basis?" The general tone of these answers was not so much toward a reduction in wages as in number of personnel. Then, increased efficiency came with the cutting out of the deadwood. Only about one fourth of those who answered had made any direct reduction of wages, though approximately 58 per cent had reduced the number of employees. One-fifth reported elimination or reduction of commissions and bonuses.

Hoover Discusses Vital Public Issues

Recommends Governmental Statistical Service—Reviews Building and Railroad Situations

In his address before the annual meeting of the Chamber of Commerce of the United States at Atlantic City last week, Herbert Hoover, Secretary of Commerce, proposed the establishment of a federal statistical service as an antidote to wide and rapid fluctuation of commodity prices; reviewed conditions in the building industry; analyzed the railroad situation, asserting that railway rates must be readjusted and reduced; and asserted that the condition of the export trade of the United States warned every American that "we have no isolation from the problems of the world." In discussing the commercial situation Mr. Hoover said that "it would be foolish not to acknowledge frankly we are in the midst of great economic difficulties, but it is infinitely more foolish for any one to think that we will not grow out of this situation."

In speaking of the service a Federal statistical bureau might perform Mr. Hoover said:

"Viewing the disastrous phenomena of boom and slump in the light of what the government can properly do, I believe there has been a great under-estimation as to the potential importance to commerce and industry in this connection of an adequate service of statistics. I believe that the stability and soundness of business can be greatly enhanced and that vicious speculation can be curtailed by a more adequate information service maintained by the government.

What I mean is that we should have more timely, more regular and more complete information of the current production and consumption and stocks of every great commodity in the United States. I am convinced that we should go even further than this; that we should secure and publish the proportion of the total equipment of more important industries that is in current production, together with the total proportion of labor complement that is in service; and that in a few commodities it may be well to procure and publish the primary prices.

If, for instance, last autumn the public had realized that our stocks of coal on the surface were probably above normal that at the time they were bidding for coal at $15 per ton the actual realization at the mine was probably less than $4, if they had been aware that the capacity of the coal mines was even then not running over 50 per cent, that the shortage of cars was due to railway difficulties which would be solved with a little patience, then I am convinced that many sensible people would have stayed out of the coal market and that we should have had no buying panic, with its profiteering, its consequent slump and great losses.

A [illegible] in the rubber industry, and I believe the records of that industry will bear me out in saying that if there had been an accurate monthly statement of the current ratio of production capacity and operation in the different branches of the industry, and of the stocks of [illegible] not only in production of goods, but also in over-expansion of [illegible]

[illegible]

lected and presented to the whole commercial community, buyer, seller and banker, by some department of the government which approaches the problem in a purely objective way, which will hold the individual's return absolutely confidential; and from which the whole public and the industry can enjoy equality of service. Such services are partially conducted in many different bureaus of the government, but to accomplish their real purpose and greatest value they must be consolidated and conducted more efficiently and from a much broader point of view. I have little doubt that the present expenditures of the government, if directed by consolidated effort, would cover the entire service necessary.

As to the situation in the building trades, Mr. Hoover said that public confidence had been destroyed to a great degree through recent investigations—doubtless referring to the New York situation—in which there had been given daily evidence that "combinations and conspiracies existed to maintain fictitious levels, a condition resulting in extortionate waste and profit, and corruption of various kinds."

Mr. Hoover asserted that reduction in railroad rates must come ultimately if the economic levels of the country are to find equilibrium. It was his contention also that there must be a commodity and class readjustment in rates inasmuch as "horizontal rate increases have thrown the relativity of rate scales out of gear, both as to value of commodities and sources of distribution." He questioned the advisability of a continued use of an emergency horizontal basis of rate increases. Though this rate-making method was based fundamentally upon charges varying roughly with commodity values, it had been "modified by competition and by the deliberate policy of railroads to stimulate local industries and local production."

Freight Rates on Road Materials Lowered in Michigan

The Public Utilities Commission of Michigan has ordered reduced 25 per cent for the lower peninsula and 22 per cent for the upper peninsula the freight rates upon the intrastate movement of sand, gravel and crushed stone. The decision applies to road hauls and switching rates and becomes effective May 10. The order of the commission is a result of a fight for reduction started by the various road commissioners of the state early last winter. In the opinion of the commission the reduction was required to insure a large movement of construction materials particularly needed in road work.

Northwest Lumber Production

The West Coast Lumbermen's Association announces that for the week ended April 23 lumber production of 115 mills reporting to it amounted to 56,311,309 ft. b.m., 33 per cent under normal. New business totaled 71,943,159 ft. b.m., and local business, handled by team and auto trucks, 5,014,498 ft. b.m.

Construction Articles in This Issue

Concrete Dam on Eel River Built on Shale Foundation Page 750.

Shield vs. Trench Method for Hudson Vehicle Tubes Page 764.

Good Practice and Some Features in Log-Flume Construction Page 768.

Submerged Gravel Pumped to Screens for Road Work Page 779.

Bucket Loader Converted Into Erection Crane Page 779.

Highway Bid in Arizona 65 Per Cent of Estimate

In a recent highway letting in Arizona eleven contractors bid upon a piece of work for which the estimate was, excluding cost of material furnished by the state and 10 per cent for engineering and contingencies, $100,601. The lowest bidder submitted a bid of $65,076 and the highest a bid of $91,987. The contract as awarded was composed of three sections, each contractor who bid bidding on the three sections. There were twenty-nine items included in the work, the largest of which were excavation, borrow, dry rubble retaining wall and Class B concrete for slab culverts. The respective estimates and low bids, expressed in unit prices, for these four items were, in order, as follows: Excavation, $1.90, $1.48; borrow, $1.90, 45c.; dry rubble retaining wall, $5, $2.50; Class B concrete for slab culverts, $27.20, $18. This was for only one section of the three, and made a total difference between estimate and bid of $20,000.

On a bridge contract which was let about the middle of April by the Arizona Highway Department thirteen contractors bid, the estimate of the work being $33,404, excluding cost of materials, engineering and contingencies, and the low bid $21,581.

Tax Exemption Stimulates Building in New York

During the past eight weeks apartment-house building in the five boroughs of New York City shows a 454 per cent increase over the corresponding period of last year for the same type of construction. The impetus is attributed largely to the tax exemption ordinance recently passed by the Board of Aldermen. The records show that during this period plans filed call for the accommodation of 2,733 families compared with apartments for 493 families planned a year ago. The average cost of the new apartment is $4,689 and they are all designed to fall within the $5,000 limit of the tax exemption ordinance. For all types of homes plans have been filed for the accommodation of 6,746 families as against 3,689 families for the same period a year ago, an increase of 83 per cent.

Contracts Let for April Exceed $105,000,000

The total value of contracts let during April as reported in *Engineering News-Record* was $105,667,398. This represents approximately 46 per cent of the total value of contracts let during the corresponding period of last year. However, omitting industrial construction from the two figures, the April, 1921, figure is $94,320,812 and $160,132,138 is the figure for April, 1920.

In only two classes of construction did the contracts let for April, 1921, exceed those of 1920. These two were water-works and excavation and dredging, the figures being: Water-works, 1920, $2,849,951; 1921, $3,342,150; excavation and dredging, 1920, $446,787; 1921, $580,039.

The two classes of construction in which there is shown at the present time the greatest activity compare well with last year's figures, the total value of street and road contracts during April of this year being 77 per cent of those let during April of 1920. The respective figures approximate $40,000,000 and $31,000,000. In miscellaneous building the total value of contracts let during April 1920 was approximately $90,000,000, and the total for April of this year is in excess of $51,000,000.

These figures do not take into account the decrease in the cost of construction of this year over last, a figure which is generally accepted as ranging between 10 and 15 per cent.

$230,000,000 Railroad Bond Issue Quickly Taken Up

Following the authority issued by the Interstate Commerce Commission, April 25 for the issue of $230,000,000 joint fifteen-year convertible gold bonds of the Northern Pacific and Great Northern Railway Cos., the subscription books of the bankers syndicate were opened April 28 and closed April 30. The authority of the commission provided that bonds should be offered made less than 91½ but the offering was at no at 96½ and interest, to yield about 6⅞ per cent. On April 29 it was announced by the bankers syndicate, headed by J. P. Morgan & Co. and the first National Bank of New York City, that the subscription books would close on the following day. The transaction is said to be the largest single private financing project that has been floated since the war.

Lockwood Committee Resumes Its Investigation

After a recess of four months the Lockwood joint legislative committee on housing has resumed its investigation of building conditions in New York City. It is centering its attention, with Samuel Untermeyer continuing as counsel, on the operations of various financial institutions concerned in home building.

Hoover Plans Industrial Service Bureaus to Aid Commerce

Herbert Hoover, Secretary of Commerce, has asked Congress for supplemental appropriations aggregating $618,728 for the fiscal years 1921 and 1922, to be used in establishing in the Bureau of Foreign and Domestic Commerce twelve distinct divisions to furnish information regarding a number of industries, among them being cotton, paper, leather, chemicals, heavy machinery, machine tools, electrical goods, automobiles, lumber, metal products, vegetable oils, hardware, and jewelry. It is planned to have these divisions undertake commodity investigations in co-operation with the leading industries of the United States interested in foreign trade.

For an investigation of structural materials, to be conducted by the Bureau of Standards $50,000 has been asked. Secretary Hoover states that there is the most urgent need for the development of economical, durable, and safe buildings, especially homes, at reasonable cost. He believes the government, with a small outlay, can lead the way in improving construction by standardization of materials and formulation of building codes.

The matter of industrial waste elimination is regarded as important enough to justify the Bureau of Standards in expending an additional $100,000 for investigations in this field. Another of the more important items making up the supplemental appropriation is $100,000 for the standardization of equipment by the Bureau of Standards.

Building Conditions and Labor Supply in New York State

According to the labor market bulletin issued by the bureau of statistics and information of the New York State Industrial Commission, March reports from the ten first and second-class cities of the state indicate a 30 per cent increase in the value of authorized building work over February. The estimated cost of building operations for which permits were issued in March was $33,235,467, 4 per cent under that of March, 1920.

The ratio of total workers registered for employment to total workers called for was 169 to 100 in February, or exactly the same as in January. In March the ratio dropped to 145, thus indicating a downward tendency of unemployment in the state. The decrease in unemployment from February to March appears to be general, quotes the report. Nearly every city and occupation covered by the report showed a smaller ratio of workers looking for positions available in March than in February. The most pronounced reductions in the surplus of labor, continues the report, appear in agricultural work, building and construction, and manufacturing.

Tax Revisions Suggested by Secretary of Treasury

The repeal of the excess profits tax, readjustment of income tax rates, retention of certain of the miscellaneous specific sales taxes and excise taxes, but the repeal of others, and the imposition of new and additional taxes of wide application were the main suggestions made to the House Ways and Means Committee and the Senate Finance Committee May 1 by Secretary of the Treasury Mellon. The specific suggestions made by Secretary Mellon were:

1. Repeal of the excess profits tax, making good the loss of revenue by means of a

Labor Rates and Conditions Throughout the Country

UNCERTAINTY as regards wage schedules after May 1 in many territories has made it impossible in those territories to do more than publish the official scale in our monthly tabulation. Wherever possible we give the prevailing scale, whether official or otherwise. As example, for Minneapolis and Birmingham we carry the prevailing scales, although they depart from the union rate. The "official" Minneapolis scale expired on May 1, and the "current" rates are now supposed to prevail generally in that city.

	Minneapolis Current	Minneapolis Official	Birmingham Open Shop	Birmingham Union
Bricklayers	$1 00	$1 25	$0 85 to $1 00	$1 00
Carpenters	80	1 00	70 to 75	875
Hoisting engineers	80	1 00		
Hod-carriers	65	75	25 to .40	
Iron workers	80	1 00	1 00	1 00
Common labor	50	60	20 to .25	....

We give the Kansas City rates as they stood on April 25, subject to change at an early date. The Detroit rates are vouched for by the Associated Building Contractors, though higher wages are being paid in some instances by certain contractors. Montreal reports that a reduction of from 10 to 25 per cent is expected this month.

The Boston strike continues, but contractors under open shop have plenty of help with the exception of bricklayers. In Denver conditions are unsettled, with some crafts accepting and other rejecting reductions, and some contractors holding out for the open shop while others are paying the old scale.

S means scarce, E, enough, P, plentiful

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0 80P	$0 70P	$1 00P	$0 30P		$1 00P	$0 25P
Baltimore	1 25	80P	87½P	40@ 54P	$0 74P	1 00P	30@ 35P
Birmingham	1 00	87½		25@ 40		1 00	20@ 25
Boston	90S	90P	90P	60P	90	90P	55P
Cincinnati	1 25P	1 00P	70E	85P	1 00E	1 25P	35P
Chicago	1 25	1 25				1 25	1 00
Cleveland	1 25P	1 25P	1 25P	87½P	1 10P	1 25P	87½P
Dallas	1 00P	1 00P	1 00E	60E	1 00E	1 00E	50@ 75P
Denver	87½	1 00	1 00	75@ 81¼	1 00	1 00	37½@ 50
Detroit	1 00P	80P	80@ 90P	50@. 60P	1 00P	60@ 80P	50P
Kansas City	1 12½	1 00	1 00		1 10	1 10	.75
Los Angeles	1 25P	1 00P	1 00P	1 12½P	84P	1 00P	62½P
Minneapolis	1 00P	80P	80P	65P		80P	80P
Montreal	40P	35P	60P	40P	40P	65P	35P
New Orleans	1 00P	1 00P	1 00P	65P	1 00P	1 00P	50P
New York	1 25	1 12½	1 25	87½	1 12½	1 12½	75@ 80
Pittsburgh	1 00P	1 00P	1 12½P	1 00P	1 00P	1 25P	80P
St. Louis	1 00	1 25P	1 25P	84P	1 25P	1 25P	87½P
San Francisco	1 12P	1 12½P	1 12½P	1 00P	1 12½P	1 12½P	81½P

modified tax on corporate profits, of a flat additional income tax on corporations and the repeal of the existing $2,000 exemption applicable to corporations.

2. Readjustment of the income tax rates to a maximum combined normal tax and surtax of 40 per cent for the taxable year 1921, and of about 33 per cent thereafter.

3. Retention of the miscellaneous specific sales taxes and excise taxes, including the transportation tax, the tobacco taxes, the tax on admissions, and the capital stock tax, but the repeal of the minor "nuisance" taxes, such as the taxes on fountain drinks and miscellaneous taxes levied under Section 904 of the Revenue Act.

4. The imposition of sufficient new or additional taxes of wide application, such as increased stamp taxes or a license tax on the use of automobiles.

5. The adoption of necessary administrative Amendments to the Revenue Act in order to simplify its administration and make it possible, among other things for the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury and the consent of the taxpayer, to make final determination and settlement of tax cases

Lower Building Costs in England

(London Correspondence)

The fall in contract prices for the erection of dwellings of an average of £100 per house since last autumn is due to four main factors: (1) Lower cost of timber, oils, lead and tubes; (2) More skilled labor available and increasing output of bricklayers; (3) Lower profits asked by contractors; and (4) Improved organization among employers.

In some districts on the East Coast £200 less is being asked for erecting dwellings over the contract figures for the early part of the year.

On the other hand, a sectional committee appointed to investigate the position of light castings used in building, reports that the National Light Castings Association controls 95 per cent of the British output, and that the present output is enough for about 4,000 houses per month. The report also states that by the pooling arrangement adopted, members of the association have been penalized for increasing output while those who have reduced their output relative to the rest have been rewarded.

Marine Strike Follows Wage Cut

Resulting from the strike call issued by the Marine Engineers Beneficial Association April 25, to become effective May 1, following the breaking off of wage negotiations between union leaders and ship owners, American shipping has been tied up since May 1. The wage agreement between union leaders and ship owners ended May 1, and the marine engineers took the lead in refusing to consent to any decrease after that date. The proposal of the employers was for a reduction of from 20 to 30 per cent, though the order issued by Admiral Benson to all operators of government merchant craft was to reduce wages 15 per cent, effective May 1. The suggestion made by Secretary of Commerce Hoover that the dispute be arbitrated was flatly turned down by the ship owners. Ships are being deserted by their crews as soon as they reach port and the statement emphatically comes from both sides that there will be no compromise.

Chicago Plumbers and Sheet Metal Workers Indicted

Federal Indictments charging conspiracy in restraint of trade were returned last week against seventy-one Chicago corporations and thirty-nine individuals in the sheet metal, steamfitting and plumbing trades.

Past Week Sets New Record for Year in Building

Contracts let for the past week as reported in *Engineering News-Record* attained a record total for the year, the aggregate value being $31,742,483. The value of street and road contracts totalled $11,138,764 and that of miscellaneous buildings $13,528,918, both of which figures have been exceeded in past weeks. Federal government contracts were larger than usual, as were sewer contracts. The total contracts let during the past three weeks are in excess of $92,000,000 in value. The largest contract for the week was for the construction of a grain elevator in Brooklyn, N. Y., costing $1,500,000, for the New York State Barge Canal.

Income Tax Data Sought From Contractors

Because of the rather startling figures revealed in an analysis of the 1918 income-tax returns, showing the small percentage of general contractors who operate even at a reasonable profit, the Associated General Contractors of America is circularizing its membership in order to secure data on the 1920 returns. The idea back of the move is to have information at hand concerning contractors' incomes that will be of benefit in suggesting revisions to existing tax laws. Letters have been sent to 7,000 contractors asking for the same information as was included in their 1920 returns. The real name of the contractor submitting such figures is to be withheld, though a key or fictitious name is to be supplied so that corrections can be made when the completed list is compiled.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—We quote the prices of the Matthew-Addy Co., although certain grades are obtainable under these quotations and producers of the steel-making grades will consider bids.

Railway Materials — Quotations on standard rails are the same as last month, but prices on light rails have been adjusted in Pittsburgh. Birmingham mill prices are included. Track supplies down in St. Louis. Track bolts are down in Pittsburgh and San Francisco.

Pipe—General decline on wrought pipe, as of basing card of April 13. Steel pipe is also down in the warehouses at New York, Chicago and St. Louis. Clay drain tile down in St. Louis. Sewer pipe down in New York, Boston, Detroit, and San Francisco, and up in St. Louis.

Road Oils and Asphalt—Business satisfactory in New York market with prices of road oils the same as last month, except that liquid asphalt is down ½c. per gal. Asphalt is down $1 per ton in bulk in New York. Sharp decrease on asphalt in Montreal. St. Louis reports sold out on asphalt for 1921.

Wood-Blocks—Down in New York. This month we show prices for Cincinnati and Kansas City.

Sand, Gravel and Stone—Very few changes in this market in any of the centers. Decrease in St. Louis but otherwise there is firmness.

Lime—Decreases in Boston, Montreal and Atlanta.

Cement—Now $2.90 delivered in New York against $3.10 last month, which allows only 4c. per bbl. profit to the dealer. Decreases in Detroit, St. Louis, Minneapolis, Dallas, Atlanta and Cincinnati. We now quote for Birmingham and Kansas City.

Steel Reinforcing—We show the reduced price at Pittsburgh, but have omitted the New York delivered price because keen competition has prevented stable quotations. New York prices are as low as the Pittsburgh-plus-freight price. Much the same situation obtains in the case of expanded metal lath in New York, but we are quoting prices about $4 lower than last month. Metal lath down also in Chicago, St. Louis and Dallas. There is a general reduction in concrete reinforcing bars.

Common Brick—Down in Chicago, New York, Dallas, Los Angeles, Boston, Cincinnati, and New Orleans.

Hollow Tile—Down in Chicago, Boston, Cincinnati, Denver, New Orleans, Detroit, Atlanta and Montreal.

Structural Shapes — Down in San Francisco. Quotations given for the first time on this item in Birmingham and Dallas. Rivets down in New York, Chicago and Dallas warehouses.

Lumber—The market appears generally to be steadier than was the case a month ago. No changes in Douglas fir in San Francisco or in pine in New York, Chicago, or St. Louis. We quote Birmingham prices for the first time and have resumed quotations at Kansas City.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$29 50	$45 60
Northern Basic	27 52	42.80
Southern Ohio No. 2	28.58	46 80
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 to 2.75)	**35.26**	49.70
BIRMINGHAM		
No. 2 Foundry	**24.00**	42.00
PHILADELPHIA		
Eastern Pa., No. 2X, 2.25@2.75 sil.	26.25@28.50*	45 65*
Virginia No. 2	28.00*	43 25*
Basic	26 25†	44.50†
Grey Forge	27.00*	43 50*
CHICAGO		
No. 2 Foundry Local	24.00	44 25
No. 2 Foundry Southern	32.92	47 00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	26.96	45 65
Basic	26.86	44 40
Bessemer	27.00	44.90

*F.o.b. furnace † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$45 00	$45 00		$45 00
Standard openhearth rails	47 00	47 00	$47 50	47 00
Light rails, 8 to 10 lb	2 30*	3.75*		2.45@3.00*
Light rails, 12 to 14 lb.	2.25*	3.75*	2 20*	2 41@2.95*
Light rails, 25 to 45 lb	2.20*	3.75*	2 20*	2.32@2.85*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8 Ft. 6 In.
Chicago, White Oak	$1 60	$1 75
Chicago, Hardwood and Red Oak	1 40	1 55
Chicago, Empty Cell Creosoted	2 00	2 25
San Francisco, Green Douglas Fir	.80	1 12
San Francisco, Empty Cell Creosoted Douglas Fir	1 78	2 48

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Sap Cypress
Grade 3	$1 35	$1 20	$1 10
Grade 2	1 25	1 10	1 00
Grade 1	1 15	1 00	90

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$3 30	$4 00	$3 40	[illegible]	[illegible]
Track bolts	4 45	6 00	4 60	[illegible]	6 81
Standard section angle bars	2 50	3 50	2 75	[illegible]	4 50

PIPE

WROUGHT PIPE—The following discounts are to apply for carload lots on the Pittsburgh basing card of April 13, 1921

BUTT WELD

Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
1 to 3	60½	50	¼	[illegible]	18½
			⅜ to 1½	[illegible]	30½

LAP WELD

2	54½	41	2	[illegible]	19½
2½ to 6	56½	45	2½ to 4	[illegible]	21½
7 to 12	54½	43	4½ to 6	[illegible]	21½
13 and 14	45	35	7 to 8	[illegible]	17½
15	42½	32	9 to 12	[illegible]	21

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60½	49	1 to 1½	36½	21½
2 to 3	61½	50			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	52½	41	2	31½	18½
2½ to 4	56½	45	2½ to 4	34½	20½
4½ to 6	55½	44	4½ to 6	33½	21½
7 to 8	50½	37	7 to 8	24½	12½
9 to 12	45½	32	9 to 12	19½	7½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 2½ in. butt welded	52%	62½%	50½%
3 to 6 in. lap welded	49%	58½%	46½%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 2½ in. butt welded	38%	50%	36½%
3 to 6 in. lap welded	37%	46%	42½%

Malleable fittings, Class B and C, from New York stock sell at [illegible] list prices. Cast iron, standard sizes, 20—5% off

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	San Francisco
4 in.	$73 30	$79.30	$60.00	$69 10	$90.90
6 in. and over	63.30	76.30	55.00	64.10	85.90

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$50.00	$35 00	$60.00	$50 00		$55 00
4	60 00	51 00	60 00	70 00	$90 00	65 00
5	90 00	65 00	90 00	90 00	115 00	84 00
6	115 00	90 00	100 00	110 00	150 00	110 00
8	185 00	130 00	150 00	160 00	250 00	181 00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0 [illegible]	$0 132			$0 15	$0 13	
4	[illegible]	132	$0 11		15	1625	$0 18
5	[illegible]	198			25	195	165
6	[illegible]	198	$ 165	182	225	2275	25
8	[illegible]	308	275	26	35	325	35
10	[illegible]	462	355	364	525	455	
12	1 00	594	4675	52	625	585	80
15	1 50	792	6875	81	90	975	
18	2 18	1 10	935	1 134	1 25	1 365	
20	[illegible]	1 32	1 2375		1 50		
22	3 50	1 98			2 00		
24	[illegible]		1 7875	1 944	2 25	2 34	2 40
27				2 80	4 50	3 25	
30			4 00	3 55	5 50	3 90	
33				4 55	6 75		
36				4 75	7 00		

	3	5	8	12	24	36
Boston	$0 153	$0 23	$0 357	$0 688	$2 29	$5 95
Minneapolis	.....	.....	.42	77	2 45	5 66
Denver	.....	15	30	50	1 95	
Seattle	.....	.....	.40	80	2 88	
Los Angeles	11*	165*	27	49	1 65	
New Orleans	37 per cent off Southern list					
Cincinnati	147	2205	343	6615	2 205	6 15
Atlanta	.11*	165*	27	4675	1 7875	
Montreal, *delivered*	30*	45*	85*	1 35	4 50	6 50
Detroit	138	207	322	621	2 02	4 215
Baltimore	.....	26	41	81	266	
Baltimore, *deliv'd*		28	44	86	2.84	

*4-in., 6-in., 9-in., 30-in. respectively

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum, f.o.b. place named

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0 07	$0 13
New York, 65% asphalt	(at terminal)	07	13
New York, binder	(at terminal)	07	13½
New York, flux	(at terminal)	07	14
New York, [illegible] asphalt	(at terminal)	08	10
St. Louis, 40-50 asphalt	[illegible]	04*	
Chicago, 40-50 asphalt		06	08½
Chicago, 60-70 asphalt		06½	0725
Dallas, 40-50 asphalt		10	07
Dallas, 60-70 asphalt		13	08
Dallas, 70-90 asphalt		15	10
San Francisco, binder per 42 gal. bbl.		15 00	2 25

* Freight $21 75 per [illegible] Wharf, bbl.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb drums, and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$28.00	$17.00
Boston	No quotations	
Chicago	28 50	21 00
San Francisco	21 50	15 00
Dallas	35 00	27 00
Seattle	27.50	..
Denver	....	50@70
Minneapolis	....	25 93
St. Louis	sold out for 1921	
Baltimore	40 00	..
Los Angeles	23.75	15.00
Montreal	28 00	21 00
Atlanta	28 40	..
Detroit (petroleum asphalt)	42 00	21 15
Cincinnati	35.50@50	29 50@44
Maurer, N. J. (asphalt)	27@38	....
Maurer, N. J. (asphalt cement)	29@36	25@31

PAVING STONE—

New York	5-in. granite	No quotations
Chicago	About 4x8x4 dressed	$3 40 sq.yd.
	About 4x8x4 common	3.05 sq.yd.
San Francisco	Basalt block 4x7x8	65 00 per M
Boston	5-in. granite	4.20 sq.yd.
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107 00 per M
Baltimore	Granite	2.25 sq.yd.
Montreal	Granite	6.50 sq.yd.
New Orleans	Granite	3 25 sq.yd.
Cincinnati	Granite	4 50 sq.yd.
St. Louis	Granite	3.40 sq.yd.
Kansas City	No. 1 Granite	4.00 sq.yd.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	70	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 70c. for 5x16 in., 80c. for 5x18 in.; in carload lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3½	Io	$2 51
New York	4	Io	2 78
Boston	3	Io	3.45
Chicago	4	Io	3 75@4.00
Chicago	3½	Io	3 25@3 50
St. Louis	3½	Io	3 05
St. Louis	4	Io	3 50
Seattle	4	Io	Off market
Minneapolis	3½	Io	2 37
Atlanta	3½	Io	2 30
New Orleans	3	Io	2 99
New Orleans	3½	Io	3 42
New Orleans	4	Io	3 85
Dallas	4	18	3 90
Baltimore	3½	Io	3 75
Montreal delivered	4	Io	130 00 per M.
Detroit	3½	Io	3 40
Cincinnati	4	Io	3 30
Kansas City	4	Io	3 80

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.50	$2 50	$2.50	$2.50	$1 25	$1.50
Denver	2 00	1 80	1.80	1.80	1 60	1 40
Chicago	2.75	2 15	2.75	2.15	2 75	2 15
St. Louis	1 55	1.78	1 60	1 82	1 60	1 68
Seattle	1.50	1.25	1 50	1.25	1 50	1.25
Dallas, delivered	3 50	2 50	4 00	2 50	3 00	2 00
Minneapolis	2 00	1 50	..	1 35	1 00	75
Cincinnati	2 56½	..	2 62½	1.55	1 95	1 50
San Francisco	2 50	1 50	2 50	1 50	1 65	1 50
Boston, per ton	2 65	2 85	2 65	2 85	2 00	2 00
New Orleans	2 85	3 00	..		1 65	1 40
Los Angeles, per ton	1 55	1.25	1 45	1.25	1.00	1 15
Atlanta, per ton	2 62½	2.25	....	2.25	1 52½	1 15
Detroit	2 50	2 50	2.50	2 00	2 50	1.85
Baltimore, per ton	1 40	1 40	1.60	1 60	70	80
Montreal, per ton	1 50	1 15	1 75		1 50	1 40
Birmingham		3 25		3 75	1 43	1 25

CRUSHED STONE—Price for cargo or carload lots is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.90@2.00	$1.90	$2.15	$2.15
Chicago	2.75	2.15	2.75	2.15
St. Louis delivered	2.60	1.90	2.60	1.65
Dallas delivered	2.80	3.50	2.80	3.50
San Francisco	2 50	1.50	2.50	1.50
Boston	3.00*(del)	3.00	3.00*(del)	3.25
Minneapolis	2.00	1.50	2.25	1.60
Kansas City	2.52	2.35	..	2.50
Denver	....	3.75	....	3.75
Seattle delivered	3.50	3.50	3.50	3.50
Atlanta	2 50*	3 10	....	..
Cincinnati delivered	3 06¼	.	3.06¼	....
Los Angeles	1.75*	1.60	1.80*	1.50
Detroit	2.00*	1.75	2.00*	1.75
Baltimore	1 75*	1 50	1 75*	1 50
Montreal	2 00*	2 00	2.10*	2 00

* Per ton.

CRUSHED SLAG—Price of crushed slag per net ton in carload lots:

	1½-In	¾-In	Roofing	Sand
Lebanon or Bethlehem, Pa.	$1.00	$1.00	$2.50	$0.90
Easton, Pa.	1.20	1.20	3.00	1.10
Buffalo, N. Y.	1 25	1 00	2.00	1.00
East Canaan, Conn.	1.25	1.35	4.00	1.10
Birmingham, Ala.	1.25	1.25	2.05	1.00
Toledo, Ohio	1 50	1.50	2 35	....
Atlanta, Ga.	2.58	2.25		....

Birmingham, f.o.b. pit $1.15 (or $2.75 per cu. yd. on site)

LIME—Warehouse prices:

	Hydrated, per Ton Finished	Hydrated, per Ton Common	Lump, per 200-Lb. Barrel Finished	Lump, per 200-Lb. Barrel Common
New York	$21.00	$20.00	$3 50* – at plant –	$3.30*
Chicago	20.00	..		1.75
St. Louis	26.00	20.00	..	2 50*
Boston	27.25	22.75	3.65	3.40
Dallas	27.50	25.00	..	3.00†
Cincinnati	17 60	16 60	..	13.10‡
San Francisco	25.40	22.00	.	2 25
Minneapolis	29 00	22 00 (white)	2 00	1 70
Denver	....	3.20 (bbl.)	1.00 (bu.)	
Detroit	22.00	19.00	2.00†	1.80†
Seattle	27.00		3.25	.
Los Angeles	30.00	30 00	3.00*	3.00*
Baltimore	22.25	17.50	..	12.75‡
Montreal	30.00	....	15.00‡	...
Atlanta	....	17 00	....	1.25
New Orleans	....	22.50	....	2.25

* 300-lb. barrels † Per 180-lb. barrel. ‡ Per ton.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosedale)	$2 80	$1.50
Kansas City (Ft. Scott)	1 60	1.60
New Orleans	3.36	3.36
Atlanta (Magnolia)	11 00 ton	1.90
Cincinnati (Louisville)	2.75	2 85
Boston (Rosedale)	3.00	....

PORTLAND CEMENT—Current prices are for barrels in carload lots, *without* bags, to contractors:

	Current Without Bags	One Month Ago Without Bags	One Year Ago Without Bags
New York (delivered)	$2.90	$3.10	$3.20
New York, alongside dock to dealers	2.40	2.40	2 35
Jersey City (delivered)	2.89	2.64	2.67
Boston	2.86	2.87	2.62
Chicago	2.17	2 17	2.00
Pittsburgh	2.17	2.17	2.05
Cleveland	2.43	2.43	2.32
Detroit	2.43	2.51	2.35
Indianapolis	2.43	2 31	2.27
Toledo	2.40	2.51	2.12
Milwaukee	2.39	2.39	2.11
Duluth	2.10	2.10	2.10
Peoria	2.45	2 43	2 12
Cedar Rapids	2.51	2.51	2.18
Davenport	2 47	2.47	2.14
St. Louis	2.50	3.40	2.80
San Francisco	3 09	3 09	2 63
New Orleans	3 36	3 36	2 96
Minneapolis (delivered)	2.00	2.70	2 22
Denver	3 10	3 10	2 82
Seattle	3 10	3 10	3 03
Dallas	2.60	2.85	2.15
Atlanta	2.75	3 00	2 70
Cincinnati	2.62	2 87	2 90
Los Angeles	3.21	3 21	3 85
Baltimore (del.) drayload lots	3.58	2.58	
Detroit	2.43	2.43	
Birmingham	3 05		
Kansas City	3.20		2 56
Montreal	3.44	3 44	3 48

NOTE—Bag charge is 10c each

TRIANGLE MESH—Price per 100 sq.ft. in carload lots

PLAIN 4-INCH by 4-INCH MESH

Style Number	Weight in Pounds	Pittsburgh, Mill	Chicago	Dallas	San Francisco
032	0.022	$0.87	$1.11	$1.15	$1.54
049	0.028	1.11	1.43	1.46	1.96
068	0.035	1.35	1.74	1.80	2.41
093	0.045	1.79	2.24	2.30	3.11
126	0.057	2.14	2.79	2.86	3.88
153	0.068	2.55	3.32	3.40	4.03
180	0.078	2.93	3.81	3.93	
245	0.103	3.86	5.03	5.15	
287	0.119	4.46	5.81	5.96	8.10
336	0.138	5.18	6.73	7.32	
395	0.160	6.00	7.81	8.00	
PAVING					
036P	0.017	$0.66	$0.85	$0.88	
053P	0.024	0.94	1.21	1.24	....
072P	0.031	1.18	1.53	1.57	....
097P	0.040	1.52	1.97	2.02	
049R	0.024	0.94	1.21	1.24	
067R	0.031	1.18	1.53	1.57	
089R	0.040	1.52	1.97	2.02	..

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 10% higher

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	New York Delivered	Chicago	St. Louis	San Francisco	Dallas
27	233	$25.00	$27.50	$29.95	$34.20	$31.55
26	250	26.00	28.90	29.95		33.30
25	300	27.00	31.15			36.00
24	340	28.00	33.10	33.00	42.70	37.17
22	450	31.00	.....		....	43.50

BARS, CONCRETE REINFORCING—Current quotations per 100 lb:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	New York	Birmingham Mill	Chicago	St. Louis	Dallas	San Francisco
		Warehouse, Uncut					
¼ and larger	$2.10	$3.38	$2.35	$3.10	[illegible]	$ [illegible]	$ [illegible]
⅜ and larger	2.15	3.43	2.50	3.17	[illegible]	[illegible]	[illegible]
½ and larger	2.20	3.48	2.50	[illegible]	[illegible]	[illegible]	[illegible]
¾ and larger	2.35	3.53	2.50	3.38	[illegible]	4.00	[illegible]
1 and larger	2.60	3.88	2.50	[illegible]	[illegible]	4.45	2.85

*Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ in and larger	$2.50	$[illegible]	$4.25	⅞	$2.90	$[illegible]	$3.40
⅞	2.55	[illegible]	4.30	1	[illegible]	[illegible]	3.45
1	2.65	[illegible]	....	1¼	....	..	3.50

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows

	Common Current	Common One Month Ago	Common One Year Ago	Paving Block 3-inch*	Paving Block 4-inch*
New York (del.)	$18.40	$21.70	$29.00	$47.25	$53.50
New York (at dock)	15.00	18.00	25.00		
New Orleans	25.50	25.50	23.00	.....	.....
Chicago	12.00	15.00	14.00	34.00	.....
St. Louis, salmon	15.00†	15.00	16.00		
Denver, salmon	14.00	14.00	17.00		
Dallas	16.00	18.50	24.00	44.00	
San Francisco	18.00	18.00	15.00		44.38
Los Angeles	15.00	15.50	13.50	[illegible]	[illegible]
Boston (del.)	[illegible]	25.00	30.00	49.25	57.25
Minneapolis (del.)	180.20	18.00	20.00	37.00	43.00
Kansas City	20.00		22.00		
Seattle	19.00	19.00	15.00	48.00	53.50
Cincinnati	20.00	21.00	24.00	43.00	
Montreal (del.)	18.00	18.00	17.50	100.00	120.00
Detroit	18.00	18.00	23.00	46.00	52.00
Baltimore (del.)	20.00	22.50	20.00	40.00‡	44.00‡
Atlanta	12.00	12.00			
New Orleans	[illegible]	21.50			

* For paving block 3x8x3 and 3½x8½x4 respectively. †Hard brick $20.50 in St. Louis. ‡Vitrified, Lodi plant, Baltimore

HOLLOW TILE—Price per block in carload lots for hollow building tile

	New York Current on Trucks	New York One Year Ago	Chicago	St. Louis	Dallas	San Francisco	Kansas City, Mo.	New York N. J., Factory
4x12x12		$0.1995	$0.[illegible]		$0.145			
6x12x12		2526	[illegible]		21			
8x12x12			1971		29			
10x12x12			[illegible]	$[illegible]				
12x12x12			[illegible]					

Note: Definite price not decided upon in New York

	4x12x12	8x12x12	12x12x12
Boston	$[illegible]	$[illegible]	$[illegible]
Minneapolis	196	[illegible]	264
Minneapolis (delivered)	104	1[illegible]	286
Cincinnati	[illegible]	[illegible]	[illegible]
Kansas City	115	207	
Denver	[illegible]	[illegible]	
Seattle	13	175	30
Los Angeles	11	[illegible]	23
New Orleans	[illegible]	[illegible]	[illegible]
Detroit	[illegible]	[illegible]	[illegible]
Montreal	[illegible]	[illegible]	[illegible]
Baltimore	16	21	45
Atlanta	[illegible]	[illegible]	[illegible]
Dallas	[illegible]	[illegible]	[illegible]

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	New York (del.)	Birmingham	Dallas	St. Louis	Chicago (del.)	San Francisco
Beams, 3 to 15 in.	$2.20	$3.33	$2.20	$4.50	$3.32½	$3.23	$4.35
Channel, 3 to 15 in.	2.20	3.33	2.20	4.50	3.32½	3.23	4.35
Angles, 3 to 6 in., ¼ in. thick	2.20	3.33	2.20	4.50	3.32½	3.23	4.35
Tees, 3 in. and larger	2.20	3.33	2.20	4.50	3.32½	3.23	4.85
Plates	2.40	3.33	2.20	4.50	3.32½	3.23	....

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York Current	New York One Yr. Ago	Warehouse Chicago	Warehouse St. Louis	Warehouse San Francisco	Warehouse Dallas
¾ in. and larger	$3.70	$4.65	$6.00	$4.88	$4.97½	$7.05	$5.80

CONE HEAD BOILER

¾ in. and larger	3.80	[illegible]	6.10	[illegible]	5.07½	7.15	5.90
⅞ and 15/16	3.95	4.90	6.25	5.13	5.22½	7.40	6.05
1 and 1⅛	4.20	[illegible]	6.60	[illegible]	5.47½	7.65	6.30

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.25	$4.15	$5.35	$5.00	$4.10	$4.95
Cut		7.65		7.75	4.75	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

	New York 1-Ply l.c.l.	New York 2-Ply l.c.l.	New York 3-Ply l.c.l.	Philadelphia 1-Ply l.c.l.	Philadelphia 2-Ply l.c.l.	Philadelphia 3-Ply l.c.l.
No. 1 grade	$2.15	$2.55	$3.00	$2.05	$2.45	$2.90
No. 2 grade	1.90	2.25	2.70	1.80	2.15	2.60

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $7.95 per square in carloads; $8.20 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices per ton f.o.b. New York:

Tar felt (14 lb. per square of 100 sq. ft.) per roll of 432 sq. ft.	$2.85
Tar pitch (in 400-lb. bbls.) per 100 lb.	2.10
Asphalt pitch (in barrels) per ton	49.50
Asphalt felt (light) per ton	98.00
Asphalt felt (heavy) per ton	102.00

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	*St. Louis	Chicago	San Francisco	New York
No. 10	$[illegible]	$4.22½	$[illegible]	$[illegible]	$[illegible]
No. 12	3.15	4.27½	[illegible]	[illegible]	[illegible]
No. 14	[illegible]	4.32½	4.33	6.10	[illegible]
No. 16	3.30	4.42½	[illegible]	[illegible]	[illegible]
Black					
*Nos. 18 and 20	[illegible]	5.30	[illegible]	[illegible]	4.95
*Nos. 22 and 24	[illegible]	5.35	5.25	6.85	5.00
*No. 26	4.95	5.40	5.30	6.90	[illegible]
*No. 28	4.00	5.50	[illegible]	[illegible]	5.38
Galvanized					
No. 10	[illegible]	5.30	[illegible]	[illegible]	5.30
No. 12	4.10	[illegible]	[illegible]	[illegible]	5.40
No. 14	[illegible]	5.60	[illegible]	[illegible]	5.40
No. 17 and 18	[illegible]	[illegible]	[illegible]	[illegible]	5.70
No. 22 and 24	[illegible]	6.05	[illegible]	[illegible]	5.85
No. 23 and 25	[illegible]	6.20	6.30	[illegible]	6.00
*No. 28	[illegible]	[illegible]	[illegible]	[illegible]	6.25

*[illegible] extra of 25c. for [illegible]

LINSEED OIL—[illegible]

	[illegible]	[illegible]	[illegible]	[illegible] Ago	[illegible] Year Ago
Raw, in barrels (5 lb.)	$[illegible]	$1.[illegible]	$0.[illegible]		$1.66

WHITE AND RED LEAD—Base price per pound

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Yr. Ago Dry and In Oil
100-lb. keg	13.00	14.50	15.50	17.00	13.00	15.50
25 and 50-lb. kegs	13.25	14.75	15.75	17.25	13.25	15.75
12½-lb. keg	13.50	15.00	16.00	17.50	13.50	16.00
5-lb. cans	16.00	17.50	18.50	20.00	16.00	18.50
1-lb. cans	18.00	19.50	20.50	22.00	18.00	20.50

500 lb. lots less 10% discount; 2000 lb. lots less 10–2½% discount.

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

	Lumber Prices in Yards at San Francisco: 6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$24.50	$25.00	$26.00	$28.00
3x6 and 8	25.50	26.00	27.00	29.00
4x4-6 and 8	26.00	27.00	28.00	29.50
3x10 and 12	26.00	27.00	28.00	30.00
3x14	26.50	27.50	28.50	30.50
4x10 and 12	26.00	27.00	28.00	30.00
4x14	27.00	28.00	29.00	31.00
	24 Ft. and Under		25 to 32 Ft	33 to 40 Ft.
4x10	$25.50		$27.50	$28.50
6x14	27.00		29.00	29.50
8x10	25.50		27.50	28.50
3x14	27.00		29.00	29.50

New York, Chicago and St Louis

	Southern Pine: New York* 20 Ft. and Under	New York* 22–24 Ft.	Chicago 20 Ft and Under	Chicago 22-24 Ft.
3x 4 to 8x8	$37.00	$38.00	$51.00	$52.00
3x10 to 10x10	42.00	43.00	53.00	54.00
3x12 to 12x12	48.00	40.00	55.00	56.00
3x14 to 14x14	53.00	54.00	60.00	61.00
3x16 to 16x16	60.00	61.00	65.00	66.00
3x18 to 18x18	72.00	73.00	69.00	70.00
4x20 to 20x20	.....	.....	72.00	73.00

* For long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis: Yellow pine, 22@24 ft. long, 3 x 12@4 x 12, $42; 2 x 16, $53; 3 x 16 @4 x 16, $53; 6 x 10 @ 10 x 10, $37; 6 x 12@12 x 12, $41; 6 x 14@14 x 14, $45; 6 x 16@16 x 16, $51.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20-Ft. and Under: P.	Fir	Hemlock	Spruce	12 x 12-In 20 Ft. and Under: P.	Fir
Boston	$45.00	$53.00	$55.00	$56.00	$55.00	$58.00
Seattle	.....	25.00	....	.....	.....	27.00
New Orleans	35.00	.....	.....	.....	38.00	....
Baltimore	60.00	.....	.....	.....	70.00	....
Cincinnati	45.00	47.50	.....	.....	62.50	64.00
Montreal	78.00	85.00	68.00	78.00	78.00	100.00
Los Angeles	.....	47.00	46.00	.....	.....	49.00
Detroit	Quotations f.o.b mills only					
Denver	.....	37.25	.....	.....	.....	38.25
Minneapolis	47.00	41.00	34.00	.....	56.00	41.00
Atlanta	27.50	....	.....	.....	40.00	.....
Dallas	45.00	.....	.....	.....	55.00	.....
Kansas City	33.00	33.00	....	.....	38.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under: P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft.: P.	Fir
Boston	$45.00	$53.00	$50.00	$53.00	$58.00
Seattle	.....	18.50	....	.....	.....
New Orleans	55.00	....	....	35.00	.....
Baltimore	42.50@45	.....	.....	40@45	.....
Cincinnati	62.00	80.00	....	35.00	....
Montreal	120.00	60.00	60.00	80.00	80.00
Los Angeles	.....	41.00	40.00	.....	82.00
Denver	.....	31.25	....	....	29.25
Minneapolis	40.50	29.25	33.25	34.00	31.75
Atlanta	15.00	.....	.....	18.00	.....
Dallas	.....	40.00	.....	35.00	....
Kansas City	44.00	32.00	32.00	31.00	34.00

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham: Dimension and form lumber delivered on building site, $26@$28. For 8x8x20 and smaller, 85 per cent heart, $33; 12x12x20 and smaller, 85 per cent heart, $42; 1x10x16 and smaller, rough, $16; 2x10x16 t. and g., $22; f.o.b. mill.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.33½	Detroit	$0.33
Birmingham	76½	Kansas City	.81½
Boston	41½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	.38	Pacific Coast (all rail)	1.66½†
Cincinnati	33	Philadelphia	.35
Cleveland	24	St. Louis	.47½
Denver	1.35*	St. Paul	.69½

Note—Add 3% transportation tax. * Minimum carload, 40,000 lb. Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEET PILING—The following price is base per 100 lb. f. o. b Pittsburgh, with a comparison of a month and a year ago

Current	One Month Ago	One Year Ago
$2.55	$2.55	$2.55@$3.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows.

	New York
Hercules red strand, all constructions	20%
Patent flattened strand, special and cast steel	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	22½%
Iron strand and iron tiller	5%
Galvanized iron rigging and guy rope	+12½%

San Francisco: Galvanized iron rigging and guy rope +17½%, bright plow, 30% off.

Chicago: Plow steel, round strand, 30% off, flattened strand, 15%, cast steel, round strand, 17½%.

Western and California territory, 30% plow steel; +17½% galvanized iron rigging and guy rope.

Montana, Idaho and Arizona, 25% plow steel, +22½% galvanized iron rigging and guy rope.

MANILA ROPE—For rope smaller than ⅝-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft.; ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils

Boston	$0.22½	New Orleans	.20½
New York	.18½	Los Angeles	.18½
Chicago	.21	Seattle	.20
Minneapolis	.23	St. Louis	.21
San Francisco	.19	Montreal	.20
Atlanta	.23	Detroit	.21
Denver	.23	Baltimore	.25
Cincinnati	.22	Kansas City	.20½
Dallas	$0.29		

*780-ft. coils.

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb keg of black powder.

	Low Freezing 20%	Gelatin 40%	Gelatin 60%	Gelatin 80%	Black Powder
New York	.....	$0.22½	$0.36½	.....	....
Boston	.225	.2475	.2825	$0.365	....
Kansas City	.1675	.2025	.2375	.28	$2.20
Seattle	.1825	.2025	.2275	.2950	2.60
Chicago	.2225	.2425	.2675	.335	2.50
Minneapolis	.2222	.2426	.2682	....	2.80
St. Louis	.245	.28	.315	.3575	2.50
Denver	.2250	.2550	.29	.3325	2.70
Dallas	.265*	.29	.375	....	2.90
Los Angeles	.22	.27	.32	....	3.10
Atlanta	.2525	.2875†	.3225	.3650	2.60
Baltimore	.2525	.2875	.3175	.36	2.10
Cincinnati	.2425	....	....	....	2.65
Montreal	.30	.32	.37	.38	4.10
New Orleans	.255	.275†	.300†	....	2.80
Birmingham, *delivered*	.1575	.1925	.2275	.27	2.10

* 30 Per Cent. † Low freezing.

PILES—For spruce and plain pine piles, delivered New York, the price is as follows:

Spruce 10-in. butts, 5-in. tops, length 20-30 ft.	$11.50
Spruce 12-in. butts, 6-in. tops, length 30-40 ft.	10.50
Pine 12-in. butts, 6-in. tops, length 41-50 ft.	13.75
Pine 14-in. butts, 6-in. tops, length 51-60 ft.	22.50
Pine 14-in. butts, 6-in. tops, length 61-71 ft.	25.25

	Dallas		St Louis
6-in. x 20-ft	$4.60	6-in. x 30-ft	$7.90
		7-in. x 30-ft	10.10
6-in. x 30-ft	7.10	7-in. x 35-ft	15.55
		8-in. x 35-ft	16.55
8-in. x 30-ft	8.45	7-in. x 40-ft	16.05
		8-in. x 45-ft	27.05
8-in. x 35-ft	10.38	8-in. x 50-ft	28.05

OLD MATERIAL—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10.50	$20.25	$11.00
Stove plate	10.50	13.00	11.50
No. 1 machinery cast	12.50	13.75	15.00
Machine shop turnings	5.50	5.50	5.00
Cast boring	5.25	7.00	7.00
Railroad malleable cast	8.50	12.00	12.50
Re-rolling rails	10.00	13.00	
Relaying rails	41.00	35.00	.....

SHIP SPIKES—Current prices per 100 lb.

In.	San Francisco Galv.	San Francisco Black	Seattle Black
⅝	$9.20	$8.50	$8.55
¾	8.75	6.75	8.25
⅞	8.60	6.60	8.30
1			

Pittsburgh base, $3.50@$3.60 per 100 lb.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

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Average Engineering

JOURNEYMAN engineering is the skeleton of the profession; without it the body would be flabby and useless. Day by day every engineering office is confronted with little problems insignificant in themselves, perhaps, but time wasting in the aggregate, particularly if the methods of attack are wrong or clumsy. To the solution of those problems the journeyman engineer must bring the essentials of his knowledge and skill. The art and science of engineering progresses more steadily by the improvements in those solutions than in the successful completion of monumental projects. To emphasize somewhat the importance of such routine work, *Engineering News-Record* has again gathered together in this issue a few of these average engineering problems. In themselves these articles are not spectacular; in the aggregate they and their like are the essence of engineering literature.

Looking Ahead on Transit Problems

ONE of the commendable features of the reorganization of the Transit Commission in New York City is the provision for advance planning of facilities to cope with the demands of the future. This phase of the work has never been given the importance it deserves and the work of the former commissions has been so organized as to tie the city's engineers largely to work actually in hand. Neither the time nor the personnel was available for the type of intensive study of future needs which was recognized as highly desirable. This condition has been remedied by a readjustment of the duties of the commission's top-ranking engineers. D. L. Turner, formerly chief engineer, assumes the title of consulting engineer and will devote his entire time to plans for the future. Robert Ridgway, appointed chief engineer, will concern himself solely with the present program of design and construction. Both engineers bring to their new duties a long and intimate experience with New York's transit problems. The new division of responsibilities promises to assure to the city an intelligent handling not only of present work but of broad plans for the future.

Estimates and Bids

NUMEROUS cases have been reported recently in which highway bids are far below engineers' estimates. In last week's *Engineering News-Record*, for instance, were given details of a recent letting in Arizona, in which it was shown that the successful bidder, one of eleven bidding, was about 35 per cent under the engineer's estimate. Such a condition demonstrates that there is keen competition among contractors to secure available work. Might it not also indicate that engineers, long used to erratic and high prices of materials and labor, are failing to take full advantage of recent reductions? Again, it is true that labor has increased its efficiency considerably within the past few months, due to the weeding out of the less competent and the competition for places, a condition which the contractor who knows the ability of his men is able to take full advantage of, and one which the engineer only with difficulty can estimate. However, since high estimates are incentives to high bids, it is essential that engineers keep a close watch on prices and make a thorough analysis of conditions in order to know as closely as possible what work ought to cost. Just now, competition is bringing prices down. Possibly that element may be lacking when the competent contractors have taken on their season's quota. Then the engineer's knowledge of the situation may be a more important factor in letting work at proper prices.

Summary Dismissal of Engineers

A PECULIAR situation obtains with reference to the summary dismissal last week of the entire board of consulting engineers for the Hudson River vehicular tunnel by the New Jersey section of the joint tunnel commission. Under the laws the New Jersey and the New York commission each has a separate existence, but they function jointly. The consulting engineers were engaged by the joint body. Now one of the constituent commissions, because the joint body would not agree to widening of some of the streets in the vicinity of the Jersey City entrance of the tunnel, has summarily dismissed the consultants. Without hearing, they have charged that the board of consulting engineers has failed "to give full and proper consideration to the plan as a whole and to the traffic conditions in the vicinity of the Jersey City entrance and exit." If the joint commission had taken similar action there would be some reason for detailed inquiry as to the work of the consulting board. The action being taken by only one constituent of the joint body, however, and that at a time when Jersey City politics may demand some fireworks preceding a nearby election, puts it rather in the category of a politician's cheap dealing with a serious matter. To show how shallow the thinking of the Jersey commission is it need only be set down that the commission now recommends the appointment of two independent consulting boards, one by the New Jersey and one by the New York commission. This is nothing more than a scheme for intensifying partisanship. If the two states propose to build a vehicular route under the river it will only be accomplished satisfactorily—if at all—by both bodies acting as one and in complete harmony. Some power is needed which will take the parties at outs, sit them down around one table, and keep them there until they all go out of the room a unit with reference to conducting the enterprise. Political and petty tampering with an engineering enterprise of such magnitude may not end in disaster, but it will inevitably lead to a waste of the people's money. Evidently the Jersey commission does not want disinterested engineers to advise it, but rather a group subservient to petty local interests.

New York Licensing Controversy

THE Governor of New York has signed the bill which permits corporations and unrestricted partnerships to practice engineering, with the proviso that those in charge of the engineering work must be licensed engineers. The new law, therefore, is substantially the same as its predecessor, the amendments merely clarifying the existing statute. Temporarily, at least, the controversy is settled in New York State. But the matter is not a dead issue. American Engineering Council has referred it to the original licensing committee for study and report. Both sides will doubtless be examined at length—which is as it should be. The issue is a fundamental one. Engineering must decide whether it is a business or a profession.

Twelve-Hour Day to Go

SIMULTANEOUSLY with the annoucement of a wage reduction, the steel corporation reiterates the position which it made plain in its annual report some weeks ago regarding the 12-hour day. In brief, the 12-hour day and the seven-day week are to go. It is time, all will agree, that they should. Tradition has probably been largely responsible for keeping them so long, though fundamental difficulties in the industry had an important bearing on causing their retention so long. The complete elimination of the 12-hour day is not possible at once, but the corporation pledges itself to its elimination as rapidly as possible. Just to whom credit for this decision is to be given, we are not in a position to say. The labor unions have long agitated against the 12-hour day, but we want to call attention to the very intelligent studies of the subject that have been made recently by engineering specialists in industrial plant operation. Without having full knowledge of the process of reasoning which prevailed in the steel corporation, we are nevertheless quite inclined to believe that the studies made by these industrial specialists had decidedly more weight in bringing the corporation to its conclusion than that of all of the agitation of labor leaders indulging solely in generalities. Without a doubt the steel corporation's own experienced operators went into the subject and checked the results which industrial engineers claimed for shorter-shift operation in other steel mills.

Reduction in Steel Wages

LAST week's announcement of the reduction in wages of the day workers in the plants of the United States Steel Corporation is the second of two recent important developments in the general adjustment of the wage situation. The first was the determination by the War Labor Board that the national working agreements should terminate next July. While no right-minded man enjoys seeing the income of his fellow men reduced, we are simply accomplishing now from day to day the adjustments that inevitably flow from the inflated period of the war. Adjustments upward were accomplished easily. The reverse movement is beset with greater difficulties. Surely, however, the steel corporation has set all industries a good example in deferring the wage reduction as long as possible and until the period when the reduction in the cost of living has, by a safe margin, preceded the wage reduction time. In doing this they set just the same good example that they did when, in the period from 1915 to 1920, inclusive, they increased wages at nine different times and without a strike (for the strike in the steel industry was not for an increase in pay); raised the wages from $2 to $5.06 for a 10-hour day. Now the wage will go back to $4.05 for 10 hours. It must be remembered that the plants of the corporation are operating on only about a 40 per cent basis, and that as a result one would not hear much adverse reaction on the wage reduction. Nevertheless, the almost total absence of any adverse inflammatory comment indicates that the workers see the fundamental economic necessity for the adjustment.

Fenced City Streets?

KILLINGS in city streets by motor traffic have increased in horrifying degree in the last few years. The truck is the chief instrument of evil in this regard. It kills more than one in ten thousand people each year, and little children are the victims in the great majority of cases. The gruesome record demonstrates conclusively that the use of streets as playgrounds is incompatible with their use as roadbeds for high-speed truck traffic, and vice versa. But trucks are increasing in number, and their importance in city life is increasing perhaps even more rapidly. Since children are not decreasing in number, no end to the continuous street fatalities is in sight; on the contrary, further increase may be expected. Attempts at police control of either trucks or children have not reached the basic trouble—the competitive use of the streets. In the modern business street we have, in fact, a roadbed of dense, high-speed traffic, closely analogous to the railroad right-of-way, and it is quite unlikely that police control will be more effective in the one case than in the other. Long experience has shown that railway roadbed is unsafe for trespassers except when trespassers are kept off; the fenced right-of-way has been found to be a necessity. In a few special localities we have already come to the point of classing pedestrians as trespassers on streets. Are we to go further and ultimately convert the street into a fenced roadbed, with the buildings and sidewalks cut off from it by barriers? It seems a strange prospect, and a city of such streets would be a strange city. Were it possible to carry out zoning so thoroughly as to put children in certain of the streets of a city and trucks in another, the problem would be solved in an easier manner. But such a solution implies traffic zoning, something rarely attempted. It has promising possibilities; but it would give the entire zoning movement a different aspect. Obviously, the point has no force in the suburbs where there is ample ground around detached homes for playground, but it has force in congested districts.

Method of Valuation Not Yet Fixed

FINAL METHODS to be pursued by the Interstate Commerce Commission in fixing the value of the railroads of the United States have yet to be formulated and announced by the commission as a whole, regardless of the fact that a division of the commission has given single sums as property values for four companies, at the same time reporting additional costs of acquiring carrier lands, as it was required to do by the decision of the Supreme Court in the Kansas City Southern case. An analysis of the more important points at issue, suggested by the recent "supplemental" reports, appears on p. 818, in an article by Judge Moore of the Kansas City Southern. Some have termed it futile to attempt

valuation on such a large scale for a number of purposes, but the importance of the subject can hardly be overemphasized since the laws requiring that the work be done are on the statute books. Moreover, the Valuation Act itself requires that values finally found shall be considered *prima facie* evidence in future proceedings before the commission. Now that field work by the commission's and the carriers' engineers is almost completed, the work of the engineers will be largely in working out accounting methods. Therefore, an authoritative statement regarding methods and purposes is of great importance to valuation engineers.

Evidently, only two or three members of the entire commission of eleven are committed to tentative valuation reports so far issued and the methods employed. The issuance of the most recent report on April 5 was occasioned by the decision in the Kansas City Southern case requiring the commission to find and report separately the additional cost of acquiring carrier lands due to severance damages, condemnation proceedings, etc. In the meantime, although the Valuation Act and the Interstate Commerce Act do not make the point specifically clear, it had been decided by the commission that it had authority to fix single sums as value, instead of reporting only cost of reproduction, depreciation, original cost, and "other elements of value." So the next step was to issue "supplemental" reports, including single sums as final value and at the same time comply with the Supreme Court decision.

Under these circumstances, it is regrettable, as Judge Moore says, that Division 1 of the Interstate Commerce Commission has not seen fit at this time to announce the method pursued in arriving at the single sums given. However, we have no doubt that the engineers of the commission and the commission as a whole will have such faith in finally adopted methods that there will be no reluctance whatever in defining and announcing them.

It is pointed out by Judge Moore that the formula for determining final value recommended by the director of the Bureau of Valuation has probably been used in determining the single sums now given. If it is a fact that such a method has been used to the exclusion of the additional costs of acquiring carrier lands, the action taken does not appear to comply with the spirit of the decision in the Kansas City Southern case. Commenting editorially, following the decision in the Minnesota rate cases, this journal recognized that the cost of acquiring railroad land is obviously a great deal higher than is the normal value of adjoining land. While the Supreme Court decision only required the Interstate Commerce Commission to find and report the additional costs of acquisition, the spirit of the decision would certainly seem to be that consideration should be given such costs in any attempt to fix single sums as "value."

Progress has been made, but final methods have not been evolved. The commission must face the question whether it shall find different "values" for different purposes, such as would be used for condemnation proceedings in the consolidation of railroad properties under the Transportation Act, or for use as a rate base. Decision may be made to fix only one value for all purposes. As pointed out by Judge Moore, "the real problem before the commission is to decide what kind of value it is to find, and how it shall be determined, and its solution of this problem remains incomplete."

Getting Together on Federal Highway Policy

A VERY material step forward in composing the differences which exist regarding a proper federal highway policy has been made through the new bill which Senator Townsend has introduced. It accepts the federal-aid principle, in lieu of the policy the Senator has previously fathered of the construction of a national highway system at the exclusive cost of the federal government.

This is a fortunate step, for it places the former national highway system advocates in harmony with the state officials whose influence in the past has been strong enough to have large appropriations voted by Congress on the fifty-fifty basis. Now that the critical issue of the basis on which the federal funds should be spent has been settled, there should be a possibility of getting together on the great remaining matter of difference—the method of administering the government's highway activities.

Senator Townsend's new bill, like those that he has introduced in the past, calls for a Federal Highway Commission. The bill fathered by the state highway officials would leave the administration in the hands of the Bureau of Public Roads. Those acquainted with the government's participation in highway activities know very well that the original purpose in advocating a Federal Highway Commission was none other than to inject vigorous action into the government's highway work. Three years ago there was widespread dissatisfaction with this feature of federal administration, and the commission was proposed and ardently advocated chiefly by those who believed it a means of replacing the inaction with a vigorous policy. In the last two years, however, there has been a material change for the better, and highway officials throughout the country are thoroughly satisfied with the way the government highway activities have been administered.

The main reason, therefore, for which the commission was at first advocated is now removed. Moreover, there is growing up today in governmental circles a strong opposition to all of the "independent establishments," except those having judicial functions. In many quarters in Washington there is strong conviction that all of these independent establishments should be thrown into appropriate departments wherever administrative functions are involved.

Advocacy of the formation of a Federal Highway Commission at the present time, therefore, not only lacks the backing which circumstances gave to the proposal originally, but must meet with the strongly developed opposition to commissions and other establishments outside of the departments and reporting directly to the President. Regarding the undesirable features of these independent establishments we are sure to hear more when hearings get under way before Senator Smoot's committee, which is to study the reorganization of the government. It will then become plain, we believe, that it is hopeless now to expect Congress to authorize any new independent establishments, such as the Federal Highway Commission would be.

With the situation as it is, we have high hopes that Senator Townsend will abandon the feature of his proposed law. Should he do that there will then be complete agreement between the former opposing federal-aid and national highway camps, and that in turn would assure an uninterrupted continuance of liberal federal support for highway development.

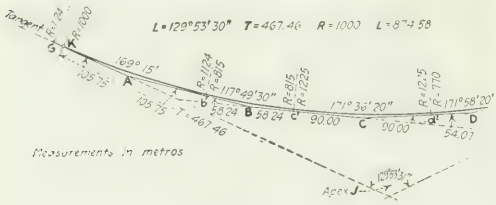
A Group of Articles for the "Average Engineer"

Resurfacing Pavements—Stray Points in Structural Design—Property Monuments—A Railroad Resurvey—Continuous Beams—Layout of Stairways—Reinforced-Concrete Chimney Design—Determining Turbine Speeds—Combined Methods in Surveying

Simple Method of Resurvey for Line Adjustment

By Peter Vassallo
Engineer, Way and Works, Egyptian State Rys., Cairo, Egypt

NECESSITY FOR line adjustment on the Egyptian State Rys. in 1920 led to preliminary resurveys being run by methods somewhat different than the curve intersection method described by J. G. Wetherell, assistant engineer, Chicago, Milwaukee & St. Paul Ry., in *Engineering News-Record*, March 18, 1920, p. 575. It was necessary to adopt a method that would accomplish the purpose with only laborers in the party in addition to one engineer. Instead of intersecting and traversing curves, I found it most expedient to locate them by running a series of tangents.



CURVE RESURVEYED BY TANGENT METHOD

The method employed is illustrated above, tangent lines intersecting at *A*, *B*, *C*, *D*, etc., starting at the point *G* of the tangent and laying off an arbitrary distance to the point *A*, where the transit is set up on the embankment outside of the curve. The point *b'* is located by sighting on the line of curvature as the point of tangency, which is marked. While the laborers are chaining the distance *Ab'*, the engineer is measuring the angle *GAB*. The line *Ab'* is again extended to a point *B* and the point *c'* is located by the same method as *b'*, and with the distance *b'B* and *Bc'* equal as tangent distances. Thus the entire curve is located with points *b'*, *c'*, *d'*, etc., as common tangent points—or as points of compound curvature. In the case of compound curves it may be recognized that the method is approximate, but it was found to serve the purpose.

With tangent lengths and corresponding angles recorded, the radius of each portion of the curve is readily calculated. If it is found that the radii closely correspond they are averaged to obtain the radius of simple curve desired to re-run for readjustment of the line. Points of compound curvature and the radii of compound curves may also be so determined.

From this determination the curves can be re-run and pegged out if rail and ties are to remain, but if general hauling is required or heavier track is necessary in adopting heavier rolling stock, pieces of rail are driven ½ m. deep with points accurately marked on the top exactly 2 m. from each peg point.

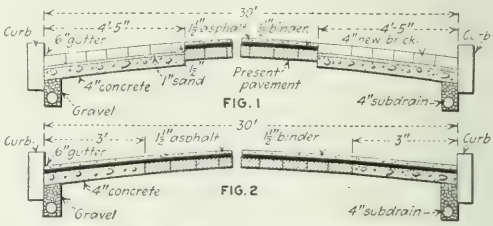
The resurvey of the line was executed by one party consisting only of one surveyor with some laborers, commonly called chainmen here in Egypt. The work was conducted in the hottest part of the year and it started exactly with the Mohammedan fasting month—Ramadan—and few foreigners know what this means. Finally the engineer produced the drawings necessary for office use.

Resurfacing of Brick and Cobble City Pavements

By W. H. Eagle
Assistant Engineer, Columbus, Ohio

THIRTY-TWO years ago three old cobble stone streets in Columbus, Ohio, were resurfaced with asphalt. After twenty-three years of traffic had demonstrated the success of the resurfacing operation, Columbus adopted it as standard practice in restoring worn out brick and stone block pavements. To date more than 145,000 square yards of old highways have been given new asphaltic wearing surfaces.

One of the streets repaved in 1888 was Bryden Road from Parson Ave. to 22nd St. This street still is in excellent condition and the indications are it will last several years longer with reasonable cost for maintenance. The maintenance cost during the life of this pavement, laid with Trinidad asphalt, has been $0.021 per sq.yd. per year. The other two streets resurfaced in 1888 still are in use although the maintenance cost



SECTIONS SHOW RESURFACING METHODS TO AVOID SHALLOW GUTTERS

as reached a point where they should be repaved. Washington Ave., from Broad St. to Town St., was resurfaced with native lake asphalt over cobble stones in 1901. This street is in excellent condition today. It has had no repairs, nor has it disintegrated, shoved or cracked. While these streets are in residential sections they are subjected to fairly heavy traffic.

The City of Columbus has a large mileage of brick and stone block streets that are from twenty to thirty-three years old. These pavements were laid on a gravel, a broken stone or creosoted plank and sand foundation. The bricks were small sized with the joints filled with either sand or tar. The gravel or broken stone foundation is about eight inches deep, with from one to two inches of sand cushion. In 1912 the City began to

resurface these brick and stone streets. Briefly, the methods used are as follows:

All depressions over three inches deep are filled with cement concrete, slight depressions being taken care of with binder. The street is then thoroughly cleaned either by flushing with a fire hose or by raking out the joints with sharp picks or hooks and hand sweeping. It is essential that the street be thoroughly cleaned, and all joints cleaned to a depth of at least ½ in. All manhole covers and street boxes must be raised to conform to the grade of the new pavement and the pavement adjusted at all paved intersections.

A closed binder 1½ in. thick, containing 20 to 30 per cent of mesh material, then is laid directly on the old pavement. When there is considerable variation in depth due to the irregular contour of the old pavement the binder is laid in two layers. It is figured that 1 cu.yd. of binder box measurement will lay 20 sq.yd. 1½ in. deep. All binder used in excess to this is paid for at price bid. This excess binder has amounted to about 2 cu.yd. per 100 sq.yd. of surface laid.

STREET RESURFACED AND GUTTER RENEWED

Upon the finished binder is laid a standard sheet asphalt surface 1½ in. in depth. Generally the department prefers to resurface an old brick street from curb to curb. As the depth of gutters in Columbus is six inches, this results in a very shallow gutter when the street is resurfaced, which is unsightly and, where grade is flat, may result in flooding the sidewalk during heavy storms.

To avoid this shallow gutter, one of two things may be done. First: a strip of the old brick, 3 or 4 feet wide, as in Fig. 1, may be taken up along the curbs and a new brick gutter constructed upon a concrete foundation, to such a grade that there will be a shoulder at the outer edge, sufficient to take care of the asphalt pavement and be 5 or 6 in. below the top of the curb at the inner edge to form the gutter.

Second: a strip of brick may be taken up along the curbs, as in Fig. 2, and replaced with concrete to such a grade that asphalt may be laid from curb to curb and still maintain a proper depth of gutter. This method is particularly advantageous where the old pavement has not sufficient crown.

By resurfacing the city saves about 25 per cent over the cost of a new pavement with a concrete foundation. In my opinion these streets have given equally as good service as streets with similar traffic conditions, where new concrete foundations were used.

All streets resurfaced since 1912 are in good condition and have had no repairs except slight repairs made by the contractor under his guarantee. These were practically all settlements over trenches or openings made in the old pavements prior to their resurface. The resurfaced streets are particularly free from cracks and shoves.

Diagram for Effect of Flange Holes in Beams and Channels

By Henry Kercher
King Bridge Co., Cleveland

THE excellent articles by R. Fleming, under the title "Stray Points in Structural Steel Design," which appeared in *Engineering News-Record* of May 27 and June 3, 1920, pp. 1040 and 1104, cover some of the vital points often overlooked by the designer. In the first of the two articles appears a paragraph devoted to the weakening effect of flange holes in beams, which is accompanied by a table of the reduction in section moduli of the different minimum-weight standard beams and channels for the various combinations of holes out of the flanges. The author also gives two diagrams showing the bending moments for beams carrying a uniformly distributed load and a load concentrated at the center of the span. By means of the table of reduction in section moduli and the moment diagrams, the designer can estimate approximately at what point it is safe to take out the number of holes desired. This paragraph gave the writer the idea from which he has prepared the accompanying chart.

Minimum-weight standard sections were used, as in Mr. Fleming's article, as were the maximum rivet diameters allowable, these being identical with those given in the Carnegie "Pocket Companion." The holes were taken as ⅛ in. greater in diameter than the nominal diameter of the rivets, as is customary. The thickness of the metal on the gage line was taken equal to that for a beam or channel next greater in weight than the minimum section; this produces a very slight error on the safe side for the minimum section, and reduces the error where the chart is used for the heavier ones.

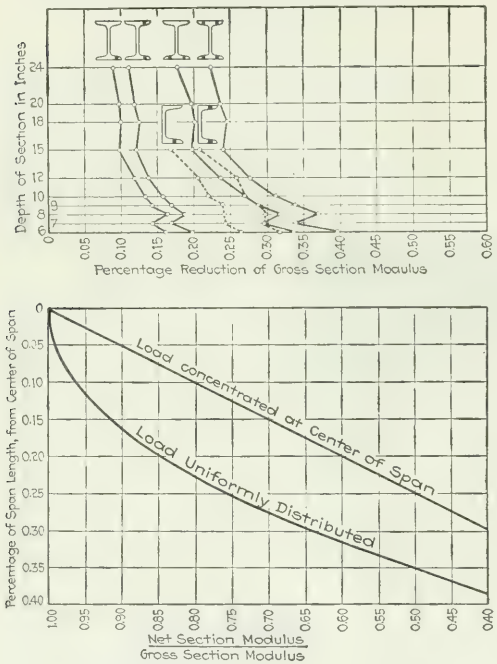
Comparison of the percentage reductions of the section moduli given in Mr. Fleming's table with those shown on the chart will disclose variations as great as 2 per cent in some cases. The writer made two independent calculations for each case as a check on his results. The thickness of the metal on gage line was calculated decimally from the profile of each section. The above-mentioned variation may be due to Mr. Fleming's using the grips of the rivets in common fractions, as they are given in the various handbooks.

It may also be mentioned that a hole in the compression flange filled with a bolt should be treated the same as a hole out of the tension flange. This is a point often overlooked by designers.

While the chart will be found to be simple and self

explanatory, an example will be given to illustrate the use of it.

Suppose we have a 15-in. I-beam of 42.9 lb. per ft., spanning 25 ft., with sufficient lateral support, carrying a uniformly distributed load of 25,000 lb. This load will produce an extreme fiber stress of 16,000 lb. per square inch at the center of the span, if no holes have been taken out of the flanges. Suppose it is desired to take one hole out of the tension flange at a distance of 5 ft. from the center of the span. The problem is to determine whether the net section modulus at this point



WEAKENING EFFECT OF FLANGE HOLES

is sufficient so that the extreme fiber stress will not exceed 16,000. Follow the curve on the chart under the sketch indicating one hole out of one flange of an I-beam until it intersects the horizontal line indicating a beam 15 in. in depth. Then follow vertically downward to the curve marked "Load Uniformly Distributed." Then trace horizontally to the left, noting the distance from the center of the span to the point where the hole can be removed. This is 0.16 of the span length, and as $0.16 \times 25.0 = 4$ ft. the proposed hole at 5 ft. is allowable. Similarly, two holes may be taken out of one flange at a distance of $0.23 \times 25.0 = 5.75$ ft. from the center of the span. The other cases for the uniformly distributed load, as well as those for the concentrated load, are worked out in the same way.

To calculate the net section modulus of a beam heavier than the net section, subtract the product of gross section modulus of minimum section by percentage reduction from the gross section modulus ot the beam in question. For example, the net section modulus of a 15-in. 50-lb. I-beam with one hole out of one flange is 64.5 less $58.9 \times 0.097 = 64.5 - 5.7 = 58.8$. The percentage reduction of the gross section modulus = $5.7/64.5 = 0.088$. Beginning at the top of the chart with this value and proceeding as before, it is found that one hole may be taken out of one flange at a distance of ($0.15 \times$ span length) from the center of the span for a uniformly distributed load.

This diagram should prove of as much use to the detailer as the designer, as often it is the detailer rather than the designer who must solve this problem.

A Group of Articles for

Bunk-Houses Built in Sections for Convenience in Moving

By R. M. Adams
Civil Engineer, Montrose, Colo.

A SUITABLE substitute for the canvas tent as sleeping and eating quarters for the workmen on the Twin Falls Irrigation Project recently became a necessity, and I drew the design shown in the accompanying drawing on that account. Before this was adopted discussion of the requirements resulted in the following specifications which the bunk-house would be required to fill: (1) The weight of two houses must not exceed the capacity of a 2-ton truck; (2) some of the sections of the buildings must be made of such dimensions that they would go into and snugly fill the body-box of such a truck so as to make a complete and stable load when the two houses were placed on it; (3) the floor plan of the house must be about 14 x 16 ft.; (4) the roof must be storm proof without the use of tarpaper roofing; (5) the house must be designed so that two or more could be joined end-on to form a longer building; (6) no section could exceed the weight or bulk that could be easily handled by three workmen; (7) the house must be so built as to outlast a tent in the ratio of at least three to one.

With these requirements laid down there was but little choice left as to design, but there was considerable latitude in the matter of devising means of increasing the speed and the ease with which the building could be put up or taken down and loaded. Experience with about a dozen of these houses during a very severe winter has shown them to be very satisfactory shelter, and they have been adopted as standard on this work.

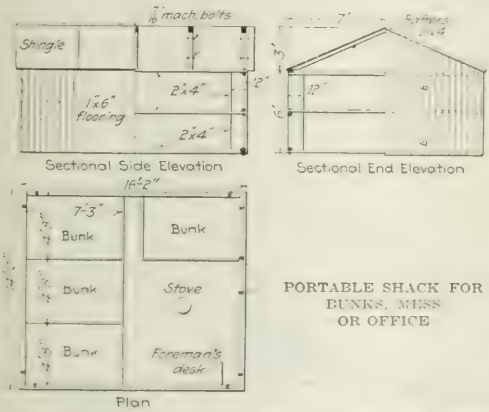
The largest piece to be handled is a side. The roof is handled in eight sections, four pieces to each side of it. Where two sections of the roof meet, the joint is made tight by fitting a U-shaped piece of metal over the upturned metal strips which the shingles cover, partly, at each edge of the piece. These strips are made of 20-gage material because any sheet iron that could be used would get bent and the light weight can be bent back to place with the fingers.

A feature of primary importance in setting up the building is that the periphery of the plan be in a plane that is level; the ground must be leveled. Unless this is done, the roof sections will not fit together snugly, and it will be difficult to make the building storm proof.

Corners that go together in the assembled structure are lettered with the house number, the number of the corner, and the piece number, so that in loading, unloading and assembling there need be no mixup to delay the process of moving camp. Black paint is used for this numbering and also for painting the house number on the two ends of each building.

the "Average Engineer"

An experienced gang of camp movers—four men—were able to put up one of these buildings singly in an hour, including the frame for the bunks and the placing of a small stove. When two houses are placed together, by sacrificing two boards on the sides at each end of the two placed together, a window may be put in at the joint without any waste of material should it later be desired to use the two buildings as single units. Windows are provided for each house, but the window hole is not cut in the end opposite the door until the house is set up the first time. This window is simply marked out and left to be cut when erected. In this way, if a new building is used for a part of a long building, the stiffest portion of the structure does not warp during the time it lays in stock pile awaiting the time it will be used as a single unit. The stiffness of the end pieces for handling is much increased by this procedure. This idea of retaining parts in stock is based on the plan of having all parts interchangeable. However,



PORTABLE SHACK FOR BUNKS, MESS OR OFFICE

so long as a part of a building is intact and fit to repair, it is assumed that it will remain in the structure for which it was built.

BILL OF MATERIAL

LUMBER

10 bunches cedar shingles	250 lb
9 pieces 2x4—18 ft. for rafters and studs	108 ft. b.m.
7 pieces 2x4—16 ft. for plates, rails, sills	74⅔ ft. b.m.
8 pieces 2x4—14 ft. for plates, rails and ties	74⅔ ft. b.m.
3 pieces 1x6—16 ft. for ridge finish	[illegible] ft. b.m.
20 pieces 1x8—16 ft. for roof sheeting	213⅓ ft. b.m.
Total 495 ft. b.m., or approx	1,550 lb.

HARDWARE

8 pieces 7/16 in. x 6 in. machine bolts	2.6 lb.
24 pieces 7/16 in. x 6 in. machine bolts	5.7 lb.
32 pieces 7/16 in. flat washers	0.7 lb.
32 pieces 7/16 in. threaded nuts	2.0 lb.
1 pair 6 in. T-hinges	[illegible]
1 Rimlock with knobs	[illegible]
16 d. nails	[illegible]
20 d. nails	[illegible]
4 d. nails	[illegible]
Twenty-gage galvanized iron roof tin	12.0 lb.
White lead paint for one heavy coat	18.0 lb
Total hardware, nearest pound	145.0 lb.
Grand total for the building	1,695.0 lb

The siding is made to extend slightly beyond the plates, so that the ends of the rafters drop down with scant clearance just inside the siding, when they fit up snugly at the peak. No bolts are used to hold the roof sections down; its weight is sufficient for this purpose. Neither are nails driven to hold any of the sections together, although four nails are used on each ridgepole board after the roof sections are in place.

When this kind of structure is made in lots of six or more buildings at a time the cost is $125 each exclusive of bunks. All subject to 1919 prices.

The life of such a building, which is lengthened by painting the entire outside except the roof shingles, and allowing for 12 moves, is about six years.

Combined Methods Useful in Topographical Surveying

By P. J. Barry,
Dominion Water Power Branch, Department of the Interior, Canada, Winnipeg, Manitoba

TOPOGRAPHICAL surveying is frequently enlivened by discussion of the comparative merits of the instruments used—transit, plane table or chain. Experienced topographers, however, see little reason for argument because a country which may be suitable for one instrument will often prove entirely unsuitable for another. The surveyor who does not confine himself to one particular method will produce the best work.

The transit theodolite may be considered as indispensable for laying out the triangulation, or the control lines, of a topographical survey but when that is done it may profitably be laid aside. Experience has shown that the plane table and chain are better adapted for the detail work. The transit and stadia method applied to the intricacies of town or city topography is very tedious and the accumulation of field notes is a fruitful source of error in plotting. Except in isolated cases, the general use of the transit for detail work cannot be recommended as economical.

The plane table, when used for supplying topographic detail, has many advantages over the transit. In conjunction with stadia it gives excellent results but it is by no means limited to this operation: in the hands of a competent topographer, very good work can be done on the traverse "table" without the aid of transit, stadia or tape. More freedom of movement is allowed by its use and many problems requiring quick solution are not possible by other methods. The plane-tabler has the additional advantage of being his own draughtsman and can give a natural finish to the map which is not possible in the office.

The "triangle and chain" method of surveying has not been used to any extent in the United States or Canada, probably due to the system of laying out land divisions in these countries. In parts of England, however, it is the only solution for the irregular and congested details which exist there. The British Ordnance Survey maps are very accurate although the field work was done rapidly. The triangle and chain principle upon which these maps are based is perhaps the simplest yet most efficient method of detail surveying known. A glance at Fig. 1A will show the firmness with which a block (shaded) can be held in position by tied lines inside a triangle.

The following three examples are typical of what a topographer is likely to encounter in the field from time to time. They show the necessity for being acquainted with two or more methods of surveying, if reasonable progress is expected.

Problem 1—In Fig. 1, the point A was the extremity

of a chained traverse; it was required to locate three points across the bay at *B, C, D,* without cutting bush. No set-up was possible off the line *ABCD* and no part of this line could be chained. Points could be given to the rodman (by signal) in the low bush shown inside the dotted line. The plane table was laid aside and the transit set up at *A* and sighted to *D*. An angle of

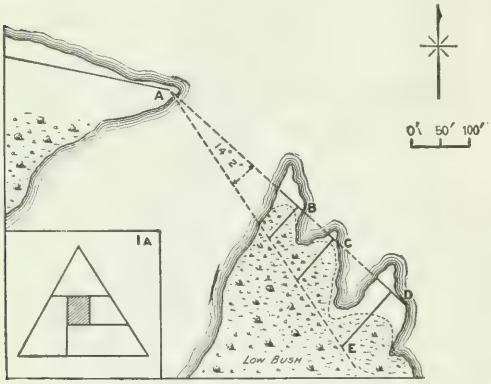


FIG. 1. TRANSIT METHOD LOCATES ISOLATED POINTS

14° — 2′ was turned to the right and sufficient points given to the rodman to establish a line in direction of *E*. Crossing over, the instrument was set up at *B, C,* and *D* in turn and a right angle turned off from the line *AD* at each set up. The right angle lines were intersected on the line *AE* by means of the points given to the rodman and their lengths chained. This operation formed three right-angle triangles. An angle of 14° — 2′ at the extremities of the base and hypotenuse of a right-angle triangle gives a ratio of base to perpendicular of 4 to 1. Therefore, the chained right angle lines from *B, C* and *D* (being in this case the perpendiculars), were multiplied by 4 to obtain the lengths of the bases, or *AB, AC, AD,* which were the distances required.

Problem 2—The problem represented by Fig. 2 is the reverse of that in Fig. 1, and the transit had to be discarded in favor of the plane table for lack of time. It was required to find the exact map location of the gun position at *B*. The only ground on which the plane table could be set up was along the narrow strip screened by the small wood, and extending for about a hundred yards north and south of G^1 and G^2. It was not possible to see through the wood and the instrument could not be set up in it, but a man could crawl through to the east edge unseen by the enemy observers. Chaining the distance was out of the question.

Before setting up the plane table the topographer proceeded to lay out two lines for intersection. Going around by way of a communication trench he placed a slender stick about 8 ft. high at the gun position *B*. Returning to his first position near G^1 he crawled carefully through the wood in front until he could see the top of the stick at *B*. This was his first point, *A*. From this point he observed an object in line with, and beyond *B*, say at *C*. Placing a small piece of paper on a stick at *A*, he retired until his object at *B* was about to disappear. Then he placed a second stick and paper at

A Group of Articles for

D in line with *A, B, C*. Backing carefully and keeping two objects in view all the time he put pickets in at *E, F* and G^1. Estimating by eye a serviceable base, he entered the wood again near G^2 and brought a second line out at G^2. Setting up the plane table at each position in turn (G^1, G^2) he verified his correct location by resection from trig. stations to the west and when the instrument was fixed at each position he sighted along the lines he had traced through the wood. The intersection of those lines gave the position of the gun at *B*.

Problem 3—The triangle and chain method already mentioned has reference to triangles fixed by trigonometry. However, under certain conditions, and where strict accuracy is not required, detail surveys may be run by chain if there are points to start and close upon, without the use of either transit or plane table. Fig. 3 is an example of this.

The first difficulty was found in not being able to cross the river, as no boat was available. But by establishing two points and producing a line through them intersections could be obtained as in plane tabling. Two

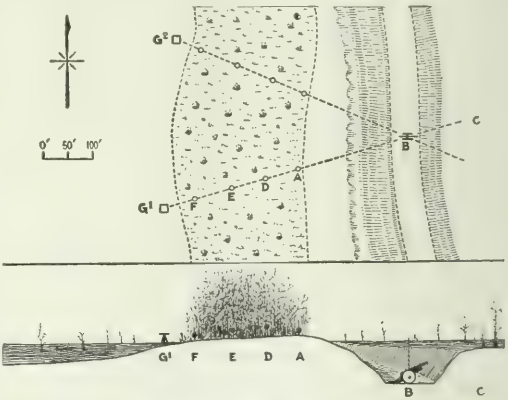


FIG. 2. LINES "BROUGHT OUT" TO LOCATE NEW GUN POSITION

pickets on an old east and west township line supplied the base, *A* and *B*. Another picket was set at *C* and a line chained from it through *B* along the river bank. A small triangle was laid off to locate the house. The returning line proved to run in the direction of a prominent object on the opposite bank (6). This object was noted, and located by an intersecting line through a stake (2) in line from *C* to (6). Another stake was put on the line *AB* at *D* and the chaining of the triangle *DBC* completed, the picket at (2) being read while doing so. The line *CD* was so arranged that the production of it would strike the end of the fence at (1) on the opposite bank. The intersecting line *FE* was also laid out to produce on the end of the fence, while at the same time watching the possibilities of following the river bank by a line from *F* through *A*. When the two sides *EF, FA* were chained this triangle was completed by chaining the remainder of the base line from *D* to *A*, the points (3) and (4) being read while doing so. The point at (5) was located in the same manner

the "Average Engineer"

as (6). The production of the fence noted at (3) and of the other one at (7) located the corner, as the eastern end of the top fence had already been fixed. The

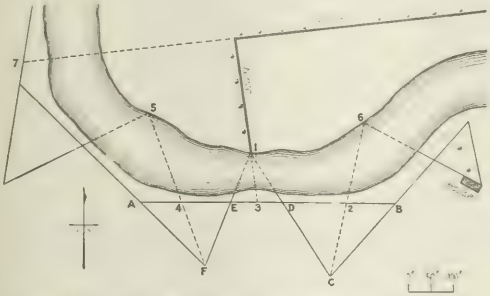


FIG. 3. SURVEY RUN BY "TRIANGLE AND CHAIN"

survey was carried about half a mile in this manner without any serious errors. The dotted lines shown on sketch are lines of sight only.

Diagrams for Designing Reinforced Concrete Chimneys

By F. E. Hertel
Stone & Webster, Inc., Boston, Mass.

THE diagrams presented herewith have been found to be particularly useful for the analysis of reinforced-concrete stacks, although they can be used for the analysis of any hollow circular reinforced-concrete beam or column subject to combined bending and direct stress. They can also be used for design by employing the trial method.

In addition to the usual assumptions adopted for the design of reinforced-concrete members, the two following assumptions have been made. (1) The reinforcing steel is replaced by an equivalent steel shell. (2) The reinforcing steel is located on the mean circumference of the concrete shell. The first assumption involves no appreciable error and the second is on the side of safety since the reinforcing steel is usually placed nearer the outside surface of the shell where it is more effective in resisting bending stress. In the computation the notation is as follows:

r = mean radius of concrete shell
t = thickness of concrete shell
N = normal component of all loads
e = eccentricity of N measured from the center of the section
p = ratio of reinforcing steel area to total area of section
n = ratio of modulus of elasticity of steel to modulus of elasticity of concrete in compression
α = one-half the central angle subtended by the neutral axis, as a chord, on the circle of radius r
ϕ = variable function of α
f_s = maximum unit tensile stress in reinforcing steel
f_c = maximum unit compressive stress in concrete
f_c' = maximum unit compressive stress in concrete at distance r from the center of the section
P = total compressive stress in concrete
P' = moment of P about neutral axis
S = total compressive stress in reinforcing steel
S' = moment of S about neutral axis
T = total tensile stress in reinforcing steel
T' = moment of T about neutral axis

From the fundamental formulas, sum of vertical forces = 0, and sum of moments of vertical forces about any point = 0, it follows that

$$N = P + S - T \qquad (1)$$

and by taking moments about the neutral axis

$$N(e - r\cos\alpha) = P' + S' - T' \qquad (2)$$

Substituting values, obtained by integrating between the proper limits, for the quantities on the right-hand side of the above equations, and dividing (1) by (2), the factors N, f_c' and t are eliminated and we have

$$\frac{e}{r} = \frac{(1 - p)\alpha - \sin\alpha\cos\alpha + np\pi}{2[(1 - p)\sin\alpha - \alpha\cos\alpha + np\pi\cos\alpha]} \qquad (I)$$

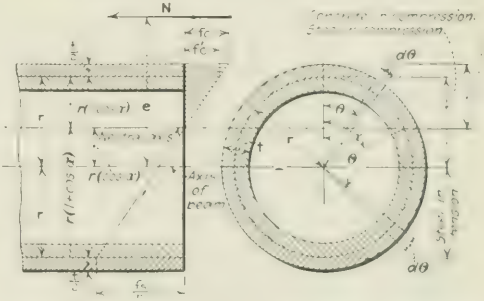


FIG. 1. DIAGRAM SHOWING REINFORCED CONCRETE CHIMNEY

From equation (1) after substituting values for P, S and T we have

$$f_c' = \frac{N(1 - \cos\alpha)}{2rt[(1 - p)(\sin\alpha - \alpha\cos\alpha) + np\pi\cos\alpha]} \qquad (II)$$

Referring to Fig. 1, by proportion we find

$$f = \frac{nf_c'(1 + \cos\alpha)}{1 - \cos\alpha} \qquad (III)$$

and

$$f_c = f_c'\left(1 + \frac{t}{2r}\,\frac{1}{1 - \cos\alpha}\right) \qquad (IV)$$

In order to simplify equations (II), (III) and (IV) let

$$A = 1 - \cos\alpha$$
$$B = \sin\alpha - \alpha\cos\alpha$$
$$C = \pi\cos\alpha$$
$$D = \frac{1 + \cos\alpha}{1 - \cos\alpha}$$

Then equations (II), (III) and (IV) become

$$f_c' = \frac{NA}{2rt[(1 - p)B - npC]} \qquad (IIa)$$

$$f = nf_c'D \qquad (IIIa)$$

$$f_c = f_c'\left(1 + \frac{t}{2rA}\right) \qquad (IVa)$$

Fig. 2 has been plotted from equation (I) and shows the values of α, in degrees, for various values of $\frac{e}{r}$ and p, with $n = 15$. From Fig. 3 the values of A, B, C, and D, to be substituted in equations (IIa), (IIIa) and (IVa), can be obtained for the same of α found in Fig. 2.

As an example of the use of the diagrams, assume a reinforced-concrete chimney for which the stresses at the base are to be determined. At the base the internal diameter is 20 ft., the shell thickness 10 in. and the reinforcing consists of sixty ¾-in. square bars equally spaced. The weight of the stack above the base has been found to be 1,100,000 lb. and the moment about the base, due to wind load, is 7,500,000 lb.-ft. Assume $n = 15$.

$$N = 1{,}100{,}000 \text{ lb.}$$

$$r = 125 \text{ in.}$$

$$e = \frac{7{,}500{,}000 \times 12}{1{,}100{,}000} = 81.8 \text{ in.}$$

$$\frac{e}{r} = \frac{81.8}{125} = 0.655$$

$$p = \frac{60 \times 0.5625}{785 \times 10} = 0.0043$$

$$t = 10 \text{ in.}$$

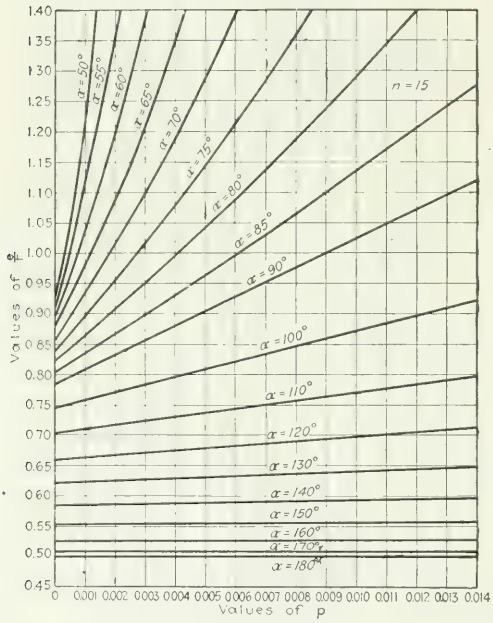


FIG. 2. CURVES FOR DETERMINATION OF α

From Fig. 2, α is found to be approximately 124° for which value the following are determined from Fig. 3.

$$A = +1.55$$
$$B = +2.05$$
$$C = -1.76$$
$$D = +0.27$$

substituting these values in equations (IIa), (IIIa) and (IVa) we have

$$f'_c = \frac{1{,}100{,}000 \times 1.55}{2 \times 125 \times 10\,[(1 - 0.0043) \times 2.05 - 15 \times 0.0043\,(-1.76)]}$$

$$= 318 \text{ lb. per square inch.}$$

$$f_s = 15 \times 318 \times 0.27 = 1{,}290 \text{ lb. per square inch.}$$

$$f_c = 318\left(1 + \frac{10}{2 \times 125 \times 1.55}\right)$$

$$f_c = 326 \text{ lb. per square inch.}$$

It will be noted, by referring to Fig. 2 that for values of $\frac{e}{r}$ less than 0.5 there is compression over the entire

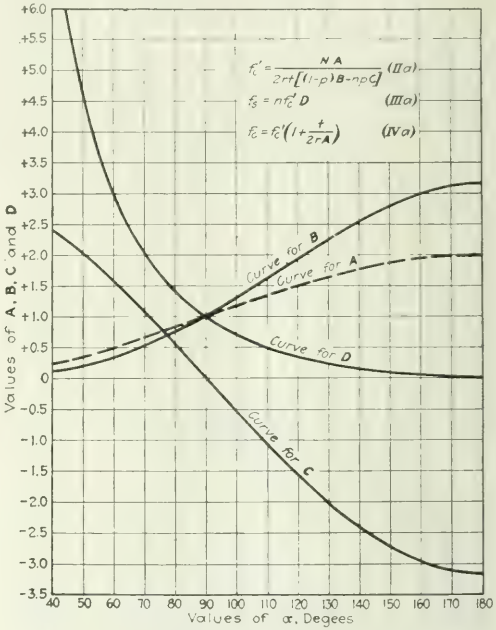


FIG. 3. CURVES FOR DETERMINATION OF A, B, C, AND D

section. For such cases the ordinary moment of inertia theory will apply.

Ready Computation of Areas in Acres

By H. N. Bradstreet
U. S. Mineral Surveyor, Mesa, Ariz.

To DIVIDE by the outlandish number, 43,560, to compute acres in land surveying is a nuisance, and this may be readily done by a decimal system, passing directly from some unit of measure to acres. Of course, there is such a unit in the almost obsolete system used by the United States in measuring the public domain, in which 80 chains make a mile and 10 square chains constitute an acre. But to transform feet into chains is usually considered as difficult a task as to change square feet into acres. But there is a simple way of changing feet to chains by converting all distances in feet into chains, by a repeating decimal method, multiplying distances together for square chains, and pointing off one place to the left for acres.

The conversion is based on the relations:

$$100 \text{ lks.} = 1 \text{ ch.} = 66 \text{ ft.}$$
$$1 \text{ ft.} = 100 \div 66 = 1.5151515 \text{ lks.}$$

Instead of dividing the number of feet to be converted into chains by 66, multiply by its reciprocal.

the "Average Engineer"

the repeating fraction 151515151515, which operation is performed as follows:

	Change 983.245 8 ft. to chains		
	Repeating fraction 151515151515		
983245 8....	represents the figure 1		in the fraction
491622 9....	represents the figure 5		in the fraction
1474868 7	represents the group	15	in the fraction
14748 687	represents the group	15	in the fraction
147 48.87	represents the group	15	in the fraction
1 4748687	represents the group	15	in the fraction
14748687	represents the group	15	in the fraction
14748687	represents the group	15	in the fraction
14976.63 636	chains.		

The result can be carried to any desired degree of accuracy.

A Method for Laying Out Rise and Run of Stairways

By Raymond C. Reese
Pittsfield, Mass.

LAYING OUT and arranging stairs is usually the province of the architect, but the structural engineer is sometimes called upon to obtain well-proportioned stairs; i.e., stairs with proper rise and run. The following analysis has been found useful:

To avoid ambiguity in the use of terms, Fig. 1 has been prepared to show the meaning of such terms as

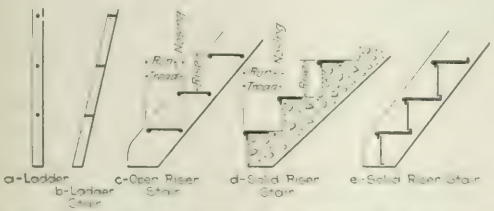


FIG. 1 STAIRWAY TYPES AND DIMENSIONS DEFINED

ladder, ladder-stair, open-riser stair, closed-riser stair, and the frequently confused rise, run and tread.

The curves in Fig. 2 were plotted to obtain a graphical comparison of the principal formulas expressing the relation of rise to run. These formulas are of three general types: (1) Rise × Run is a constant varying from 66 to 75, or generally from 72 to 75; (2) Rise + Run is a constant varying from 17 to 17½; and (3) 2 Rise + Run is a constant varying from 23 to 25. The first of these is, of course, an hyperbola, and the second a right line at 45 deg. While they give good results when the rise is in the vicinity of 7 in. or 7½ in., they call for very steep stairs at the higher values of the rise, and very shallow ones for the lower values. The third type of formula improves on the two others, by changing the slope of the right line, resulting in a more balanced stair for widely varying values of the rise.

Still another type of relationship is shown on the plot from the Cleveland Building Code, as given in the *Engineering Record*, Aug. 28, 1915, p. 260. From this curve the writer has derived the formula: Rise = 25.4 Run — 0.5359. While this gives consistent results, it is a bit awkward to remember and apply, and a more convenient and simpler formula is: Rise × √Run = 23½, which is shown by the heavy line on Fig. 2. This equation is readily solved by one setting of the slide rule.

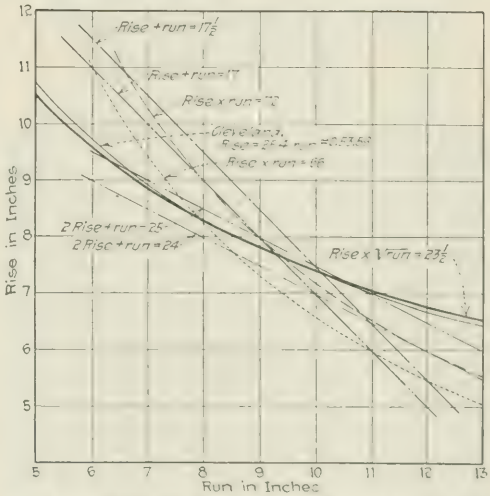


FIG. 2. CURVES FOR STAIRWAY DIMENSION FORMULAS

On the basis of this formula, Fig. 3 was drawn to be used as a standard for the design of stairs. It indicates the relationship between rise and run for all stairs and what seem to be suitable limits for the use of ladders, ladder-stairs and the like. At the lower end of the curve, for slopes of 15 deg. or 18 deg. and less, ramps would be used instead of stairs.

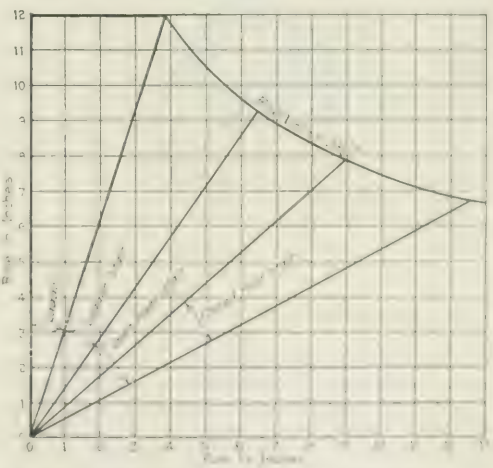


FIG. 3. CURVE FOR SIMPLIFIED DIMENSION FORMULA

On the original drawing from which Fig. 3 is taken, directions were included for the width of stairs and exit doors, the styles of safety treads to be used, headroom required, etc., all of which must have attention in the design of a stairway.

Diagram to Determine Turbine Specific Speed

By E. A. Van Deusen
Jackson, Mich.

IN THE preliminary investigation and design of hydro-electric developments it is frequently necessary to know, before consulting the manufacturers, the probable specific speed and revolving speed of the turbines. The usual procedure is to assume either the specific speed or the r.p.m., and then to ascertain the other unknown factor from a suitable diagram or the usual formula

$N_s = \frac{N\sqrt{HP}}{H^{5/4}}$, in which N_s = specific speed, N = r.p.m., HP = horsepower, and H = head in feet. This method however is not always satisfactory, and moreover, it is sometimes a difficult matter to judge what should be the specific speed.

The appended chart overcomes this difficulty to some extent, for with a given head and power, both the probable specific speed and r.p.m. can quickly be determined.

The curve of specific speeds was obtained by plotting the speed characteristics of more than one hundred existing plants against their respective heads, and then passing a smooth curve through the centers of gravity of the various groups. There was found a wide divergence in the specific speeds for any given head, indicating lack of agreement as to what is the desirable specific speed for the head in question. However, it is believed that the curve shown represents the average and probable desirable values. It is interesting to observe that this curve very closely follows Pfau's classification for successful turbine operation.

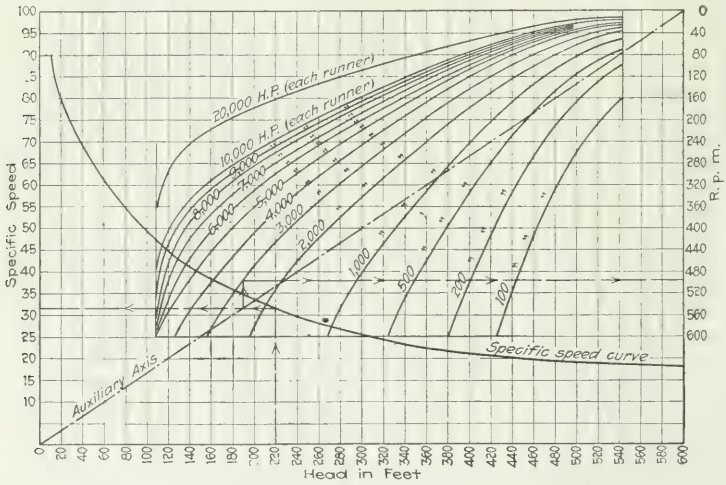


CHART FOR DETERMINING SPECIFIC SPEED AND REVOLVING SPEED OF TURBINES

This chart refers only to Francis single-runner reaction turbines and should not be used for the Nagler high-speed runner, nor for impulse wheels. When used for multiple-runner Francis turbines, the h.p. per runner, not per turbine, is to be used.

As an example in the use of the chart, assume a head of 220 ft., and a 3,000 h.p. single-runner Francis turbine. Enter the chart at 220 ft. head on the axis of abscissas, pass vertically upward to the specific speed curve and read the specific speed on the axis of ordinates as 31.5. From the intersection with the specific speed curve pass horizontally to the diagonal auxiliary axis, then vertically upward to intersection with the curve for 3,000 h.p. On the right axis of ordinates can then be read an r.p.m. of nearly 500.

It should be understood that this chart is only intended to be used as a guide for the preliminary selection of runners. The final decision on specific speed, r.p.m., etc., is a matter to be carefully considered later and may be affected by other factors not taken into consideration at the time of the preliminary investigation.

A Group of Articles for

Concrete Monuments Mark Miami District Property

By C. S. Bennett
Field Engineer, Miami Conservancy District, Dayton, Ohio

SPECIAL concrete property mounments with brass markers have been used for marking property corners on lands of the Miami Conservancy District, including rights of way for the location of levees and walls, borrow pits and earth dams. Since 2,000 monuments were required a study was made of the most economical and satisfactory design and the best method for placing them.

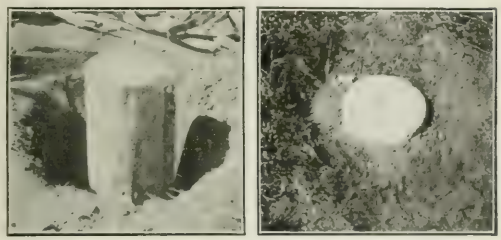
A monument of circular section was chosen, with top diameter of 8 in. and a bottom diameter of 9 in., with a standard length of 36 in., the taper facilitating the pulling of sheet iron forms. When rock was encountered the length, of course, varied. The monuments were cast in place, the markers being placed and centered while the concrete was green. A 1:2:4 mix was used for the concrete, with a richer mix on top to facilitate smoothing of the top surface. The two photographs show the monument before the form was pulled, with its flanges at the side, and after the form had been pulled and earth tamped in. Details of the marker are shown in the accompanying drawing.

Forms consisted of one piece of sheet iron with a pair of flanges turned out to take three bolts with wing nuts as clamps. The bolts were released after concrete had set. The form was easily withdrawn. The general method employed was to dig holes for from four to eight monuments, depending on the distance between them, after preserving the location of the transit points by the string intersection method. Then the forms, with bolts tightened, were placed in position and filled with concrete. The markers were placed at once and the top of the monument pointed up with a trowel. The markers were carefully centered when placed, although final

the "Average Engineer"

centering was done after the forms were pulled and part of the backfill made. Forms were removed within 24 hr., the position of the center point checked (and adjusted when necessary), and backfill was tamped in.

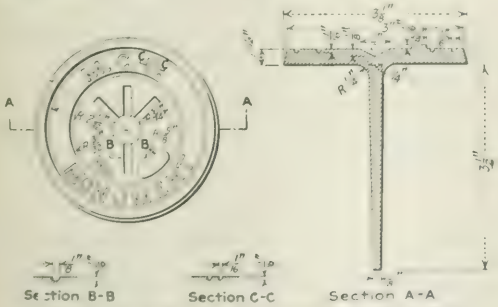
The markers were of special design, cast of brass and weigh about 12 oz. each. The crow foot was devised as a symbol and the center of the depression in the middle marked the transit point. The prong was bent, before placing the marker, to hold it in place, the beveled edge



PROPERTY MONUMENTS FOR MIAMI DISTRICT

also serving this purpose, embedded in the concrete with top face flush.

Marking was recorded only by number in the blank space provided opposite the letters "No." An index was made of all monuments and the necessary references and descriptions recorded while in the field. Usually the monuments projected about 1 in. about the surface of the ground when completed, but when placed in highways or other exposed points they were lowered so that the top was from 6 to 9 in. below the surface.



SPECIAL MARKER FOR PROPERTY MONUMENTS

A truck with two bins for sand and gravel, a water cask with pipe and hose connections was used.

The work was done for the Miami Conservancy District, Arthur E. Morgan, chief engineer, and Charles H. Paul, assistant chief engineer.

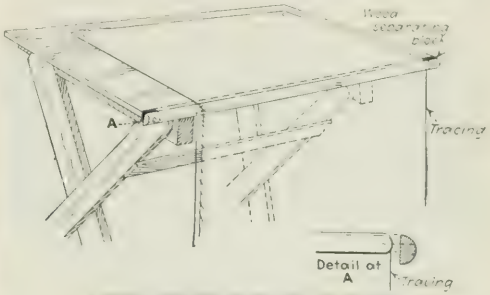
A Collection of Beam Design Diagrams

S. M. Cotten, of Phoenix, Ariz., has gotten out a series of blueprint charts for the design of beams of reinforced concrete or timber of both rectangular and T form. ($3.) The charts are quite readable and clear. They are devised on a new system of transformation ratios whereby the original diagrams for certain fixed quantities of design are readily transformed.

To Protect Tracings on Drafting Board

By H. G. Fay
West Somerville, Mass.

The accompanying sketch of a drawing board shows half-round strips to protect tracings from harmful creasing. I think this is an improvement over the drawing of C. Nye which you printed in *Engineering News-*



ROUND STRIPS PROTECT TRACINGS

Record of May 6, 1920, p. 929, inasmuch as the molding is separated from drawing board by wood blocks. Thus the tracing may be placed between the molding and drawing board—the edge of which is to be rounded so the tracing is doubly protected as no pressure can come on tracing while leaning over it. The cost of installing is practically the same.

Moments for Continuous Beams of Uniform Live Load

By H. M. Gibb
Rawalpindi, India

VALUES of positive and negative moments for continuous reinforced concrete floor and roof slabs and beams under moving uniform live loads are standardized by the Joint Committee on Concrete and Reinforced Concrete as follows:

$$M_1 = +\frac{wl^2}{10}$$

$$M_2 = \frac{wl^2}{12} \quad \text{or} \quad \frac{wl^2}{8} \text{ for two spans)}$$

$$M_3 = +\frac{wl^2}{12}$$

These values have been derived primarily with a view to the design of slabs for bridge and building floors and flat roofs. When almost any other kind of continuous slab or beam is considered, however, such severe conditions from moving live load do not generally exist as the live load is not movable along the spans and for such structures some reduction of the above moment values should be permissible.

All structures subject to earth or fluid pressure come under this category which includes foundation slabs and beams, face and base slabs of counterfort retaining walls, sloping roof slabs, and the floors and walls of water tanks and silos.

In the recommended values of the moment coefficients in Tables I and II, the center moments have been considerably increased over what is actually required to compensate for any probable departure from the ideal.

Table I gives the moment coefficients of wl^2 for equal spans and uniform load (see American Civil Engineers' Handbook, 1920, p. 357).

As the intermediate supports are of appreciable width, the moments at supports may be safely replaced by the moments at the edges of the support. Assuming that the average width of supports is $l/10$, an inspection of the moment diagram shows that moments M_2 can be multiplied by 4/5 and moments M_4 by 3/4.

The last two columns give the moment coefficients of wl^2 in decimals and fractions which would appear to meet best the requirements of theory and the uniformity desirable in design.

For three or more spans the moments for design in the end spans are greater than the moments for the intermediate spans and supports by 33 per cent. This lack of uniformity in the moment coefficient can be overcome by making the end span shorter that the intermediate ones.

An investigation, by the theorem of three moments, of the effect of shortening the end span shows that for three or more spans the best balanced condition results when the end span is $\frac{8}{10}$ of the intermediate span.

Table II gives the moment coefficients of wl^2 for this case, l being the length of the intermediate span.

An inspection of the moment diagrams shows that for a support of width $l/10$ the moment at the edge of the support is $\frac{3}{4}$ of the support moment.

The last two columns give the moment coefficients of wl^2 in decimals and fractions.

In both tables, the recommended values of M_3 and M_5 are at least 50 per cent in excess of the required values. The considerations which have influenced the recommended values are that the center moments for design should be in excess to compensate for slight settlement of supports or the deflection of the supporting beams and also in Table II, that the sum of the plus and minus moments is not less than $wl^2/8$.

The above results may be specified as follows:

Where the live load on continuous reinforced concrete beams or slabs is uniformly distributed and is not capable of motion to cause uneven distribution (as in foundations, retaining walls and all slabs retaining fluids) and the spans are all equal,

$$M_1 = +\frac{wl^2}{12}$$

$$M_2 = -\frac{wl^2}{12}, \text{ or for two spans} = -\frac{wl^2}{10},$$

and points of contraflexure are $l/4$ from center of support M_2.

$$M_3\ M_4\ M_5 \text{ etc.} = -\frac{wl^2}{16},$$

MOMENT COEFFICIENTS FOR BEAMS UNDER STATIONARY LIVE LOAD

TABLE I

All spans equal		l = span															w = load foot run
		2 Spans		3 Spans			4 Spans				5 Spans				
		$+M_1$	$-M_2$	$+M_1$	$-M_2$	$+M_3$	$+M_1$	$-M_2$	$+M_3$	$-M_4$	$+M_1$	$-M_2$	$+M_3$	$-M_4$	$+M_5$
Theoretical coefficients of wl^2		0 07	0 125	0 08	0 10	0 025	0 077	0 107	0 036	0 071	0 078	0 105	0 033	0 079	0.046
			×4/5		×4 5			×4 5		×3 4		×4 5		×3 4	
Moments at edge of support		....	0.10	....	0 080	....	....	0 085	....	0 053	....	0 084	....	0 059	....
Recommended for use	Decimals	0 083	0 10	0 083	0 083	0 062	0 083	0 083	0 062	0 062	0 083	0 083	0 062	0 062	0 062
	Fractions	1 12	1 10	1 12	1 12	1 16	1 12	1 12	1 16	1 16	1 12	1 12	1 16	1 16	1/16

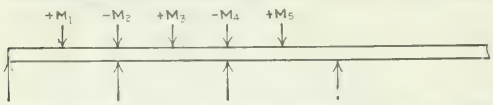


TABLE II

End spans = 0.8 l		Intermediate spans = l													w = load foot run
		3 Spans			4 Spans				5 Spans				
		$+M_1$	$-M_2$	$+M_3$	$+M_1$	$-M_2$	$+M_3$	M_4	$+M_1$	M_2	$+M_3$	$-M_4$	$+M_5$
Theoretical coefficients of wl^2		0 045	0 082	0 043	0 045	0 082	0.043	0.034	0 044	0 082	0.042	0.084	0 042
			×3 4			×3/4		×3/4		×3/4		×3/4	
Moments at edge of support		....	0 0615	....	....	0 0615	....	..	....	0 0615	..	0.063	. .
Recommended for use	Decimals	0.062	0.062	0.062	0 062	0.062	0.062	0.062	0 062	0 062	0.062	0.062	0 062
	Fractions	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$

and points of contraflexure are $l/5$ from center of support M_2.

Where the end span is made $\frac{8}{10}$ of the intermediate spans the moments for three or more spans are

$$M_1\ M_2\ M_3\ M_4\ M_5, \text{ etc.}, = -\frac{wl^2}{16},$$

and points of contraflexure are $l/5$ from center of supports and l is the length of the intermediate span.

In the above

M_1 = Moment in first or end span near the center.
M_2 = Moment at second support of end of first span.
M_3 = Moment in center of second span.
M_4 = Moment at third support.
M_5 = Moment in center of third span.

Consulting Engineers Education of Employees

IN Chicago a firm of consulting engineers, to educate and broaden the horizon of its staff, periodically gives a dinner for the staff to which a few representative men of the profession are invited. No speeches are made, the idea being simply to get together socially. The scheme had a three-cornered recompense. The firm builds interest and loyalty in its staff, the guests learn something of the individuality of the firm and the staff broadens its acquaintance. After the dinner an excursion is often arranged to view work of the firm or of some other engineer going on in the city or its vicinity. Another firm of consultants in Kansas City has recently come to the conclusion that there are too many commercial products being used by them of which all but a few members of their staff know too little. To educate their members they make it a point once a week to ask in some manufacturer's representative to speak for an hour on those products of his company which are of interest to the staff.

New Concrete Arch Survives Washout of Centers

Flood Carries Away Falsework Twelve Hours After Arch Rib Was Completed With No Disastrous Result

By C. Leland Wood
Civil Engineer, Herkimer, N. Y.

During the construction last winter of a new reinforced-concrete arch bridge over West Canada Creek near Herkimer, N. Y., a sudden rise in the creek to flood stage carried away the arch centers and left an arch entirely self supporting, within a period of less than twelve hours from the time that the concrete was completed. Although the carrying away of the centers by flood must have racked them some time before they went out, the arch was left uninjured. The crown deflection of about ¾ in., which occurred was but little more than the arch should have taken if the centers were struck with eight-day concrete. A careful examination of the arch ring concrete showed no evidence of cracks or other injury. This premature striking of the arch centers, under such unusual conditions affords some idea of the large factor of excess strength which is inherent in a concrete arch of proper design.

This new bridge is to replace the present old covered wooden bridge of three spans, which has served traffic on this highway for about 95 years, and is located a few feet down stream. It consists of three arches over the stream and three girder spans over the railroad. Each arch has a span of 86 ft., a rise of 20.5 ft., and consists of two 5-ft. ribs spaced 8 ft. apart, having a thickness of 1.8 ft. at the crown and 5 ft. at the springing line. The reinforcement in the arch ribs consists of twenty ⅞-in. longitudinal bars, 10 placed near the intrados and 10 near the extrados. Transverse rods, spaced about 8 ft. on centers, tie together the main reinforcing bars, and hooked rods placed radially connect the tie rods.

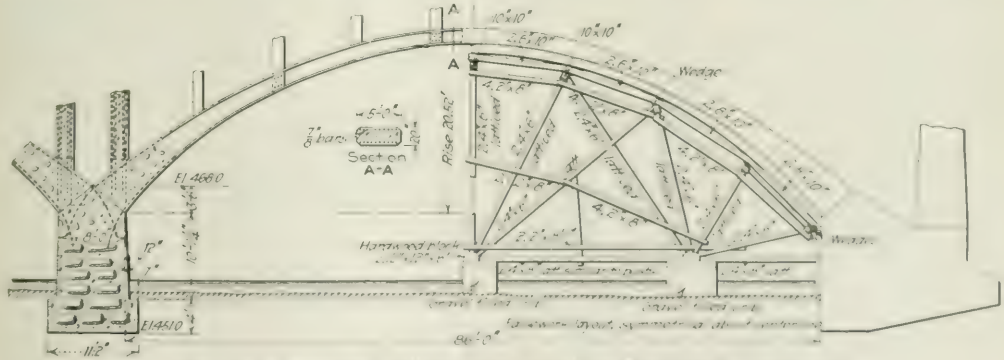
The concrete in the arches is of a 1:2:4 mixture, the aggregates being bank sand and crushed limestone rock. The concrete in the piers and abutments is of a 1:3:6 mixture, using screened gravel and creek sand.

The centering of the northerly arch was of a fan-shaped design and the foundation for this falsework consisted of gravel filled boxes set in the bed of the stream. These boxes were bottomless and about 4 ft. deep. They were placed on the stream bed, in water not over 18 in. deep, and were then filled with gravel and rock to support timber sills. The arch centering and gravel boxes are shown in the accompanying drawing.

The temperature of the atmosphere previous to and during the time the concrete of the first arch was poured was about 34 deg. F. Because of the mild weather, the aggregates used in the concrete for this arch were not heated, except for what heat was imparted by the hot water used in mixing, so the mixture went to the forms at a temperature of not more than 55 deg. F.

THE ARCH AFTER CENTERS WERE WASHED AWAY

The upstream rib of the first arch was poured Saturday, Nov. 20, 1920, and the downstream rib, with the connecting struts, was poured Monday, Nov. 22, the work being completed at 6 p.m. each day. Due to a rain on the night following the pouring of the last rib, the water in the stream rose approximately 5 ft., and this flood, along with driftwood, washed out or undermined the gravel boxes and carried out some of the centering at 6 o'clock the next morning. Thus within twelve hours after the last concrete was placed, the centering was entirely struck, so it could be readily seen that there was no point of contact between the arch form and the falsework. This same condition existed in both ribs of this arch. Upon a more detailed investigation no cracks were observed in the struts connecting the ribs or in any other point of the arch.



DETAILS OF CONCRETE BRIDGE FROM WHICH CENTERS WERE WASHED OUT

This bridge is being built partly to eliminate a grade crossing, for the towns of Herkimer and Fairfield and the New York Central R.R., E. J. Doyle of Albany, N. Y., is consulting engineer, the writer is resident engineer for the towns, William McClellan is resident engineer for the railroad, and the Peckham Construction Co., of Buffalo, is the contractor.

Economics of Highway Improvements

Analysis Based on Conditions in Summit County, Ohio, to Determine Limits to Cost Between Which Is Economy and Outside Which Is Waste

By H. G. McGee
Bureau of Municipal Research, Akron, Ohio

Analyses of road systems based on the conception of a road as a business investment are rare. The following economic study of the highways of an Ohio county, which is condensed from a report made by the Bureau of Municipal Research of Akron, Ohio, has, therefore, special interest. It is based on the sound theory that transportation returns are a measure of the value of highway improvement. Ordinarily it is assumed that lack of traffic data makes such studies inconclusive. This article indicates that search will disclose sufficient information to permit tentative conclusions. At least the roads which may be profitable can be separated from those certainly not profitable. Finally the article indicates clearly that temporary surfacing, at the cost of higher maintenance charges, is wiser practice than the invariable construction of paved roads, even on main lines of travel.—Editor.

IMPROVED highways are assets when and where there is traffic, and as they lower the time and money cost of operating conveyances over them. Road improvements involve expense in proportion to their maintenance and fixed charges. Effective and efficient highway management may be expected to strike a balance between improvement expense and operating savings, with reasonable provisions for emergencies and growth. What seem to be the savings which determine proper expenditures for roads?

An analysis of traffic in Summit County, Ohio, in which Akron is the principal city, is the basis of the following attempt to answer this question for this region. Ten years' growth in automobile registrations and in road improvements in this county are shown by Table I.

TABLE I. TEN YEARS' GROWTH IN AUTOMOBILE REGISTRATIONS AND IN ROAD IMPROVEMENTS IN SUMMIT COUNTY, OHIO

Item	1910	1920	Per Cent Increase
Automobiles registered in Ohio	32,941	615,000	1,764
Automobiles registered in Summit County	1,198	34,000	2,740
Miles of road improved by Summit County to date	3 32	130 53	3,830
Outlay for road improvements in county to date	$24,424	3,201,143	1,310
Outlay to date per mile of road improved	7,350	24,500	236
Outlay per registration	20 45	$102 40	401

The method of this study is to take traffic apart, examine the limitations and possibilities of each part, and then add these possibilities together again for each road under consideration. For this purpose, traffic is separated into (1) local or suburban (2) rural and (3) inter-city or through.

The apparent neglect of pleasure traffic may invite question. This neglect is more apparent than real, since pleasure traffic is included in the through traffic counts; further, if roads are properly improved for rural and inter-city traffic, it is quite possible that they may also be adequate for pleasure traffic; and lastly, it may be a question of just how much of community income, in taxes, it is just to expend for the lessening of pleasure riding costs alone.

Local or Suburban Traffic

Local or suburban traffic is that which arises from the extension of built-up city areas across corporation lines. Being identical with interior traffic it ought to be provided for physically and financially as is interior traffic, viz., by the construction of streets almost wholly paid for by special assessment on the benefited property.

A slight variation of this case appears where road improvements are requested in anticipation of local traffic, that is, to make allotments salable. Assuming that the county is justified in taking the chance of investing its capital in anticipation of allotment development, it may be fair to limit such expenditures to the maximum possible return such allotment areas might make to the county road fund during the life of the improvement. Under existing conditions, such a policy would allow the construction at most of one mile of paved road to each 1½ square miles of new allotments, as is indicated by Table II. Since the maximum profitable mileage will hardly cover intersections plus 2 per cent in a well-developed street system, the following Ohio city rule seems also justified for the county.

TABLE II. EXPENDITURE FOR ROADS JUSTIFIED BY LOCAL OR SUBURBAN TARFFIC

Item	Amount
Area of Summit County in acres	253,165
Assessed valuation, exclusive of city of Akron, Sept., 1920	$140,774,790
Assessed valuation per acre for county	$550
Area of the city of Akron in acres	16,079
Assessed valuation of the city of Akron, September, 1920	$375,006,140
Assessed valuation per acre for city	23,300
Difference between average county and average city acre	22,750
County tax levy for roads, for 1921, cents per $1,000	31
Annual expenditure per acre for roads justified by $22,750 increase in valuation	$7 05
Amount of ten-year 5% equal annual payment bonds which $7.05 per year will carry	$54 50
Average bids on reinforced-concrete roads, October, 1920, per mile	$47,642 31
Number of acres required to be increased $22,750 each to pay for building one mile of road at $47,642.31	874

The public's share in the improvement of roads in residential sections or for allotment development shall be limited to 2 per cent plus the cost of intersections.

Rural Traffic

Rural traffic starts or ends away from towns or cities; it is farm to market traffic primarily. Tax values along Copley road, serving an almost solely agricultural district, and farm hauling in Hudson township, Tables III and IV, are taken as bases. Table III indicates that a good road adds from $18 to $33 an acre to taxable property values.

TABLE III. INCREASE IN LAND VALUES BY ROAD IMPROVEMENTS AS EVIDENCED BY ASSESSED VALUATIONS

Item	Amount 1915	Amount 1920
Acres of lands in Copley township	16,664	14,200
Assessed value of 14,200 acres	$901,680	$2,199,460
Assessed value per acre	$54.11	$154 80
Percent increase in value per acre, 1915–1920	.....	186
Copley Road No. 2		
Acres in eleven tracts on Copley Road No. 2		269 78
Assessed value per acre of 269.78 acres in 1915 (before improvements)		$72 60
Difference in value per acre between eleven tracts and average of township in 1915		$18 49
Assessed value per acre of 269.78 acres in 1920 (after improvements)		$207 00
Difference in value per acre between 11 tracts and average of township in 1920		$52 20
PORTION OF INCREASE WHICH MAY BE DUE TO ROAD IMPROVEMENT		$33 71
Average assessment per acre on 269.78 acres for road		$4.63
Copley Road No. 3		
Acres in ten tracts on Copley Road No. 3		313 33
Assessed value per acre of 313.33 acres in 1915 (before improvement)		$64 10
Difference in value per acre between ten tracts and township in 1915		$9 99
Difference between value per acre between 10 tracts and township, 1920		$28 20
Assessed value per acre of 313.33 acres in 1920 (after improvement)		$183.00
PORTION OF INCREASE WHICH MAY BE DUE TO ROAD IMPROVEMENT		$18 21
Average assessment per acre on 313.33 acres for road		$4 84

TABLE IV. COST OF FARM HAULING IN HUDSON TOWNSHIP, BASED ON CROP REPORTS OF 1917 AND INFORMATION FURNISHED BY COUNTY AGRICULTURAL AGENT ON OCTOBER 23, 1920.

Produce hauled 6,633 acres seeded produced 1 348 tons per acre of which 68 2% were moved from producing farm	6,078.1 tons
Backhaul: Fertilizer, lime, and feed hauled from town to farms	1,396 tons
Total produce and supplies hauled during year	7,474.1 tons
Average distance from farms by road to center of village of Hudson, shipping point and mill, in miles	2 38
Total farm haul for township during the year, 7,474.1 tons moved 2.38 miles, in ton-miles	17,800
Average price of team and man per 10-hr. day, capacity of 1-ton on earth roads	$7.00
Cost per ton-mile by $7.00 a day team, going 2 miles an hour loaded and returning at 3 miles an hour empty	$0.58
Total cost of hauling 17,800 ton-miles at $0 58 each	$10,320
Total acreage of township, including woodlots, swamp, waste, and other uncultivated areas	10,042
Total haul per gross acre yearly, in ton-miles	1.77
Annual cost of producing 1.77 ton-miles per acre at $0.58 each, subject to reduction by road improvement	$1.027
Maximum outlay in 5% ten-year annuity serial bonds per acre which saving of entire $1.027 a year would justify	7.94
Maximum outlay at 5% on which $1.027 a year would pay interest only (assuming no depreciation and no consequent need for amortization of investment)	$20.60

Table IV summarizes the extent of farm hauling in 1917 in Hudson township. It was about an average crop year. The length of haul is perhaps short of the average, resulting in a small ton-mileage per acre. For an improvement whose probable life is ten years and which would wipe out hauling cost entirely, an outlay of about $8 an acre is apparently justified. Since, however, improved roads allow the farmer to haul at the slack season and possibly, to sell at most favorable price seasons, and bring recreational centers, schools and churches within reach the year round, they may net him more than the entire hauling cost. These other benefits may apparently increase the total benefit to between $20 and $30 an acre. There are about 1.88 miles of road to each 640 acres in Summit County.

Ordinarily a road improvement does not increase other county governmental costs, and the increase in land values after improvement automatically increases the county tax revenues for other than road purposes. It may be fair, therefore, for the county or township, to assume so much of the cost of the improvement as will be returned to it in increased taxes. In Summit county, the total county levy has for several years been about three mills. At $25 an acre increased valuation, three mills will produce $25.50 per 340 acres. At 5 per cent, $510 will purchase an income of $25.50 a year. Fairness, therefore, would seem to justify a general county contribution of about $500 per mile of road improvement for rural traffic.

At $25 an acre benefit, and 340 acres per mile of road in the county a total of $8,500 a mile apparently reaches about the maximum economic investment in road improvements for the benefit of agricultural lands; of this amount, about a third may be expected to be balanced by lowered hauling costs, and $500 may be justly carried by the general county tax levy.

Inter-City or Through Traffic

For each vehicle traveling a certain road, any improvement worth paying for will save something of the time and money cost of operating over it. Obviously, this saving per vehicle cannot exceed the total cost of operating over the road without improvement. Practically, it may be limited also by the cost of some alternative means of transportation, as railway. This saving per vehicle or any other unit, multiplied by the annual number of such units passing over the improvement, will produce a gross annual saving. But, within rather wide limits, the total cost of the improvement for interest, depreciation, and maintenance, may vary only slightly with the number of vehicles or other units passing over it. The net value of the improvement then, will depend upon there being enough traffic to pile up a sufficient number of unit savings to exceed the cost of the improvement.

Through traffic probabilities in Summit county are estimated on the basis that the following principles hold: (1) Highway traffic will be proportional to the product of the populations connected; (2) it will vary inversely with the distance between centers; and, (3) beyond a somewhat indefinite distance between centers, say fifty miles, highway haul does not seem to have proved sufficiently economical yet to justify public expenditures for its sole use.

It has been generally observed that increased traffic follows road improvements. If improvement costs are to be less than operating savings, it seems vital to be able to estimate what traffic will be after a contemplated improvement is completed. For this reason, only counts on improved roads have been used in the following estimates.

If the principles indicated above hold and if available counts are truly representative of the total annual traffic, then there ought to be some constant relation between traffic counts and the populations of and the distances between the cities connected by the roads where the counts are made. Four traffic counts, taken at three points in or near Summit County were studied in detail to discover evidence of this constant. This study is summarized in Table V.

TABLE V. SUMMARY OF RELATIONS INDICATED BETWEEN TRAFFIC FACTORS AND ACTUAL COUNTS

	Freight Service								Passenger Cars				
	Road Traffic Factor	No. of Trucks Weekly	No. of Trucks in 30 Weeks	Average Load per Truck, Including Empties	Tons Moved Annually	Tons per Unit of Traffic Factor	Difference Between Col. 7 and Average of Col. 7	Col. 8 Squared	No. of Cars Weekly	No. of Cars in 30 Weeks	No. Cars per Unit of Traffic Factor	Difference Between Col. 12 and Aver	Col. 13 Squared
Cleveland-Akron, May 18–25, 1918	3,333	1,438	43,140	2 33	100,400	30 1	15.	225	6,586	197,500	58 3	11.7	137
Cleveland-Akron, May 6–7 1920	4,620	2,740	82,200	2 50	205,500	44 4	0 7	0 49	9,450	283,700	61.4	8.6	74
Akron-Kent, May 6–7 1920	3,060	2,270	68,000	2 50	170,000	55.6	10 5	110 25	9,975	299,500	97 8	27.8	772
Pittsburgh-Youngstown, June 16–17, '20	3,090	3,030	90,900	1 77	161,000	52 0	6.9	47.6	6,940	208,000	67.4	2.6	6 75
Totals and averages	14,103	9,478	284,240	2 24	636,900	45.1	8 27	95 83	32,951	988,700	70.0	12 7	247 19
Standard variation	..							9 8	.	.....			15 7
Probable error						15 1%	6 9	6.6	.	.....	15.2%	10 7	10 6

Intercity traffic may be expected to flow from each city on one side of a counting point to each city on the other. For each of these traffic points, then, cities within about 50 miles of each other were listed. Tabulations were made of their populations in thousands at the time of count and the distances between their centers in miles, measured on a large scale map. For each pair of cities, these population figures were multiplied together and their product divided by the distance between them in miles. The sum of all these quotients, for a given road at a given point was called, for want of a better name, the "traffic factor" of the road at that point.

TABLE VI. TWO-TON TRUCK TEST—REPORTED IN SERVICE BULLETIN, IOWA STATE HIGHWAY COMMISSION

Type of Surface	Pound Pull per Ton	Miles per Hour	Miles per Gallon
Earth	92 218	4 6	7.
Gravel	78 2 81 8	9 1	7 19
Macadam	64 3	12 6	9 48
Paved	27 6	16 4	11 44 11 78

Fig. 3 (hourly and daily variations in road traffic counts) indicates variations which may be expected for truck, passenger car, and horse-drawn traffic from hour to hour and for different days of the week. On the basis of these curves the four counts were expanded to estimates for one

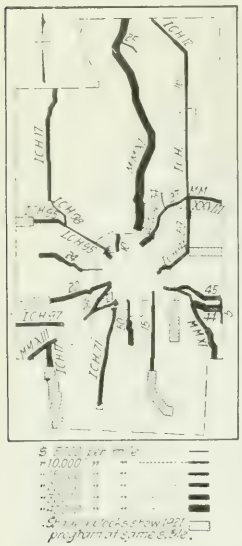


FIG. 1. RELATIVE COSTS OF IMPROVEMENTS IN DOLLARS PER MILE

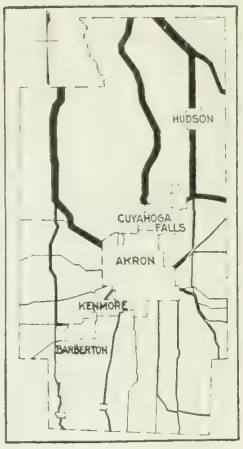


FIG. 2. RELATIVE THROUGH TRAFFIC DEMANDS BASED ON POPULATIONS AND DISTANCES

Amount of traffic is indicated by relative strength of lines representing roads.

week's traffic. Tonnage for trucks was based on the observed size of each truck and the number of trucks which were loaded. Horse-drawn traffic was eliminated as probably rural and not intercity; and the inclusion of farm motor traffic may result in a somewhat high estimate. No counts for a whole year were available; it was assumed that for Summit County climatic conditions thirty times the weekly estimate would represent fairly the annual traffic. These weekly and annual estimates are given separately for trucks and passenger cars in Table V.

Dividing the estimated 30-weeks' tonnage by the traffic factor gave results varying from 30.1 in 1918, after about a year of freight-car shortage and embargoes, to 55.6 tons per unit of traffic factor in 1920, after three years of such obstacles to rail shipments. Passenger-car traffic ranged from 58.3 to 97.8 cars per unit of traffic factor on different roads and during different years.

As a measure of the precision of these relations, the table contains a comparison of the results with the normal law of error. Columns 9 and 14 show the square of the individual variations from the average of all the observations; and the last line indicates the probable error based both on the average variation and on the standard variation. It would hardly be expected that one-day counts during different business conditions and at different times of year expanded to a year's time would correlate closely; but we do find that the variations follow the normal law of error fairly well. It is possible that the average relation is no more than 15 per cent in error.

On the basis of the counts shown, then, the average annual Summit County intercity traffic on paved roads in passenger cars will be 70 times the traffic factor; the freight traffic, in tons, 45 times the factor; in trucks, 20 times; and that these figures are probably within 15 per cent of the true values.

TABLE VII. RELATIVE HAULING COSTS FOR EQUAL TONNAGE IN DIFFERENT TYPES OF ROADS

Item	Earth	Gravel	Macadam	Pavement
Operating cost per mile, proportional to gas used	100	80 3	60 9	50 5
Per diem charges per mile while traveling proportional to speed	100	48 4	36 5	28 0
Per diem charge per mile while traveling 90% of time on earth road	100	53 6	42 8	35 2
Per diem charges per mile while traveling 80% of time on earth road	100	58 76	49 2	42 4
Per diem charges per mile while traveling 70% of time on earth road	100	63 9	55 6	49 6
Per diem charges per mile while traveling 60% of time on earth road	100	69 0	61 9	56 8
Per diem charges per mile while traveling 50% of time on earth road	100	74 2	68 2	64 0
Per diem charges per mile while traveling 40% of time on earth road	100	79 4	74 6	71 2
Per diem charges per mile while traveling 30% of time on earth road	100	84 5	80 9	78 4
Per diem charges per mile while traveling 20% of time on earth road	100	89 7	87 3	85 6
Per diem charges per mile while traveling 10% of time on earth road	100	94 8	93 6	92 8
Per diem charges per mile while traveling 0% of time on earth road	100	100	100	100

TABLE VIII. ESTIMATED LIMITS OF ECONOMIC EXPENDITURE FOR SMOOTH ROAD SURFACES BASED ON RELATIVE COSTS OF OPERATION SHOWN IN TABLE VII

Item	Earth	Gravel	Macadam	Pavement
Freight Service:				
Running expense in cents per ton-mile assumed at 60% of total operating cost on pavement and to vary with gas used	5 94	4 76	3 62	3 00
Per diem expense in cents per ton-mile at 40% of operating cost on pavement and varying inversely as speed	7 13	3 45	2 61	2 00
Total cost in cents per ton-mile to operate truck over different road surfaces, sum of lines 1 and 2	13 07	8 21	6 23	5 00
Gross saving in operating expense in cents per ton-mile by different road surface improvements		4 86	6 84	8 07
Outlay in 5% 10-year annuity serial bonds which would use up entire gross saving per ton-mile annually, in cents	....	37.6	52.8	62.4
Passenger Service:				
Total cost in cents per car-mile at 8c. on pavement and increasing in proportion to gas used per mile	15 85	12.73	9.68	8.00
Gross saving in cents per car-mile by different road surface improvements		3 12	6 17	7.85
Outlay in 5% 10-year annuity serial bonds which would use up entire gross saving per car-mile per year in cents		24 10	47 65	60 65

With the traffic thus determined, there remain operating savings to be estimated and compared with construction costs. Distance, grades, rise and fall, curvature, grade crossings, hardness and smoothness, all affect tractive resistance, safe operating speeds, or both. All, except hardness and smoothness seem of minor importance in determining whether an improvement is or is not justified. For example, the reduction of one mile in distance justifies a maximum operating expenditure of 85c. to $2.20, depending upon whether the debt for this improvement is or is not to be amortized, for outlay per vehicle yearly, at a saving of 11c. per vehicle mile given by W. G. Harger, in *Engineering News-Record*, July 22, 1920, page 171.

The smaller figure assumes a ten-year amortization of capital outlay; the larger assumes the earning of interest on a permanent debt. In the same article, Mr. Harger presents figures indicating practically no operating savings in eliminating grades of 2 per cent or under. In ordinary highway improvement, material reduction in distance, or of long grades, except at great expenditure, is not often possible.

TABLE IX. SAVINGS TO INTER-CITY TRAFFIC FROM PAVED ROADS

Item	Gravel	Macadam	Pavement
Freight service: 45 times line 4 of Table VIII	$2 19	$3 08	$3 64
Passenger service: 70 times line 7 of Table VIII	2.19	4.32	5.50
Total annual saving per mile of improvement for each traffic factor unit	$4 38	$7 40	$9 14
Freight service: 45 times line 5 of Table VIII	16 90	23.74	28 06
Passenger Service: 70 times line 8 of Table VIII	16 90	33 36	42 50
Total outlay per mile of improvement justified for each unit of traffic factor	$33 80	$57 10	$70 56

Vehicle operating economies due to improved road surfaces may be judged by combining two kinds of data, namely, observed operating results for different surfaces and the actual costs of operating over any one type.

Table VI shows tractive resistance, speed and gasoline consumption on a 2-ton truck test over four types of surface. This table gives a clue to two sorts of economies effected by improved surface. The per mile power demand varies; it seems reasonable that with this power demand variation, certain running expenses per mile will vary, such as gas-

oline consumption, oil, tires and depreciation. It has been assumed that these cost items will vary with the gasoline consumption, as indicated in the first line of Table VII.

But there is another type of cost, including driver, garaging, obsolescence, interest and insurance, which goes on whether the machine is running or not; this is designated as the per diem charge. While the machine is running such

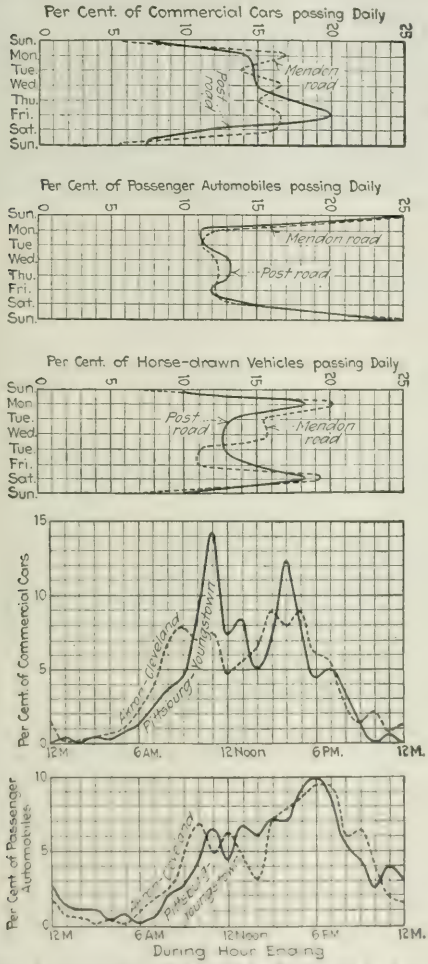


FIG. 3. HOURLY AND DAILY VARIATIONS IN ROAD TRAFFIC COUNTS

charges per mile will vary inversely as the speed. This latter saving cannot be entirely saved, however, unless standing time for loading and waiting for work is reduced in the same proportion. Table VII indicates the relative per diem charges per mile as speed rises on improved surfaces and as running time occupies more or less of the total working hours. While it may be too optimistic to hope that the full saving from increased speed will be obtained, line two of Table VII, which makes this assumption, is used for further computations.

The most efficient truck costs which the writer has found have varied between 4.2 and 6c. per ton-mile for pavement operation during a year's test. Five cents has been used as a base. Of this 5c., 3c. has been assumed as the total of the expenses which depend on power demand per mile; 2c. the total of the per diem items per mile, varying inversely as the speed. The gross savings from 5 to 8c. per ton-mile for gravel, macadam and pavement surfaces are shown in the fourth paragraph of Table VIII. The next line shows the maximum outlay in ten-year 5 per cent bonds one such saving each year will justify, varying from 38c. for gravel to 62c. for pavement. For passenger cars an average cost of 8c. a mile on pavement has been assumed; and, since passenger cars can ordinarily make reasonable speeds over most types of road surface, the power saving, proportional to line one of Table VII, has alone been applied. Gross savings from 3 to 8c. per car-mile are shown in paragraph 7, Table VIII. One of these savings a year will pay interest and principal on 24c. to 61c. in ten-year 5 per cent annuity bonds.

For convenience in computation Table IX applies the relation between the traffic factor and the savings and justified outlays of Table VIII, to determine savings and outlays as follows:

Improvements for inter-city traffic should be limited to from $34 to $70 a mile multiplied by the product of the populations in thousands of the centers connected and divided by the distance between them in miles; as inter-city traffic is a community benefit, none of the cost of providing for it should be specially assessed on abutting or adjacent property.

Maintenance

Obviously, the above figures are based on the false assumption that there will be no maintenance expense. Such expense will lower the allowable capital outlay. But maintenance costs do not yet seem sufficiently definite in terms of traffic and type of roadway to justify any attempt to reach the real economic solution, namely, the maximum excess of savings over costs, including operation, maintenance and capital charges, for any given traffic conditions.

What has been attempted is a separation of the sheep from the goats, the roads which may be profitable from those certainly not. For instance, the Cleveland-Hudson-Akron road apparently saves $41,500 a mile annually to through traffic alone; it originally cost less than $20,000 a mile which, with an appropriation of $8,000 a mile maintenance in 1920, makes its general physical failure of concern only as it interferes with traffic. There seems no fundamental objection to an enterprise which costs even $28,000 a year to taxpayers and returns $41,600 in general transportation savings. On the other hand, the recently let contract for a section of the Akron-Medina road at $57,000 a mile, with total capitalized savings to farmers and through traffic of less than $10,000 a mile, ought to cause worry.

Applying such an analysis to all the road improvements in Summit county, Ohio, it appears that one-half of the existing and proposed improvements, costing $2,106,000, effect savings which will pay interest and principal on $8,600,000 more than they cost; and that one-half, costing $2,063,000 will effect savings which will pay interest and principal on $1,157,000 less than they cost. While the county's results to date indicate a good profit from road improvement, it may be significant that the entire $1,114,650 program for 1921 construction shows a net loss of $708,900.

In other words, if these roads were built as toll roads, if farms along them contributed $25 an acre, if every passenger car paid eight cents a mile and every truck paid as much per ton-mile, if these tolls did not discourage any traffic, if there were no maintenance or administration expenses, if all these things were true, then the supposed toll company might be expected to fail for $708,000 when its ten-year five per cent bonds became due.

Conclusion

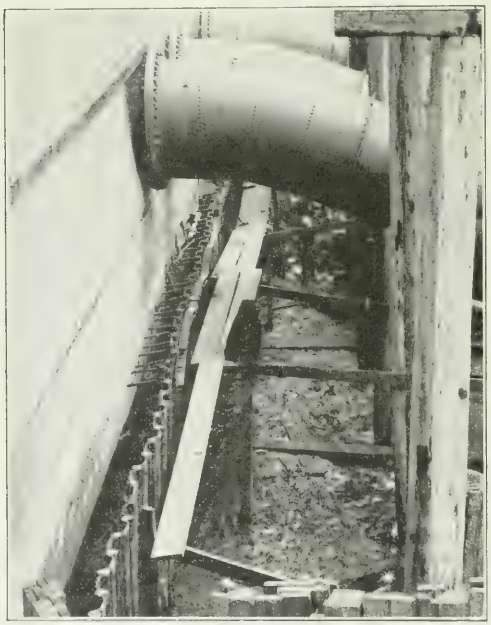
Apparently, there may be some very distinct limits to profitable road improvement expenditures. These limits may vary widely within a small section of the country. High authorities have recently declared that no one today has the necessary information to design a rational road improvement. Immense sums are being spent by states and even counties which have not yet learned to value adequate

engineering services and research as highly for public benefit as do contractors, material and equipment companies for private profit. Without reflection on the ability or efforts of highway authorities, these facts seem to indicate that highway design and construction methods today are not on that high plane which justify those expenditures for capital outlay for which fixed charges may approach the economic limit; and that, as a general policy, it may be better to build with a smaller outlay and to spend more for maintenance until such time as adequate records and better knowledge of traffic make certain the desirability of vast public investments.

Levee Settlement Causes Seepage Under Pump House

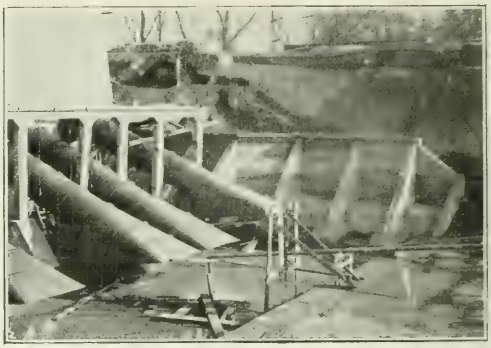
Cured by Driving Tight Row of Steel Sheetpiling Next to Pump House and Building Retaining Wall

A LARGE drainage pumping plant built in a levee on the Sacramento River in California was constructed with pump house, intake and discharge lines rigidly connected and each of these three structures supported on a separate pile foundation. As the levee consolidated with age the piles held the structures at the original level but the earth settled away from the under side of the



SHEET PILING ALONG REAR OF PUMP HOUSE
Note bolts, also depth of wash beneath bottom of concrete

concrete, and thus opened a channel in which river water came through the levee despite the concrete cutoff wall around the discharge lines. This seepage carried away earth under parts of the pump house to a depth of 2 ft. and caused caving in the earth embankments around the sump. Undermining of the foundations was considered a menace to the joints between pump house and the group of large concrete discharge lines because if one of these structures settled slightly the joint would be broken. A prompt and entire



SUMP SHOWING INTAKE PIPES AND PROTECTING WALL

stoppage of this seepage was therefore deemed necessary and was accomplished by driving a line of sheet piling which virtually brought the cutoff wall of the levee well toward the toe of the slope on the side away from the river. At the same time the bottom of the sump was paved with concrete and retaining walls were built around its sides to prevent further caving of the banks.

The pump house, which contains five 50-in. centrifugal pumps, direct connected to 600-hp. motors, is 42 x 106 ft. in plan and was designed to withstand a head of water 20 ft. above the floor of the plant. In order to give the structure sufficient weight so that it would not float when the water rose to this level walls and floors were made 6 to 7 ft. thick.

The pump house is supported on 24-ft. wood piles driven on 6-ft. centers, both ways, with a double row around the outside driven on 3-ft. centers. The foundation material is a combination of clay and sand with occasional layers of quicksand. The inner ends of the intake pipes which supply the pumps are bolted to the pump house wall, from which they extend about 40 ft. into the sump. About midway of their length these pipes are supported by iron rods slung from a cap across a row of concrete posts. Each pump discharges through a 60-in. reinforced-concrete pipe about 125 ft. long, these pipes being cast monolithic with the pump house structure. The discharge pipes are also supported on wood piles.

After the seepage was first noticed it increased gradually until, when repairs were being made, it required two 6-in. pumps delivering a total of about 5 sec.-ft. to remove water that came under the structure in this way. This seepage so loosened the banks around the sump that considerable caving resulted, one of the slides carrying away the end post in the row of posts supporting the intake pipes.

Partly because of the presence of quicksand, which made it a difficult foundation job at best, and partly because of the difficulty of getting an effective water cutoff around the concrete discharge pipes, it was considered best to stop the seepage by driving a line of sheet piling entirely across the landward side and both ends of the pump house and extending riverward to the levee axis. This made a total of 246 ft. for which interlocking steel piles were driven to a depth of about 30 ft. This plan had the advantage that it was unnecessary to make any water-tight joint around the discharge lines The piles could be driven along the rear or landward

side of the pump house by simply unbolting the intake pipes from their flange connections on the pump house wall and swinging them back a few inches to allow the followers with which the piles were driven to work in between.

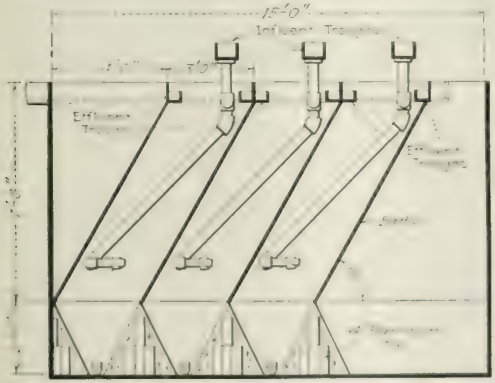
In order to attach the piling permanently to the pump house holes were drilled in the concrete, in which 48 x 1¼-in. bolts were placed and grouted with molten sulphur. The threaded ends of these bolts projected far enough to extend through holes in the sheet piles. After the piles had been bolted up in this manner the space between them and the pump house wall was filled with concrete to make a watertight seal.

Data for the foregoing was supplied by Fred H. Tibbetts, civil engineer of San Francisco, who had charge of the repair work.

Final Report on Waste Disposal of Chicago Stockyards

During Nine-Year Period of Study Activated Sludge Discovered—Early Decision Favoring Imhoff Tanks Revised

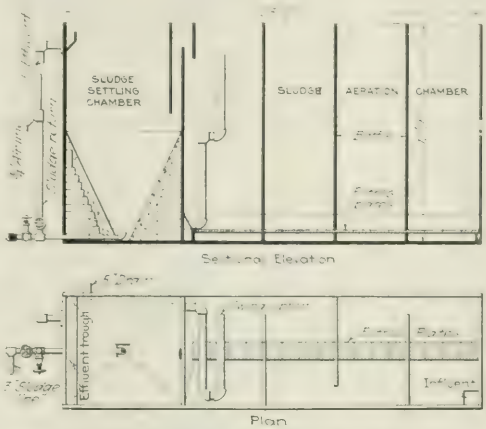
FOR nine years engineers and chemists of The Sanitary District of Chicago have been studying the sewage and sewerage conditions of the Chicago stockyards region. The wastes put an estimated load on the drainage canal equivalent to the sewage of 1,000,000 people. In 1914 a preliminary report stated that Imhoff tanks would solve the problem. Shortly thereafter the activated-sludge process was discovered and the present report indicates that this latter process, with the necessary preliminary and after treatment, will more nearly meet the requirements. The packers have offered to assume 60 per cent of the cost of a plant if the Sanitary District will pay the remainder.



INCLINED-BAFFLE VERTICAL-FLOW HOPPER BOTTOM SETTLING TANK

This offer is now under consideration. It is therefore possible that within a reasonable time Chicago will have one of the first activated-sludge plants yet constructed to handle industrial waste three to four times as strong as ordinary domestic sewage. In 1914, when the waste was strongest, the day sewage averaged as follows: Suspended solids, 281 to 506 p.p.m.; oxygen consumed, 150 to 269; fats, 80 to 191; bio-chemical oxygen consumed, 834 to 1477 p.p.m. In the night sewage the suspended solid content was 73 to 313 p.p.m.; fats, 12 to 134 parts.

The three methods of operation deemed available for the stockyards wastes are: (1) Sewage and sludge aërated together, (2) the sewage and sludge settled and re-aërated during its return to meet the incoming sewage, and (3) the sludge settled and re-aërated and the re-aërated sludge re-settled before its return to the incoming sewage. Only the first and



SLUDGE AERATION AND SETTLING TANK

third methods were experimented with. In summer under the first method a stability of over 50 could be secured with about 9 hr. aëration and 3½ cu.ft. of air per gallon of sewage. In colder weather lower stabilities, 10 to 38, were secured with 9 hr. aëration and 4 to 5 cu.ft. of air. Under the third method the aëration period was 5.3 hr. in the sewage tanks and 3.8 hr. in the re-aëration tank, the weighted average being equivalent to a 6.6-hr. period. Although showing a substantial saving in tank space, more settling space was required with re-aëration, the settling periods being 1.3 hr. with aëration and 1.7 hr. without re-aëration. The air consumption was 3.5 cu.ft. per gallon, about the same in both cases.

Although re-aëration effects a substantial saving in tank space, it increases the complexity of the process and necessitates more careful supervision, and it is on these accounts that the engineers are still doubtful whether re-aëration and re-settling are desirable in a working plant.

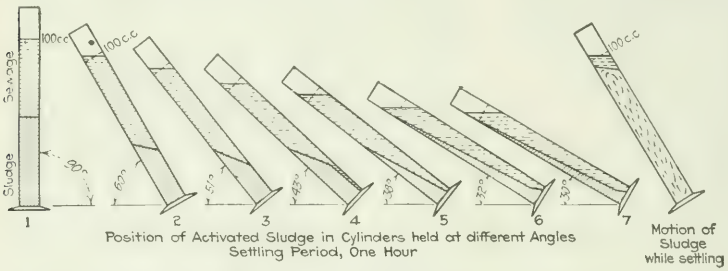
Another set of experiments on the first method was made under winter conditions without re-aëration of the sludge before return to the aëration tank. An average of 4.3 cu.ft. of air was used with an aëration period of 8 hr. The stabilities ranged from 41 to 71 per cent.

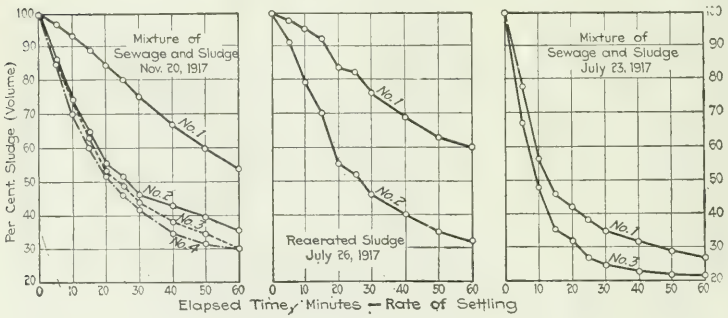
The quality of the effluent produced by the activated-sludge treatment was considered reasonable and the amount of air and tank space not excessive in view of the strength of the waste. Milwaukee results indicated that 4 to 5 hr. aëration with 1.5 cu.ft. of air is required for the sewage of that city which is about one-third the strength of packing-house waste.

Screening the sewage through a 20- or 30-mesh screen before aëration was considered desirable to remove much comparatively inert coarse material which resists oxidation and might settle on the bottom of the tank unless an excessive amount of air were used to

keep it in suspension. Inasmuch as this material contains only 80 per cent moisture it would not require filter pressing.

In addition to about 400 lb. of dry screenings about 2,300 lb. of dry sludge was removed in the experimental tanks from each million gallons of waste. It contained 99 per cent of water. As the total flow of packinghouse waste is 58 m. g. d., 162,400 gal. of wet sludge must be disposed of daily. By pressing through small filter presses for 3½ hr. under an ultimate pressure of 125 lb. the water content could be reduced to from 90 to 75 per cent. Adding 2 c.c. of sulphuric acid per gallon of sludge cut the time of pressing in half. No tests on drying the pressed sludge were made. Dry, the sludge contains 4 to 5 per cent of nitrogen and 5 to 7 per cent of fats. Conclusions on some of the factors in more detail are as follows:





SETTLING ACTIVATED SLUDGE IN INCLINED CYLINDERS

Sludge—Typical activated sludge from Packingtown is brown, settles quickly and leaves a distinct line of demarcation. The moisture content of the sludge in the aëration tanks after one-hour settling runs over 99 per cent.

TYPICAL ANALYSES OF PACKINGTOWN SLUDGES

Sludge	Sp.Gr.	Per Cent Moist.	Calculated to Dry Weight Per Cent Nitrogen	Volatile	Fixed	Ether Sol.
Activated	1.004	99.15	4.17	62.6	37.4	6.0
Imhoff	1.02	91.5	2.72	65	35	6.6
Dortmund, tank D	1.02	91.7	2.88	76	24	8.6
Dortmund, tank C	1.02	90.6	2.65	72	28	8.1
Acid treatment	1.02	92.5	3.07	74	26	18.8

Dewatering Experiment — In the dewatering experiment air-drying on sand beds was much more rapid with Imhoff than activated sludge. Lagooning was unsuccessful. The sludge settled to the bottom with the water on top. Concentration was effected only by evaporation; considerable odor developed.

Sludge was pressed successfully without the use of lime in a standard plate press. Tests were made with an 11-chambered plate press of the center-feed type, containing 12 corrugated plates, each with 225 sq.in. of filtering area. For the best results air pressure was built up as follows: At start, 15 lb. per sq.in.; at ½ hr., 60 lb.; at 1 hr., 100 lb.; at 2 hr., 140 lb. The time varied from 2 to 5 hr. but was materially shortened by providing a sludge that was well activated. The sludge experimented with ranged from 97.9 per cent moisture upward. The first 20 tests were made with a ⅞-in. cake. Radial ribs were then added, which improved the hardness of the cake. Thicker cakes were less firm. A ⅞-in. cake had a moisture content of 73.9 per cent and one of 1⅜ in. 78.2 per cent.

Sulphuric acid, or acid cake in sufficient amount to neutralize the alkalinity of the sludge, improved the yield of the cake from 11.7 to 38.5 per cent, prevented decomposition of the sludge, reduced clogging of the filter cloths and increased the nitrogen content of the sludge from 0.72 to 2.88 per cent.

Cotton duck cloths gave as satisfactory results as linen. For the 52 tests two complete sets of cotton duck cloths were used. The addition of ribs increased the relative drainage area as compared to cake area. The improvement was pronounced on a ⅞-in. cake, the yield being doubled.

Slopes in Tank Bottoms — In hopper bottom tanks slopes of 30 deg. with the horizontal were found insufficient. A 45-deg. slope was not entirely satisfactory, but 61 deg. was.

Filtros Plates—Tests showed that each filtros plate needs support on four sides in a sturdy box. A marked increase in air pressure equivalent to 3.2 ft. during the period April 23 to Nov. 14, 1917, was largely attributed to iron rust.

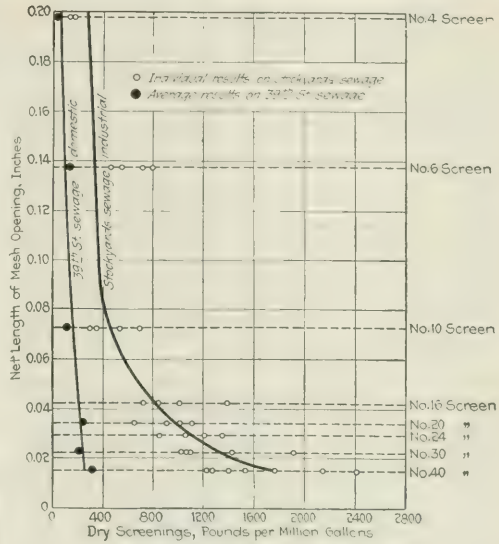
Screen Tests — A 30-mesh screen operated for 124 days recovered 858 lb. dry weight per million gallons from 6,000,000 gal. total passed. This was a reduction of 18.8 per cent of the total suspended matter. The 20-mesh screen operated 139 days, handled 5,000,000 gal. and recovered 368 lb. dry weight per million gallons, equivalent to 9.6 per cent of the total suspended matter. However, the crude sewage averaged 547 p.p.m. during the 30-mesh run against 460 p.p.m. during the 20-mesh run.

Acid Treatment—With a crude sewage made slightly acid with sulphuric acid somewhat better removal of suspended matter, 70 per cent, is obtained than by plain sedimentation. Scum formed slowly and was small compared to plain sedimentation in Dortmund tanks. The accumulation of sludge and scum for the Dortmund tank C was 5.8 cu.yd. per million gallons; for Dortmund tank D, 9.6 cu.yd.; for the Imhoff tank 8.1 cu.yd.; for chemical precipitation, 12.7 cu.yd., and for the acid treatment, 7.8 cu.yd. The acid sludge is somewhat higher in nitrogen than Imhoff or plain settling sludge and is highest of all the sludges in ether soluble matter. It was foul in odor, drying much less rapidly on a sand bed than Imhoff sludge.

Imhoff Tank — Conclusions from the operation of a 9-ft. diameter, 17-ft. depth Imhoff tank for six years are that higher reductions are obtained from a horizontal flow than with a vertical flow. Suspended matter removed by upward velocities, ranging from 1.9 ft. to 5 ft. per hour with corresponding detention periods of 4 hr. and 1.5 hr., were 45 and 50 per cent reduction respectively. Horizontal velocities of 12.5, 9.2 and 6.0 ft. per hour with detention periods of 1.4, 1.9 and 2.9 hr. gave 42, 59 and 57 per cent reductions respectively. The ebullition of gas from the sludge chamber was continuous. Although generally inoffensive, hydrogen sulphide was sometimes noted. Scum was nearly always

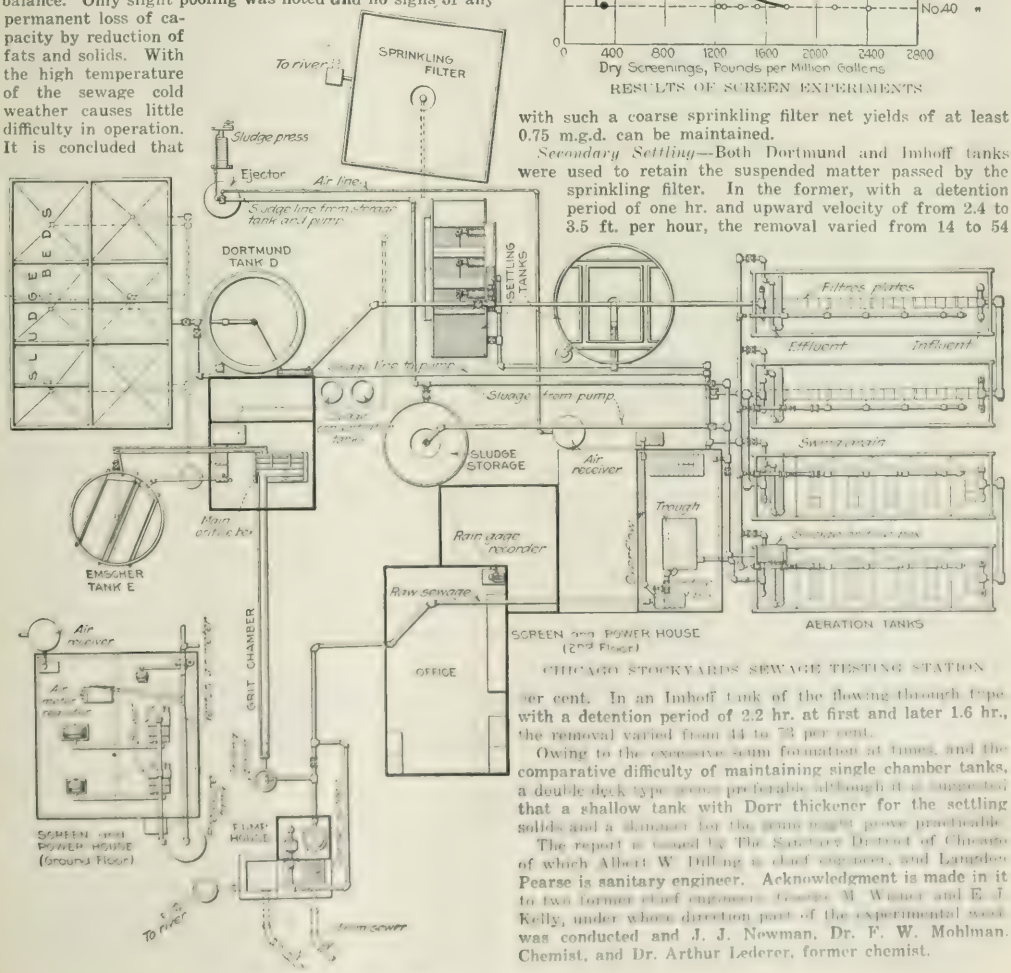
present on the gas vent surface. A thin grease scum persisted on the surface of the settling chamber and was removed at the rate of 0.4 cu.yd. per million gallons. The sludge was uniformly black or dark gray in color, flowed freely and drained readily on the drying beds to a spadable condition in summer in 4 to 7 days, and in winter under glass in 4 to 5 days.

Sprinkling Filter—Four years' operation of a sprinkling filter 6 ft. in depth, consisting of 3½ ft. of 1½ to 2 in. limestone overlying 6 in. of 2 to 4-in. stone, receiving the effluent from the Imhoff tank was satisfactory. It was dosed with a Taylor circular spray nozzle with a cam device for regulating the head. Rates (actual net yields) were 0.786, 0.987, 1.313 and 0.965 m.g.d. Suspended matter applied varied from 43 to 340 p.p.m. and the removal ranged from 48 to 63 per cent. Nitrates in the effluent varied from 5.3 to 34 p.p.m. An average relative stability for the whole period was 68.7; with high rates in the winter it ranged from 18 to 29 and with low rates in the winter from 24 to 74. During the summer it ranged from 61 to 98 with one month only at 40. The performance was best emphasized by the reduction in dissolved oxygen requirements; 990 p.p.m. was required for complete stabilization for the crude sewage, whereas the filter effluent was 137, a reduction of 87 per cent for the tank and filter. Unloading maintained a balance. Only slight pooling was noted and no signs of any permanent loss of capacity by reduction of fats and solids. With the high temperature of the sewage cold weather causes little difficulty in operation. It is concluded that with such a coarse sprinkling filter net yields of at least 0.75 m.g.d. can be maintained.



RESULTS OF SCREEN EXPERIMENTS

Secondary Settling—Both Dortmund and Imhoff tanks were used to retain the suspended matter passed by the sprinkling filter. In the former, with a detention period of one hr. and upward velocity of from 2.4 to 3.5 ft. per hour, the removal varied from 14 to 54 per cent. In an Imhoff tank of the flowing through type with a detention period of 2.2 hr. at first and later 1.6 hr., the removal varied from 44 to 73 per cent.



CHICAGO STOCKYARDS SEWAGE TESTING STATION

Owing to the excessive scum formation at times, and the comparative difficulty of maintaining single chamber tanks, a double deck type seems preferable although it is suggested that a shallow tank with Dorr thickener for the settling solids and a skimmer for the scum might prove practicable.

The report is issued by The Sanitary District of Chicago of which Albert W. Dilling is chief engineer, and Langdon Pearse is sanitary engineer. Acknowledgment is made in it to two former chief engineers, George M. Wisner and E. J. Kelly, under whose direction part of the experimental work was conducted and J. J. Newman, Dr. F. W. Mohlman, Chemist, and Dr. Arthur Lederer, former chemist.

An Analysis of the Current Valuation Report on the Kansas City Southern Properties

Status of Investigation to Date—Present Announcement of Interstate Commerce Commission Includes Single Sums as "Value" But No Statement of Method—Land Acquisition Costs Apparently Disallowed

By Samuel W. Moore
General Counsel, The Kansas City Southern Railway Co., New York

On a few occasions, the pages of this journal have carried articles written by prominent members of the legal profession and bearing on subjects in which engineering plays a leading rôle. Judge Moore's contribution, written especially for Engineering News-Record at the request of the editors, is notable as an authoritative analysis of the more important questions at issue in the federal valuation of the railroads of the United States. With the issuance, April 5, 1921, of "supplemental" valuation reports, including additional costs of acquiring lands, as required by the Supreme Court decision in the Kansas City Southern case a year ago, there is reason to believe that the valuation of this property will continue as a test case of final methods to be employed. Judge Moore's connection with the case dates from its inception and it was he who finally secured a favorable decision from the Supreme Court even after many railroad men, in light of the Minnesota rate case decision, had discouraged the project of compelling the Interstate Commerce Commission to find and report separately additional costs of acquiring carrier lands. This article brings the discussion up to date and includes a clear, well measured statement of the railroads' viewpoint. Discussion of the subject at this time, previous to formal hearings before the Interstate Commerce Commission as a whole, is thought proper since at this stage of progress the matter is considered in the nature of an investigation rather than a "case." It appears that the investigation is far from completed.—Editor.

FOUR "supplemental tentative valuations" were announced by Division 1 of the Interstate Commerce Commission, April 5, 1921, in the cases of the Kansas City Southern, the Los Angeles & Salt Lake, the Atlanta, Birmingham & Atlantic, and the Winston-Salem Southbound, marking the most recent, if not the final action of the commission in the valuation of those properties. A statement summarizing these reports appeared in the *Engineering News-Record*, April 21, 1921. For each of these roads, the commission, through Division 1 (which for convenience will be referred to as the commission), has fixed a single sum as the tentative final figure of value. These single sum values, as their name indicates, are tentative only, and the companies are entitled again to file their protests and to have further hearings before the commission, at which they may urge that values of their properties should be greater than those made in the reports. It is only after these protests shall have been heard by the commission, and disposed of, that its single sum figures of value, whatever they may then be, will become final.

It is generally assumed by those interested in valuation work that the Kansas City Southern has been selected by the commission as a test case, or as one of several test cases, for the purpose of trying out the act for the valuation of railroads. What follows, therefore, is an analysis of the valuation proceedings in so far as they affect that road and with particular respect to the current "supplemental" report.

The supplemental tentative valuation deals with two subjects: First, single figures of value assigned to the Kansas City Southern proper, and separately for its subsidiary companies, and, second, the so-called excess cost of acquisition of lands. These two matters are considered separately and in the order named.

No single figure of value has been stated for the Kansas City Southern as a system. The company had asked that this be done, for the reason that Section 422 of the Transportation Act, 1920, providing for the disposition of earnings in excess of 6 per cent of the value of railway property held and used for the service of transportation, provides that the value of railway property and the net operating income of a group of carriers, "which the Commission finds are under common control or management and are operated as a single system, shall be computed for the system as a whole irrespective of the separate ownership and accounting returns of the various parts of such system." It would seem necessary that system values should be established, and doubtless this will ultimately be done.

The single figures of value for the Kansas City Southern, and separately for each of its constituent lines, as nearly as they can be ascertained from the commission's report, are as follows:

Kansas City Southern Ry	$30,086,595
Texarkana & Fort Smith	8,077,191
Kansas City, Shreveport & Gulf	8,725,737
Port Arthur Canal & Dock	1,927,309
Maywood & Sugar Creek	34,000
Ft. Smith & Van Buren	47,000
Poteau Valley	94,068
Arkansas Western	343,228
Kansas City, Shreveport & Gulf Terminal	150,779
Total	$49,485,907

The first thoughts that suggest themselves are: Do these figures represent the deliberate judgment of the commission? Has it definitely determined how railway property shall be valued? Has it decided that there is one value for all purposes, or different values for different purposes? Has it formulated the rules, principles, processes and methods of railroad valuation?

It seems highly probable that these questions must be answered in the negative, for the following reasons: The first tentative valuation of the Kansas City Southern was issued by the commission in 1916. It stated no single sum value. A protest was filed; thousands of pages of testimony were taken, and the case argued and submitted to the commission in 1918. A decision was

handed down, dated July 1, 1919, not giving any single sum figure of value, but confined entirely to statements of original cost to date, cost of reproduction new, cost of reproduction less depreciation, and lands. The report of the commission is contained in *Valuation Reports*, 1, pages 223-442. Commissioners Hall and Daniels dissented, and Commissioners Aitchison and Eastman did not participate in the disposition of the case. The commission, as soon as the President shall have completed the appointment of four new members, will consist of eleven commissioners, and there will then be upon the commission but three out of the eleven who voted for the decision of July 1, 1919. Of the remaining eight members, four will be newly appointed members who have not participated in any of the previous hearings, and of the remaining four, two did not sit, and two dissented at the previous hearing. Division 1, which issued the recent report, is composed of Commissioners McChord, Aitchison and Meyer, and of these three it may be assumed that Mr. Commissioner Aitchison did not participate, since he did not participate at the previous hearing. This apparently leads to the inference that the recent report reflects the views of but two members of the entire commission. It is hardly to be supposed that the commission would assume the tremendous responsibility of deciding upon the rules and principles which are to govern the valuation of the vast railroad property in this country without the fullest consideration by the entire commission as finally constituted and reorganized after the four new appointments.

Single Sums as "Value"

So far the commission has not at any time made any announcement whatsoever of the kind of value it is to find, or the rules for its determination. In the hearings and arguments thus far had before the commission, in the numerous briefs that have been filed and in the articles and books that have been written, the greatest confusion prevails upon this subject. For several years it was maintained, and argued to the commission on several occasions, that the commission was not required to find a single sum of value, but only to ascertain for each carrier its cost to date, its cost of reproduction new, its depreciation and the value of its lands, thus leaving to the court or commission, whenever the subject should come up, the duty of fixing its own single sum of value. But in the Texas Midland case, decided June 1, 1918, the commission determined that it was authorized to find a single sum as the value of the property for purposes under the act to regulate commerce, although it was questionable in its mind whether it was required to do so. It is said:

> While it may be questioned whether or not the act requires the finding of a single sum as the value of the property, we are of the opinion that it authorizes the finding of such value for purposes under the act to regulate commerce, and it is our purpose ultimately to make such a finding as to each property.

What is value "for purposes under the act to regulate commerce"? Is it value in the ordinary and usual sense of the word, or is it a "rate base," in the sense of an arbitrary figure to be used in the making of rates? Is it value in the commercial sense, sometimes called exchange value or pecuniary value? Is there one value for rate-making purposes, another for purposes of condemnation or consolidation, another for purposes of recapture of excess earnings, another for purposes of taxation; or is there, as the carriers contend, but one true value for all purposes? These questions have all been exhaustively presented to the commission. They are now pending before it, and must soon be determined.

While the commission has remained silent upon this all-important subject, its director of valuation, Hon. C. A. Prouty, has prepared a formula for the valuation of railroad property, and in January, 1920, at a public hearing, he urged the commission to adopt it. This recommendation from the director of valuation is highly important, not only because of his close relation to the commission, but because of his great familiarity with the railroad problem, and most important of all, his thorough appreciation of the difficulties which it presents and the grave responsibility which it imposes upon the commission.

Would Not Consider Commercial Value

Judge Prouty's recommendation is that the commission do not attempt or undertake to find value in its economic or commercial sense. His conception of the value required by the Valuation Act is an equitable sum to be determined for each carrier, resting in the discretion of the commission, and considered and deemed by it a fair and equitable amount upon which the carrier should be permitted to earn a fair return. In his printed Memorandum Upon Final Value (page 2), above referred to, he says:

> In a memorandum filed with the commission upon the first valuation hearing I stated that this value to be fixed by the commission was not the exchange or condemnation value, so called, but was rather that sum upon which, giving due consideration to all relevant facts, a fair return ought to be allowed. Nothing which has transpired in all the elaborate discussions then and since has in anywise tended to alter that opinion.

For this "sum" there is no known standard or measure. It bears no relation to commercial or pecuniary value. In fact, Judge Prouty entirely rejects commercial value, and in rejecting it, says (page 5): "I can not believe that this kind of going value can be at all considered by you in finding the rate-making value for which you are in search."

Formula Proposed by Director Prouty

Judge Prouty then proceeds to state his formula for determining the value that he recommends be found by the commission, starting with cost of reproduction less depreciation as the basis of computation. The formula adds an element of value known as "going value" which attaches to the property itself and "is the same whether the exchange value of that property is great or small." It also adds appreciation as an element of value, for the reason that "it is universally admitted that an old and seasoned roadbed is worth more for the transaction of business than a new one." The director then proceeds to a consideration of the proper measure of appreciation and going concern value, and reaches the rather surprising conclusion (page 10) that the aggregate of these two elements is "some 7 or 8 per cent of the cost of reproducing the road, including general expenditure but excluding land," and that "that sum should be added to the depreciated cost of the property in reaching its value." In practice he takes the average of these two figures—7½ per cent of the cost of reproducing the road—and adds that to cost of reproduction less depreciation, and to this sum he adds "present value" of lands, materials and supplies, and working capital, and

the result is given as the value of the road. In order to illustrate his formula he takes as a concrete illustration the Texas Midland Railroad, and computes its value as follows (page 10):

Cost of reproduction, less depreciation	$2,597,389
Add 7½ per cent of cost of road, new, including general expenditures, excluding land	214,025
Present value of lands	254,759
Materials and supplies	96,875
Working capital	60,000
Total	$3,223,038

Judge Prouty concludes that a valuation of the Texas Midland at $3,225,000 would be a fair value upon which to permit the owners of that property to earn a return, and expresses his conclusion in the following language (pages 10-11):

For my own part, considering the history of the Texas Midland, I am satisfied, from an examination of the whole matter, that something in the vicinity of $3,225,000 would be a fair value upon which to permit the owners of this property to earn. That value includes materials and supplies and working capital. The materials and supplies are stated at the amount actually on hand upon the date of valuation. Ordinarily this figure can probably be accepted.

This does not profess to be the pecuniary or economic value of the Texas Midland. It would scarcely be claimed that the road could be sold at that sum, or anywhere near it, or that if the Government condemned the road for the purpose of consolidating it with some other railroad, it would be required to pay this sum, or anything near it. It may be an equitable "sum" or a rate base. Certainly it does not pretend to be value in the commercial sense.

Formula Evidently Used in the Current Report

Coming, now, to the supplemental tentative valuation of the Kansas City Southern, it is apparent that while the commission has not seen proper at this time to disclose the method by which it has arrived at the sum of $49,485,907, in the aggregate (which has been found to be value, "as that term is used in the Interstate Commerce Act"), it seems highly probable that Judge Prouty's formula has been employed. It is greatly to be regretted that there has been no disclosure by the commission of the processes employed, in view of the fact that the Valuation Act requires it to state "an analysis of the methods of valuation" employed. The commission, however, appears also to have followed the recommendation of Judge Prouty in his memorandum (page 9), where he says: "The commission is under no obligation to state the mental processes by which it arrives at that conclusion, nor does it seem to me that it should attempt to do so."

The commission's final revision of the figures showing cost of reproduction new and the cost of reproduction less depreciation has not been made public. Approximating these figures as nearly as possible, it seems highly probable, however, that the commission, following Judge Prouty's formula, has taken, for each carrier, the cost of reproduction less depreciation as the base, and has added to it (a) about 7½ per cent of cost of reproduction of the road accounts (excluding land and equipment), (b) the so-called present value of lands (not including excess cost of acquisition), (c) materials and supplies and working capital, together with (d) the cost of the Port Arthur Ship Canal. The aggregate of these items is evidently stated as the tentative final single sum figures of value, for each of the carriers constituting the Kansas City Southern System.

There are a number of significant conclusions to be drawn from these figures. They do not purport to be the commercial or economic value of the properties. No one would for a moment contend that they could be bought or condemned for any such sum. It is apparent that no consideration has been given to their earning power. The company has heretofore insisted before the commission, and still insists, in the language of the Supreme Court of the United States (Branson v. Bush, 251 U. S., 181), that the value of its properties results from the use to which they are put, and varies with the profitableness of that use, present and prospective, actual and anticipated. On that basis it has submitted evidence to the commission that the value of its properties, on June 30, 1914, was somewhere between $75,000,000 and $80,000,000.

Land Costs Apparently Disallowed

The formula of value apparently employed by the commission makes value largely dependent upon estimated cost of reproduction and depreciation figures. A dollar of estimated cost in a bankrupt road is given the same value "as that term is used in the Interstate Commerce Act" as a dollar of cost in the most prosperous road in the country. This value, it should be remembered, is to be used for the purpose of the consolidation of roads, for the issue of securities and for the recapture of excess earnings, as well as for the purpose of rate making. It may be noted in passing that in the Grand Trunk arbitration, two out of the three arbitrators have very recently decided that the value of that system was to be determined by its earning power under reasonable rates, and that evidence of its cost of reproduction was not even admissible.

It is further apparent that nothing has been allowed for the so-called excess cost of acquisition of land, which the commission has computed in response to the Kansas City Southern mandamus suit, decided by the Supreme Court of the United States on March 8, 1920. The aggregate amount of such excess cost of acquisition of land, stated for the first time in the supplemental tentative valuation of April 5, 1921, and apparently disallowed in the figures of final value, is $4,371,970. The so-called present value of the company's lands which apparently has been included in the final figures is stated at $4,609,377. The aggregate of these two amounts, which represents the estimated total cost of acquisition of the company's carrier lands as of June 30, 1914, is $8,981,347.

It is of the highest importance that a clear understanding be had of the so-called "present value" and "cost of acquisition" of lands. The impression has been created in some quarters that the commission has allowed the railroad companies the "present value" of their lands, but that they are not satisfied with that allowance and insist upon having something additional, called "excess" cost of acquisition.

The so-called "present value" is not present value at all. The use of the expression is highly misleading. If it were true that the carriers had been allowed the real present value of their lands, they would be entirely satisfied with it, and would not be asking for something in addition. The so-called present value is determined by taking the average market value of adjoining land and applying it to the area of the right of way. The cost of acquisition is an estimate of what it would cost, as of valuation date, to acquire the right of way by purchase or condemnation.

The meaning of these expressions will be made clear by an illustration. The railway company, let us assume, desires to acquire a strip of right of way 100 ft. wide and containing 5 acres, running diagonally through a farm of 160 acres, the average value of the entire farm being $300 per acre. The 5 acres of right of way multiplied by $300, the average market price per acre, gives $1,500, which the commission calls the "present value" of the right of way. But every one with the slightest experience knows that to acquire a 100-ft. strip of right of way through a 160-acre farm would cost much more than the average market value per acre of the entire farm.

There would be consequential damages to pay, resulting from the damage to that part of the farm remaining after the right of way strip was taken out. In the case supposed, it would cost not less, let us assume, than $3,000, or double the so-called present value, to actually acquire the strip of right of way by purchase or condemnation. The real present value would be what it would cost to acquire the right of way, or to acquire an adjacent right of way of equal value, and that cost, in the case supposed, would be $3,000. The cost of acquisition would be $3,000; the so-called present value would be $1,500, and the so-called excess cost of acquisition would be the amount by which the cost of acquisition exceeded the so-called present value, which would be $1,500.

The cost of acquisition of lands is only another and more appropriate name for cost of reproduction of lands. Cost of reproduction, whether of physical property or of lands, is a recognized element or factor in determining value. The commission has apparently included in its formula the cost of reproduction of rails, ties and other physical property, but has declined to include the cost of reproduction of lands.

"Kind" of Value Must Still Be Determined

While it is probable that this most recent tentative valuation of the Kansas City Southern does not represent the deliberate and considered judgment of the commission and should be regarded only as an additional step in the development of this most important subject, it is, nevertheless, manifest that its outstanding feature is that a purely physical valuation, on a basis of estimated cost, appears to have received the commission's approval.

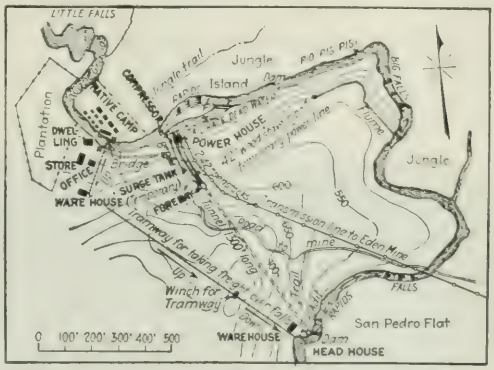
Apparently the cost of reproduction of carrier lands is to be ignored in so far as it exceeds the so-called present value; the earning power of the road is to be disregarded, and bankrupt roads and prosperous roads are to be valued, in the main, in proportion to their estimated reproduction costs. This process may be appropriate for the fixing of a "rate base," to be used in the determination of reasonable rates. But the law as it stands requires the commission to determine a value which shall be used for the purpose of consolidation of railroads, and this clearly means a commercial or economic value, or, as it is sometimes called, an exchange value. The law also requires the commission to determine value for the purpose of recapture of excess earnings, and this contemplates the same kind of value, that is, the value which the Constitution protects against confiscation. The real problem before the commission is to decide what kind of value it is to find, and how it shall be determined, and its solution of this problem remains incomplete.

Tunnel Building in Nicaraguan Jungles

Natives Expert Boatmen and Adepts with Broad Axe and Adze — Many Local Woods Suitable for Construction Work

By H. L. Thackwell
Engineer, Denver, Col.

Tunnel construction with native labor, in building, during the last years of the world war, a hydroelectric plant in the interior of Nicaragua taught the writer the advisability of letting piece-work contracts for all operations which cannot be supervised personally. Incidentally the pioneer heading method was shown to be practicable and highly economical in driving a tunnel of small cross-section. These facts, with the knowledge gained of managing native workmen and of the utility of native timbers for construction purposes, rounded out a jungle experience in engineering which may be useful to others required to undertake operations in the interior of Central America.



HYDRO-ELECTRIC PLANT AT THE BIG FALLS OF THE RIO PIS PIS, NICARAGUA

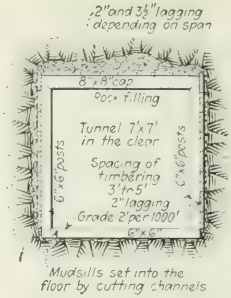
As indicated by the map, Fig. 1, the location of the power development was at the Big Falls of the Rio Pis Pis, which are about 150 miles inland from the Atlantic coast and about 60 miles south of the Honduranian border. All supplies were freighted up the river in dugout canoes, locally called pit-pans. The Indian canoe men were remarkably adept at handling heavy freight in the swollen torrents, and over dangerous rapids and the average time for a loaded canoe to make the trip from the coast to the falls was ten days.

Part of the work comprised the driving of a tunnel some 1,300 ft. long, through which a portion of the Pis Pis River was to be diverted for power purposes. On account of the war machinery was difficult to obtain on short notice, so it was decided to commence immediately driving the tunnel by hand. Months later a compressor was obtained, which, driven by a 50 hp. Pelton wheel, furnished sufficient compressed air for the operation of two Leyner-Ingersol rock drills, and one Jackhamer drill.

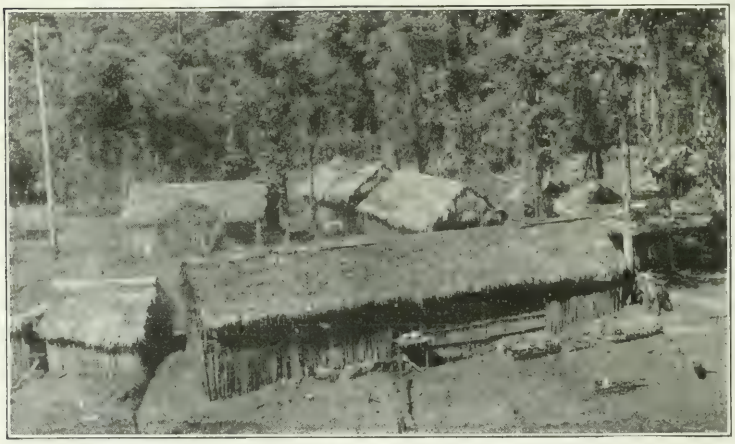
A cross-section of the tunnel is given in Fig. 2. In plan, the only part requiring explanation is the adit at the river end. This was driven to give access to the workings when the river end was closed to keep out the river.

Tunneling Methods.—Using hand drills the first plan was to drive the full section. However, the rock, an altered andesite seamed with kaolin, would fall when least expected so that it was dangerous to drive more than 5 ft. without timbering. This necessity for timbering close to the face cut down the advance to 2 ft. a day at each heading. Finally the plan was adopted of driving a small pioneer heading and enlarging it to full section. Several advantages resulted.

On account of the small dimensions of the advance tunnel, 4 x 5½ ft., no timbering was necessary, and the chief cause of the previous delay was avoided. The rate of the advance made by the pioneer section was greater than that of the larger section, and in consequence the tunnel was holed through months ahead of the time required to make a connection of the full sized headings. As soon as the pioneer headings met, proper ventilation was obtained, and more important than that, drainage was established through the tunnel thus abolishing the expensive pumping system required for the upstream heading. Moreover, as the pioneer section advanced, miners working in the rear could drill holes into the sides and roof of the tunnel and blast out the sidewalls and roof as desired. The efficiency of a charge of powder exploded in this manner was far greater than an equivalent charge in the face of the bore. By this procedure an average full section advance of 3 ft. per day was made; the pioneer advance varied from 3 to 5 ft. per day in each heading.



SECTION OF PENSTOCK TUNNEL


CONSTRUCTION CAMP IN NICARAGUAN JUNGLE

At first an attempt was made to work three shifts of 8 hr. each. This was soon abandoned when it was found that it took from ¾ to 1½ hr. to allow the smoky atmosphere to clear sufficiently, so the men could work at the face of the heading. The most rapid progress was made by letting contracts to native miners, one contractor taking the upper heading and the other the lower. The term contractor, as here used, is more or less misleading, when one thinks of contracts as made and kept in the United States.

The native contractor is generally a penniless and irresponsible miner who agrees to drive the bore for so much a foot. The company sells him powder, fuse, caps, candles, etc., at a fixed price. Should the contractor find that he is losing money, he is likely to stop his work the week after signing the contract. Since he is not under bond, nothing can be done to hold him to his agreement and new terms have to be agreed on. On the other hand if he should be striking it rich the company is in honor bound not to change the contract price until the end of the term, which in this particular case was generally placed at one month. At the end of the month after measurements had been made and the contractor paid up, a new agreement was made, based on the progress of the previous month, and on the nature of the rock encountered in the heading. The best results were obtained by letting a contract at a fair price per foot, and also promising a bonus of so much a foot for each foot over a specified advance made during the month. It was found that No. 8 X detonators gave the best results in blasting. Hercules dynamite of 40 per cent and 60 per cent strength was used throughout the work.

Labor and Laborers — In Nicaragua the laborers are of several races, and, in numbers, predominate in the following order: Nicaraguans, Mosquito and Suma Indians, Honduranians, Jamaicans, Costa Ricans and a scattering of Chinese. Day labor receives about $1.50 per day while skilled drillers and carpenters get from $2 to $3 per day. Blacksmiths and machinists are the highest paid workers; some of them receive as high as $4 per day.

With the contract method several days were lost reorganizing the crews, at the end of each month. Meanwhile the money obtained in wages by the workmen would be gloriously spent in a couple of days, in drunken orgies at the native mining villages, or else at the gaming tables of professional gamblers.

The Nicaraguans, proverbially careless in regard to the handling of explosives, seem to have been protected by a gracious Providence in this work, for although tons of explosives were used on the tunnel, dam-site and other work, there were no accidents. The natives always crimped the caps with their teeth, lit the fuse with burning sticks of dynamite, and tamped powder with anything that happened to be handy. In the Nicaraguan mining code provisions are made for the safety of miners as regards ventilation, timbering, etc. One provision of paradoxical nature reads as follows: "In the preparation of the shots (that is to say, the ramming of the powder in the drilled holes) only ramrods, the outside surfaces of which are of soft iron, bronze or other metals which do not produce sparks, shall be used."

The indifference with which the natives regard life is simply appalling. For instance some bull-packers were unloading dynamite from the backs of their panting beasts. They deliberately allowed the cases of 60 per cent dynamite to fall from the backs of the bulls to the ground. When warned of the danger of such a method of handling high explosives, they shrugged their shoulders and said, "Ah! Senor, and what do we care for living anyway."

Usually Nicaraguans are not as efficient as the Mexican or Chilean miners, but this is not to be wondered at, when one considers the enervating climate, and the chronic malarial affections of the majority of the workers.

Never employ Jamaican negroes on any work, with the possible exception of that of house-boy or groom. They are generally lazy, insolent, and ask for more favors than all the other natives together. Indians are unexcelled on river work, and in the handling of heavy freight; also, when given tasks, they do well at clearing land. The stronger Indians make good car-runners and shovelers.

Native Nicaraguans are the best miners, but it is well to discriminate between the good and bad. Dark skinned workmen are better and generally healthier than those of lighter hue. Don't employ English-speaking Nicaraguans, except as timekeepers, clerks, etc. As soon as a native learns English he forgets how to work. Avoid working Costa Ricans, Nicaraguans, and Hondurians together. Don't hire men who are loaded with malaria germs and who show obvious spleenic enlargement. Those suffering from chronic malaria simply act as media for the anopholes mosquito to infect the whole camp. Chinese make the best cooks for the "white mess," while native Nicaraguan women will cook and season the food more to the taste of the natives.

Make it a point to get rid of gamblers and agitators just as soon as they are observed. It is well to make an example of the more prominent boot-leggers, and other disturbers. When discovered in camp such men should be immediately arrested, and either thrown into jail or heavily fined.

Try to contract all work that cannot be personally supervised, such as timbering operations in the jungle, and night shift work in tunnels.

Native Woods Excellent for Construction.—The natives are adept at broad-axe and adze work in hewing and shaping of mine timbers. The following is a list of the more important native woods which are much used for mine timbers and for general construction work: Come-Negro, Granadilla, Binbayan, Santa Maria, Leche Amarilla, Nancita, Cortez, Pronto Alivio, Laurel (Greenheart), Lagarto, Cedro Macho. The last-named wood should be studiously avoided, since it rots out in a few months' time. In appearance it resembles Santa Maria, which is an excellent hard-wood similar to our oak. Wily native contractors will try to impose on the uninitiated American, and turn in timber which is of inferior grade but easier to procure in the neighboring forests.

All timbers are whip-sawed by hand in the surrounding jungle, and are then hauled over muddy trails by yokes of oxen to the point of delivery. Lumber ordinarily sells at the rate of $75 per M. ft. B.M. while mine timbers bring about $45 to $55.

Come-Negro or "Iron-wood" is the best mine timber procurable. It weighs about 80 lb. per cubic foot and is as hard as flint. It is almost impossible to drive a nail into the heart-wood, but it can be worked down to shape with good steel adzes. Come-Negro turns black on aging, and seems to be very resistant to wet or dry rot, fungi, and the united attacks of several varieties of white ants.

Granadilla is a beautiful rose-wood, which would be of great value as a cabinet wood, but due to its scarcity and isolation it is chiefly used as a mine timber. It is nearly as heavy as Come-Negro and about as durable under all conditions.

Binbayan is chrome yellow in color, very hard, and suitable for mine timbers, but it checks badly when used in the open air. Santa Maria is the best all-round timber in the bush. Its weight is slightly less than that of water, and its strength greater than that of oak. It is easily worked and has a life of about ten to twelve years under ordinary conditions.

Germany Returns to Adobe Building

THE efforts made toward lowering the cost of building and saving coal in the manufacture of building material have resulted in a reversion to former building methods. Though many of the cheap building methods devised seem to be short-lived, it appears that the adobe building has come back to stay. It has been thoroughly tested under all climatic conditions, and in various forms. The conclusion arrived at, expressed in a recent report made by the Prussian Agricultural Ministry, accepts loam as a suitable building material where greatest economy is the chief object. According to this report the experiences gained with numerous buildings erected in various parts of Germany are very encouraging.

Three forms of adobe construction have been used: The stripped wall in connection with frame work; the rammed loam; and air-dried loam bricks. Good results have been obtained from all three methods.

The first-named method is used for country houses of a more permanent character. Saving-banks have been given permission to grant loans on such buildings. A house containing four rooms, kitchen, garrets, and coops for small animals, costs 52,000 marks without the wood (current value of mark 1.5 cents).

Hammering is performed either by hand or by compressed air, which latter method is declared preferable. With the help of one pneumatic tool and four workmen, a house has been completely rammed in 6 to 8 days. The corners are not made from concrete, as has been suggested, but also from loam, as the two materials have different shrinkage.

Air-bricks are made in usual brick size, larger sizes do not dry well. Loam is also used as mortar. Walls made by such bricks are durable, and they keep out the moisture. Less damage is caused by frost than in the case of rammed loam. As in the case of concrete it is necessary to protect the building against rain while under construction. Before plastering the outer surface is first covered with a coat of tar.

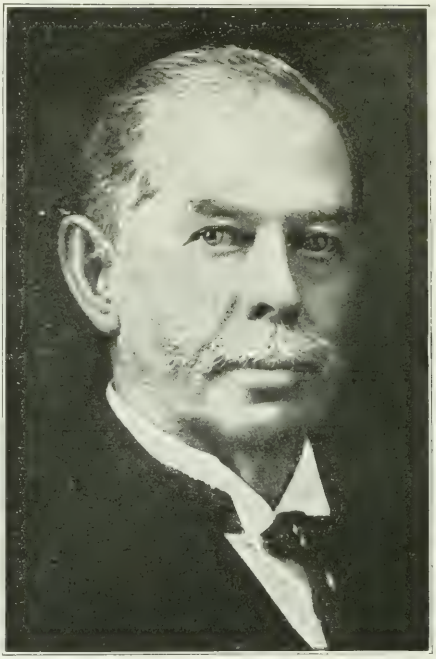
Ramming in of slag or pieces of brick is advantageous, as they draw moisture from the interior of the walls, and also provide a better surface for coating. As lime mortar adheres badly to loam, a coating of loam mortar with an addition of lime in the proportion of 1:2 is first applied, upon which, after drying, the lime coating is put on.

William Hood Retires After Fifty-four Years of Service

Chief Engineer of Southern Pacific Company Closes Long Career of Railroad Building—Many Notable Works

AFTER fifty-four years, to a day, of continuous service in the Southern Pacific Co., William Hood, chief engineer, retired, May 2, announcement being made by President Sproule April 27. On May 3, 1867, Mr. Hood entered the engineering department of the Central Pacific R.R., now a part of the Southern Pacific Co., as a member of one of the engineering parties constructing the first Pacific-Transcontinental line, which started at Sacramento and met the line from Omaha at Promontory Point on the Great Salt Lake in May, 1869, after the memorable race between the Union Pacific to control the Salt Lake Basin. His first work was as axeman and he was quickly promoted to rodman, and then instrument man and assistant engineer. His career has been one of railroad building, and he has held positions of great responsibility in the engineering department of the Southern Pacific almost since the first construction was started. In 1875, he became chief assistant engineer of the Southern Pacific and the Central Pacific. From 1885 he has been chief engineer of the Southern Pacific Co., Pacific System ,and chief engineer of each of the lines leased by that company. Mr. Hood was born Feb. 4, 1846, in Concord, N. H. At the age of 16 he enlisted in the Union Army and saw active service in the Potomac campaign. After the war he entered Dartmouth College, but in the spring of 1867 he left for California, following newspaper accounts of the attempt being made to build a railroad across the continent. With a letter to Charles Crocket, the construction executive of the Central Pacific, he entered the service of the road on May 3 as an axeman and was sent to Cisco, which was then "end of track" in the Sierras. Within a few months, during the construction of the line and preparatory work on the down grade, Mr. Hood was made assistant engineer under S. S. Montague, chief engineer, who had succeeded Theodore D. Judah. He remained as assistant engineer under Montague during the entire construction, carried out under tremendous pressure, until the two lines met at Promontory Point.

Retiring Chief Engineer of Southern Pacific Co. Has Served Fifty-Four Years



WILLIAM HOOD

After Mr. Hood was made chief assistant engineer in 1875, he completed the Tehachapi traverse loop on the Valley Route from Oakland to Los Angeles, directing location and construction work in the field.

Possibly the most important and spectacular accomplishment to Mr. Hood's credit was the Lucin cut-off across the Great Salt Lake. Before the railroad passed into the hands of the late E. H. Harriman Mr. Hood had assured Collis P. Huntington that the lake could be spanned at a cost that would not be prohibitive as an economic project to reduce operating costs. Harriman ordered the work to go ahead and in November, 1903, the cut-off was completed, with rock fill hauled from quarries started in mountains to the east and with trestle built at the rate of 1,000 ft. a day.

Although Mr. Hood reached the age of 70, five years ago, he has been in active service continuously, spending a large part of his time on the lines, more particularly in connection with the recent construction of the San Diego & Arizona line, which forms a direct connection between San Diego and the inland. This line was started before the war but was not completed until about two years ago. It was shut down for the repair of a tunnel for some time but put in service again last fall. He is widely known among railroad contractors in the West and often he has been called upon to act as the final arbiter in difficult disputes. A familiar biography of him appeared in the *American Magazine*, January, 1921.

With the retirement of Mr. Hood from active service, George W. Boschke, assistant chief engineer, has been appointed chief engineer of the Southern Pacific Co., as noted in the News Section of this issue.

Start Construction of New Trans-Andine Line

Construction on a new international railway to complete direct rail connection between Buenos Aires and either Antofogasta or Mejillones, Chile, was started during the latter part of March. The new link will connect the Argentine city of Salta, near the summit of the Andes, with the west seacoast. The Argentine section is being built from Salta to Huatiquina on the Chilean frontier in the Andes. In Argentina, construction is being carried out by the state railways. The most direct route at present from the Atlantic coast to Buenos Aires is by ship through the Panama Canal to Valparaiso, Chile, and thence by rail over the Trans-Andine Ry. to Buenos Aires, since Valparaiso lies in approximately the same longitude as New York. Antofogasta being several hundred miles north of Valparaiso, on the west coast, is on a more direct route and the journey through the port over the new railroad connection will be shortened by about two days.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Prof. Hatt Only Ex-officio State Engineer

Sir — The notice of my appointment as State Engineer of Indiana in *Engineering News-Record*, Apr. 14, p. 657, needs some qualification in the interest of accuracy.

Purdue University is co-operating with the State Conservation Commission, and the Professor of Civil Engineering of Purdue was appointed Chief of the Division of Engineering of the Conservation Commission as an addition to his regular duties. Consequently he was not selected from a number of applicants.

There is no salary attached to the position.

W. K. HATT,
Professor of Civil Engineering,
Purdue University.

Lafayette, Ind.,
Apr. 26.

Concrete Building Failure Shows Monolithic Nature of Frame

Sir—With regard to the interesting article which appears in the April 7 issue of *Engineering News-Record*, by Walter H. Wheeler, the problems involved in the reconstruction operations described constitute probably one of the most important phases of reinforced-concrete design and construction.

In many buildings which are in most ways completely adapted to the use of reinforced concrete, there are sometimes conditions which necessitate the introduction of a certain amount of structural steel as the only feasible method of overcoming certain difficulties. In connection with this comes the all important problem of transferring the stresses and strains between two materials—structural steel and reinforced concrete—which by nature of their respective designs are clearly not intended for mixed construction. A combination of the two is generally more of a makeshift than a legitimate design.

The different proportionate deflections between structural steel and reinforced concrete create a feature which must necessarily tend to produce many indeterminate stresses. The exact nature of the regular stresses and strains of reinforced concrete are sufficiently indeterminate in themselves without the additional complications of mixed construction.

In the operations described in the erection of the United States National Bank Building, at Denver, there can be little doubt that it was absolutely necessary to resort to unusual methods. Undoubtedly, structural steel was successfully carried on reinforced concrete in this case, as has been done in other instances. However, I should like to point out that it might not be advisable to make undue reference to the operations as an unlimited precedent for carrying structural steel directly on reinforced-concrete columns and vice versa.

I have in mind an example which leads me to believe that there is an element which strongly prohibits the use of the Denver building as a general precedent. Any reinforced-concrete building, after the concrete has been thoroughly cured, possesses monolithic qualities which make it possible to remove, sometimes, one or even two of the most important columns in a building, without apparently injuring, in any way, the balance of the structure. Therefore, what may in the case of the United States National Bank building look like a successful operation in mixed construction, may in reality be due more particularly to the monolithic nature of the reinforced concrete than to the ability of reinforced-concrete columns successfully to carry the structural steel directly imposed upon them.

I base my conclusions upon the failure of a 7-story reinforced-concrete building with which I am familiar. The dimensions were approximately 50 x 120 ft. and with skeleton frame throughout, with one row of interior columns and with floors spanned laterally by a concrete joist design. The framework was poured during July and August. The failure occurred the following January, approximately six months after the completion of the concrete frame. Two interior columns between the ground and first floor failed about thirty seconds apart. The cause of the failure was traced to a batch of dirty gravel, and also to the fact that these two columns had been made somewhat smaller in size than the plans called for, through a mistake in construction. The building was re-shored and these columns were replaced by structural steel.

The tensile stress of the reinforcing steel in the original building was figured at 16,000 lb. per square inch, while the maximum compressive outer fiber stress in the concrete beams and floor system was 750 lb. per square inch. The columns were designed for 550 lb. per square inch compressive stress in the concrete. Stone concrete was used throughout, the weight of which was taken at 150 lb. per cubic foot. A net live-load of 50 lb. per square foot was allowed on the floor system throughout, with the usual percentage live-load reductions on columns.

As stated, the columns which failed were smaller in size than the design called for. On this account, these particular columns would have a corresponding compressive stress in the concrete of about 750 lb. per square inch, if the complete dead and live loads for which the structure was designed were imposed. As the building had not been occupied none of the live-load, or any extra load was on the columns at the time of the failure. They failed without warning merely under the dead load of the structure.

It might easily be argued by anyone not familiar with the conditions surrounding the accident that the upper reinforced-concrete columns in this building after the repairs were being successfully carried on structural steel columns. During the time it took to re-shore the building, however, and subsequently to place the steel columns in position, no cracks developed, even in the beams and floors, immediately above and adjacent to the defective columns which failed.

R. E. W. HAGARTY,
Consulting Engineer.

Toronto, Ont., April 20.

Predicting Probable Rainfall Intensities

Sir—I have been much interested in the article, "The Prediction of Probable Rainfall Intensities" by Kenneth Allen, appearing in Enginering News-Record, April 7, 1921, p. 588, as indicative of the increasing use which is being made of probability methods in studying problems connected with hydrology. In a discussion of a paper by me entitled "The Probable Variations in Yearly Runoff as Determined from a Study of California Streams," which appeared recently in the *Proceedings* of the American Society of Civil Engineers, Mr. Allen referred to his probability paper for predicting rainfall intensities, but at that time presented none of his basic data and did not outline the method of derivation of his paper.

In reviewing Mr. Allen's article it has been noted that although the record from which the data were obtained covered a period of 51 years, in tabulating the maximum rainfall intensities in Table I, the total number of occurrences of total frequency is always less than 51; in other words there are always certain years in the record which remain unaccounted for. As the rainfalls of longer durations are approached this omission becomes more apparent. For example, for durations of 120 minutes there are only 16 occurrences tabulated and these are used to represent 100 per cent of the time. As a matter of fact, they cover only (16 ÷ 51) 31.4 per cent of the time. If, in tabulating the results, the maximum total rainfall in different periods of time (expressed perhaps in intensities per hour) had been used this difficulty would have been overcome. Thus, if a certain storm showed a total rainfall of 2 in. in 80 minutes, the same total would hold for 100 and 120 minutes; the fact that the rain may have ceased after 80 minutes would be immaterial. The principal point is that in deter-

mining total frequencies every year in the record must be considered.

In determining the average curve shown in Fig. 1, Mr. Allen has assumed that in corresponding intervals from the mean, proportional to the standard deviation, the frequency in all series will be a constant. The writer has seen this assumption applied in other cases and while it may hold with records having approximately the same coefficients of variation, as a general theorem it has no justification. The coefficient of variation, *CV*, is obtained by dividing the standard deviation by the mean. As it is a pure number and not affected by the magnitude of the quantities involved, it is more useful than the standard deviation in comparing the relative dispersion of the series involving quantities of varying magnitude. As an example of the fallacious results that the assumption referred to above may lead, consider two series having *CV*'s of 0.20 and 0.60, respectively. In the first case a negative deviation of 2 to 2.25 of the *CV* would lie between 55 and 60 per cent of the mean, such a variation is entirely possible; in the second case the same negative deviation would lie between —35 and —20 per cent of the mean, and as zero is the lower limit for such phenomena as rainfall intensities such a deviation is absolutely impossible. A comprehensive study of a large mass of runoff data has convinced the writer that for this class of phenomena the type of the frequency curve changes with the increase in the coefficient of varition. (See p. 9 closure to my paper in Proceedings, Am. Soc. C. E., Feb., 1921.)

In general, the method employed by Mr. Allen is the logical one to use in treating statistics of this nature and the results obtained are probably quite satisfactory, but with a more careful attention to the points made above the final curves would yield a closer agreement with the actual probabilities of the case. As mentioned in the article, the use of theoretical statistical methods is quite laborious and rather complex, hence when adopting such treatment it behooves the engineer to carefully analyze his data and the application of the theory of probability thereto, before commencing the actual work of determining the frequency distribution.

L. STANDISH HALL,
Hydraulic Engineer.

San Francisco, Cal., April 20, 1921.

Sir—Referring to the foregoing comments of L. Standish Hall on my method of predicting rainfall intensities, I would say in the first place that Table I is based on a record published by the Municipal Engineers of the City of New York in their Proceedings for 1913, extended to embrace the year 1920.

In preparing the table, the omission of certain downpours in the earlier tabulations was taken to indicate a failure to record the rates left blank for these years, and this seems to be true in a few instances. But in the majority of ommissions, which are confined to periods of 80, 100 and 120 minutes, it would appear, on further investigation, that Mr. Hall is correct in his contention that the percentages in Table I should be based upon the complete 51-yr. record. He probably overlooked the fact that storms of over 60 minutes' duration were not used in the computation of Standard Deviation (Table III), and as the greatest number of omissions in the 51-yr. period for any year is 5 (for 40, 50 and 60 min.) and 0 to 2 for the five shorter durations, the resulting curves up to 60 min. are practically correct.

The original tabulation might have included a figure for every duration up to 120 minutes, as rainfalls of greater duration occur every year. But in their absence I am unable to find any warrant for supplying the omission by assuming rates for their durations equal to half the downpour of some shorter period, such as 80 min., as proposed by Mr. Hall.

Mr. Halls' second criticism is of the assumption that "in corresponding intervals from the mean, proportional to the standard deviation, the frequency in all series will be a constant," but he adds that "it may hold with records having approximately the same coefficient of variation." The following table gives the coefficient of variation calculated by dividing the Standard Deviation by the mean, for the series of data in question.

Downpour Interval	*CV*	Downpour Interval	*CV*
5 min.	0.298	30 min.	0.420
10 min.	0.329	40 min.	0.303
15 min.	0.368	50 min.	0.400
20 min.	0.399	60 min.	0.400

The *CV*'s quoted in Mr. Hall's original paper have a decidedly wider range than this, running from 0.21 in the case of Stream 28, to 0.81 in the case of Stream 32.

Mr. Hall is no doubt correct in saying that the assumption that the frequency for all series is a constant has no justification "as a general theorem."

If I am not mistaken, he would suggest, in place of my Fig. 2, a series of diagrams, each for a single duration and with a special ruling. The graph on each would then be a straight line and the result would undoubtedly be more accurate, but the work involved could hardly be justified as a practical procedure. The method described in my article, by which an average curve of Standard Deviation is employed, appears to overcome the difficulty without a material sacrifice of accuracy.

The absurdity mentioned by Mr. Hall of any method resulting in negative rainfalls is evident and might perhaps exist in attempting to combine the New York rainfall record and that of say Phoenix, Ariz., in the calculations for Fig. 1, but the fact is that in the New York computations such a situation did not exist. The lower limit of the frequency curve in Fig. 1, or the point at which the rainfall will be exceeded every year, is 2 SD below the mean, and the following table gives the values of this point translated back into inches of rainfall per hour for the eight series of data utilized in computing the probability ruling.

5 min.	1.90 in. per hr.	30 min.	0.33 in. per hr.
10 min.	1.26 in. per hr.	40 min.	0.68 in. per hr.
15 min.	0.82 in. per hr.	50 min.	0.30 in. per hr.
20 min.	0.53 in. per hr.	60 min.	0.27 in. per hr.

Conceding that by some imaginary combination of rainfall data, an absurd result might be reached the above tabulation shows that as a matter of fact this was not the case.

It should be stated that the computations and diagrams shown in the article referred to were all prepared before receiving the reprint of Mr. Hall's paper on "The Probable Variation in Yearly Runoff" and any advantage in using the Coefficients of Variation instead of Standard Deviations did not seem to warrant the recomputation and plotting of the data. It was my intention to prepare a paper so ruled that intensity of frequencies could be plotted as described, with graphs approximating straight lines, and the use of Standard Deviations seemed a good basis for this purpose. It is quite probable that there may be some better method of securing this result, possibly by the use of Coefficients of Variation as proposed by Mr. Hall. Mr. Hazen's paper, to which I referred, suggested a number of probability rulings, one of which might be selected which would avoid the laborious computation involved in either Mr. Hall's method or mine.

KENNETH ALLEN.

New York City, May 9.

Road Work, Mosquitoes and Malaria

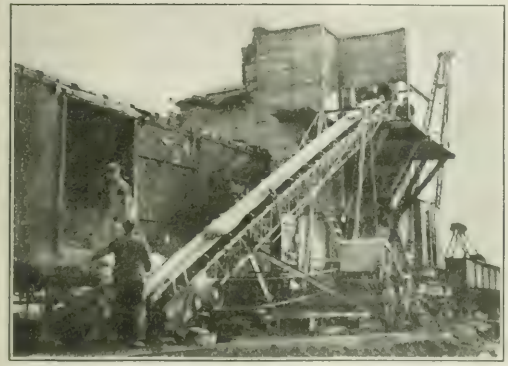
That road construction and maintenance should be so carried out as to avoid leaving pits or improperly drained culverts in which water may accumulate and give rise to mosquito breeding, and thus probably contribute to the spread of malaria, is urged in a circular recently issued by the U. S. Public Health Service. The importance of this precaution has been recognized by Dr. T. F. Abercrombie, health officer of Georgia, who, according to the circular, "has suggested that the convict and other gangs who work along the roads be required to fill up borrow-pits, place culverts properly, clean ditches, and attend to other small but important details that any man can do and that will deprive the mosquito of many of her breeding places."

HINTS FOR THE CONTRACTOR

Portable Belt-Conveyors Handle Cement to Elevated Mixers

PORTABLE belt-conveyors fitted excellently into two concrete plants employed in 1920 on Government work near Savanna, Ill. A concrete pit 1,600 ft. long, 234 ft. wide, and 10 ft. deep was constructed to store about 6,000,000 bu. of nitrate. The floor and side walls were 5 in. thick of reinforced concrete.

Two concrete plants, on opposite sides of the pit, were mounted on gondola cars. Each plant consisted of a mixer, with bins mounted above it for the storage of sand and stone. The sand and stone were unloaded



CAR MOUNTED MIXER PLANT WITH PORTABLE CEMENT CONVEYORS

from cars with a locomotive crane and placed in the bins as needed. The cement car was spotted at one end of the plant car and the sacks as unloaded were placed on a Barber-Greene portable belt conveyor which carried them up to the platform where men measured the materials and charged the mixers.

The mixed concrete was spouted into place where possible and beyond the reach of the spout was carted and dumped into place. The entire operation was carried on with practically no lost time, when moving, the locomotive crane picked up the spout, trestle, etc., and carried all to the next set-up.

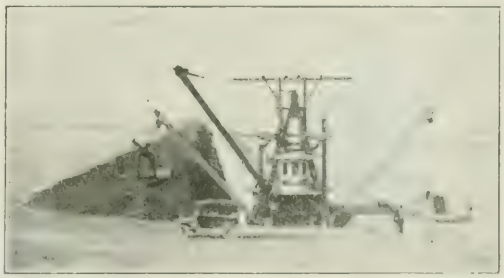
As first planned, the locomotive crane handled the cement from the car to the platform, lifting it on a large wooden skip. However, this consumed time when the crane should have been handling sand and gravel so the conveyors were added. The second day of operation the output was increased 20 per cent. The conveyors operated at an angle of 26 deg. and handled a maximum of ten sacks per minute though on the average they carried five sacks per minute. They were 38 ft. long and were driven by 15-hp. gasoline engines.

Henry W. Horst Co., Rock Island, Ill., were the contractors and, when this contract had been completed and work started on a concrete road contract, they planned a central mixing plant requiring two conveyors to handle sand and gravel to storage bins.

Dredge Digs Narrow Canal

IN PLANNING the construction of a canal 18 ft. wide in the Sacramento Valley, the use of a floating clam-shell dredge was decided upon as the cheapest method of carrying out the work. In order to place the excavated material back far enough from the edge of the canal to leave the prescribed width of bern, a boom exceeding 60 ft. in length was necessary. Such a boom would ordinarily require a dredge with a hull wider than could be floated in an 18-ft. canal, or the use of so-called "bank spuds." The latter were not considered feasible because the material traversed was very soft. A plan was developed, however, whereby with the use of counterbalances, 12 miles of 18-ft. canal were built with a dredge floating in the canal and without disturbing the canal banks.

The dredge used for this purpose had a hull 16 ft. wide, 65 ft. long and 5½ ft. deep. The boom was 75 ft. long and operated a 1½-cu.yd. bucket. To adapt the dredge to this special work, timbers were stepped on either side of the A-frame and from their ends were suspended boxes filled with earth to serve as counterweights. The distance of the counterweights from the side of the hull was made great enough so there was no danger of sloughing the soft material along the bank.



DREDGE WITH COUNTERWEIGHTS IN ACTION
(Note that counterweight to the right is suspended while the other rests on the spoil bank)

The length of the lines by which the weights were suspended was also adjustable and the height of the weights was changed as often as was necessary to keep them hanging only a few feet above the ground. Thus when the loaded boom swung to the starboard side, the list of the dredge hull caused the starboard counterweight to rest on the ground, leaving the port counterweight to balance the overturning moment of the loaded bucket. When the boom returned toward the center and the hull righted itself, the counterbalance that had rested on the ground was again lifted. The dredge was always free to move forward when the boom was on center line. Ordinarily one of the counterbalances was hung just over the spoil bank and rested upon it when the boom was swung into dumping position.

The work was done by the Ajax Dredging Co. under the general direction of F. F. Cooper, general manager and chief engineer.

NEWS OF THE WEEK

New York, May 12, 1921

Vehicle Tunnel's Engineer Board Told to Quit

Jersey Commission Acts Independently of New York Body Which Denies Its Jurisdiction

Controversy over the proposed widening of certain streets in Jersey City, involving a difference of opinion as to whether or not the work should be paid for as part of the Hudson River vehicular tunnel project upon which the states of New York and New Jersey are engaged under a joint agreement, culminated in a resolution passed by the New Jersey Interstate Bridge and Tunnel Commission at its meeting April 26, discharging the board of consulting engineers consisting of Col. W. J. Wilgus, Major John A. Bensel, Prof. William H. Burr, Edward A. Byrne, J. Vipond Davies, and Col. George L. Watson. The New Jersey commission's action was taken without giving the members of the consulting board an opportunity for a hearing and on the ground that the consulting engineers and the engineering staff had failed "to give full and proper consideration to the plan as a whole and to the traffic conditions in the vicinity of the Jersey City entrance and exit," thereby delaying the work.

The New York State Bridge and Tunnel Commission, May 10, denied that the New Jersey body had jurisdiction in the action it had attempted to take and refused to follow its example in appointing three new members to the consulting board. A statement signed by the members of the "dismissed" board was also issued denying that the action taken had force.

It is understood that three of the eight Jersey commissioners opposed the passage of the resolution and demanded evidence justifying the dismissal of the consulting board, but they were met only with cries of "Vote," and the measure was railroaded through. In place of the present consulting board, the New Jersey commission appointed as its representatives on the board George M. Wells, St. John Clarke and Col. George L. Watson, and suggested that New York also appoint three representatives. The chief engineer to the two commissions, Clifford M. Holland, is not mentioned in the New Jersey resolution ousting the consulting board.

The New Jersey commission's action was made independently of the New York commission and doubt has been expressed as to its regularity, especially in view of a clause in the resolution originally appointing the board of consulting engineers which states: "That said board of consulting engineers shall be filled by appointment by the two commissions, to hold office at the pleasure of the said commissions." It will be noted that in each case the plural of the word "commission" is used. As the members of the New York body have not concurred in the resolution of the New Jersey commission, the opinion has been expressed that the action of the New Jersey body is without legal status.

The main points in the history of the controversy may be briefly stated as follows: After a contract for sinking the tunnel ventilating shafts on the New Jersey side has been publicly advertised in March the call for bids was suddenly rescinded when the New York commission refused to accede to demands of the New Jersey representatives for the widening of a number of streets beyond the tunnel entrance in Jersey City. The chief engineer's plans as published in his 1920 report provided for an entrance plaza at 12th St., but the majority of the New Jersey commission caused a deadlock by demanding the widening, in addition, of 14th St., Henderson St., and Jersey Ave. This additional street widening, the New York commissioners maintained, was purely a local improvement for Jersey City and, as such payment for it by the States of New York and New Jersey could not be justified. The point as to whether New York has the right, under the provisions of the interstate tunnel treaty, to participate in the expense of the street widening work in Jersey City is now before the attorney general of New York for a ruling.

The proposed street widening has been made a political issue in the Jersey City election this month.

Western Society Elects Officers on Regular Ticket

In the electrion of officers for the Western Society of Engineers, the entire regular ticket was carried by a large majority. President, Charles H. MacDowell, president of the Armour Fertilizer Works; vice-presidents, Julius L. Hecht, F. F. Fowle and Benjamin S. Shapiro; trustee, Edwin W. Allen; treasurer, Homer E. Niess; members of Washington Award Commission, John F. Hayford and Henry J. Burt.

Some of the sections of the society have elected chairmen as follows: Railway section, F. L. Thompson, chief engineer, Illinois Central R. R.; bridge and structural section, J. E. Love, structural engineer, H. T. Ryerson & Son; hydraulic, sanitary and municipal section, L. R. Howson, of Alvord & Burdick, consulting engineers.

Federal-Aid Road Bill Impresses Legislators

Dowell Measure Carefully Drafted — Vulnerable Points Discussed in Townsend Bill

(Washington Correspondence)

There is a very general feeling on Capitol Hill that the state highway officials did themselves proud in drafting the federal-aid road bill which was introduced by Representative Dowell, of Iowa, May 3. That it has been worked out with the greatest care is admitted, even by opponents. Lawmakers who are not greatly concerned as to which of the highway policies is adopted regard the Townsend bill as being much more vulnerable than is the Dowell measure.

So far as its legislative course is concerned, the most vulnerable point in the Townsend bill, it is believed, is the fact that five men are to sit in Washington and lay out all the roads in the United States. There is very strong feeling in Congress against forcing people to come to Washington, "hand in hand," to make arrangements to comply with a federal law and the administrative regulations which go with it. Regardless of the advantages which may be gained in the selection of a road system by a central commission stationed in Washington, such a plan is assured in advance of strong opposition. This sentiment is a legacy from the war period when licensing and permit systems made it necessary for a very large number of persons to journey to the capital to discuss complicated points arising in the issue or administration of such permits. This procedure came into such disfavor that its continuance has been avoided, wherever possible, in subsequent legislation. The fact that the people of the several states would have to come to Washington to get their roads on the map is expected to arouse a type of opposition which it would be hard to appease. The selection of highways by a commission in Washington, friends of the Dowell bill contend, is approaching the problem from the wrong end. They contend that the people in the locality must select the roads. It is pointed out, in that connection, that even when selected locally, the designation of roads for improvements almost always gives rise to heated controversies, while bitter fights are not infrequent.

Another element of weakness in the legislative position of the Townsend bill is the fact that it is open to the contention that the federal highway commission plan would add to the overhead expense of road construction.

There would be five commissioners at a salary of $10,000 each. It is admitted that the establishment of a commission would in no way curtail the present force employed by the U. S. Bureau of Roads. A chance will be given opponents of the bill to argue that the tendency would be to build up a much larger bureau.

The fact that no definite system of roads is outlined in the Townsend bill is certain to give rise to apprehension in the states as to the mileage which may be expected. Sight will not be lost of the fact that the first Townsend bill planned to expend all federal funds on two roads, and no more, in each state.

The provision in the Townsend bill empowering the commission to maintain a federal-aid highway, if the state fails to do so, is certain to meet with the criticism that this would put the government into the construction business on a large scale. The corresponding provision in the Dowell bill is very generally considered the stronger. In the Dowell bill, the Secretary of Agriculture is empowered to let a contract to cover a default in maintenance and charge the cost of the work against the federal funds allotted to the state. The Secretary is precluded from approving further projects for that state until the state has reimbursed the federal government. The funds thus repaid are returned to the treasury and are forever lost to the state.

Hearings on the Townsend bill are to begin in the near future; at this writing, the exact date has not been set. Members of the House committee on roads have not determined whether or not it will be necessary to hold general hearings on the Dowell bill.

Two Confirmations Complete Membership of I. C. C.

With the confirmation by the Senate of E. I. Lewis of Indianapolis and J. D. Campbell of Spokane as members of the Interstate Commerce Commission, all of the vacancies on the commission have been filled. The incoming administration found four vacancies on the commission. Mark W. Potter, who was nominated by President Wilson but whose nomination was not confirmed at the last session of Congress, was re-nominated by President Harding and was confirmed early in the present session. The other vacancy was filled by the appointment of John J. Esch.

New Bascule Span for Troy, N. Y.

A 224-ft. double-leaf bascule is to be built as part of the 12th St. bridge over the Hudson River and Barge Canal, at Troy, N. Y. The state engineer's office adopted the Strauss type of bascule for this structure, and designs are now being prepared by the Strauss Bascule Bridge Co., Chicago. The bridge will carry both street car and highway traffic.

Ridgway Named Chief Engineer of N. Y. Transit Commission

Robert Ridgway has been made chief engineer and Daniel L. Turner consulting engineer of the newly created Transit Commission in New York City, which takes the place of the Transit Construction Commission. In the new division of duties Mr. Turner, who has served since 1916 as the commission's chief engineer, will devote his entire time to the planning of transit facilities for New York while Mr. Ridgway, formerly engineer of subway construction, will, in his new capacity of chief engineer, have administrative charge of all design and construction work. Both engineers will receive a yearly salary of $15,000 and will report to the newly appointed executive officer of the commission, Brig.-Gen. Lincoln C. Andrews, U.S.A., retired.

Other appointments announced in connection with a valuation of existing transit lines, proposed by the new commission, are as follows: John H. Madden, valuation engineer, at a salary of $1,000 per month while employed; F. W. Lindars, chief accountant, at $10,000 a year; Major John C. Hooper, assistant chief accountant, at $6,000 a year; Capt. Edward T. Fitzgerald, acting chief of the transit bureau, at $4,000 a year. All of the new appointees, according to chairman George McAneny, were connected with the old Public Service Commission before the war.

Chicago Stops Bridge Work

Owing to the city's shortage of funds an order from the municipal authorities has stopped all contract work on the new Chicago River bridges.

New Acting Secretary of American Society of Civil Engineers

ELBERT M. CHANDLER

Los Angeles Terminal Plan Is Ordered

State Commission Adopts Plaza Union Station Project—Under Joint Engineering Committee

The Railroad Commission of California on April 26 ordered the four railroads entering Los Angeles to proceed with the Plaza union terminal. The order directs that (1) a joint engineering committee, to supervise and direct the construction of the union depot, be selected within 30 days after May 20, 1921, when the order becomes effective; (2) that plans covering the necessary grade changes be filed within 60 days, and (3) that plans for the union depot be filed within 6 months. The work can be completed within five years, the commission states. The first step is to eliminate grade crossings, particularly along Alameda St., and pending these changes the city is directed to withhold future permits for industrial tracks in the streets. The railroads involved are the Southern Pacific, Santa Fe, Los Angeles & Salt Lake and the Pacific Electric. The provisions of this order, however, do not require the Pacific Electric to make grade separations since the commission is now conducting a separate investigation into the affairs of this road.

The joint committee is to consist of two men appointed by the city and two by each of the roads, they in turn to select a disinterested party to serve as chairman. If a chairman cannot be agreed upon, he will be appointed by the commission. The order states that "the commission assumes that the city will carry out its repeatedly affirmed intention to further in every possible way the consummation of the general plan."

The cost and division of the expenditure is not covered in this order and is not to be taken up in detail until after the plans of the joint engineering committee have been filed. The order is accompanied by a table showing the itemized cost estimate of all the work involved, as made by the commission engineers, totaling $25,000,000, and also that made by the railroad engineers which totals $45,000,000. The order specifically states, however, that these tables are used to identify construction items and not as a finding of cost.

The commission's order contains a résumé of the union terminal project history. In 1915 Los Angeles organizations petitioned the commission to order the elimination of grade crossings. A friendly suit that was then instituted in the State Supreme Court resulted in a decision that the commission had full authority in the premises and should satisfy the petitioners. Meantime the city advanced $20,000 toward the cost of an engineering report concerning complete grade crossing elimination to be made by the commission.

After a two-year study the engineering department of the commission brought out a 1,000-page printed report that specified these locations and

carried a recommendation for adopting the Plaza site. This was two years ago. The Mayor of Los Angeles then appointed a board of five engineers to review the report and submit conclusions. This board approved the Plaza site and, in general, the commission's findings as a whole. Following this, both the commission and the city held public hearings on the question of location. For several months since these hearings the commission has had the matter under advisement and has finally handed down the order announced in the foregoing.

In its report the commission says: "Representatives of the Southern Pacific, the Los Angeles & Salt Lake and the Pacific Electric railroads have frankly admitted that they are in opposition to any plan that will interfere with the consummation of their own proposal, which provides for a partial union passenger terminal on the present Southern Pacific depot site. These railroads are not opposed to terminal unification *per se*, rather are they in favor of it. They do not desire however, to depart from their own plans."

Press reports state that the several railroads affected will fight the decision in the United States Supreme Court, on the ground that the commission has acted without authority.

Missouri Franchise Tax Law Is Held Constitutional

That the Missouri franchise tax law is not in contravention of the commerce clause of the Constitution is stated in the opinion rendered by the Supreme Court of the United States on May 2. This decision sustained the opinion of the lower court, which had ruled adversely on the application of the St. Louis-San Francisco Ry. Co. to restrain the State of Missouri from collecting the franchise tax. That the value of the franchise is derived partly from the fact that the corporation operates in interstate commerce does not invalidate the tax, the court holds. The Supreme Court also expresses the opinion that the constitution of Missouri has not been violated. "We cannot much doubt," says the opinion, "that the tax was intended to be measured by the proportion of stock and surplus in the state and that the omission of reference to surplus is a misprision or abbreviation that does not conceal the purpose to be gathered from it."

Interstate Drainage Lawsuit Is Reopened by Court

The final decision of the U. S. Supreme Court in the Dakota-Minnesota drainage case will not come as soon as expected. Although the final hearing has been held (see *Engineering News-Record*, Jan. 27, p. 187) the court has decided to hear further testimony from each side as to the possibility, within the limits of reasonable expenditure, of improving the flood conditions along the Bois de Sioux River by means other than an injunction against the maintenance of drainage ditches. The various means suggested for relief are: (1) Detaining basins in the Mustinka watershed, (B) a sluice dam to make Lake Traverse a detaining resorvoir, (C) dredging the channel of the Bois de Sioux River, (D) discharging part of the Lake Traverse waters south into Big Stone Lake, (E) diverting part of the upper Mustinka River flow into the Rabbit River.

Evidence concerning the proper equitable basis for apportioning the expense of any feasible project among the states drained is also asked by the court, which included other minor matters in the order. Thus the final decision will be delayed for several months at the least. Proposed improvements at Lake Traverse and on the Bois de Sioux River, as recommended by the U. S. Department of Agriculture, were described in *Engineering News-Record* July 29, 1920, p. 225.

Dismiss Luten Suit Based on Falsework Patents

Two of the Luten falsework patents, Nos. 802,004 and 1,106,880, the first entitled "Centering For and Method Of Constructing Arches," and the second, "Falsework," figure in the suit decided March 24, 1921, by Judge A. S. Van Valkenburgh in the District Court of the United States for the Western Division of the Western District of Missouri. Suit was by Daniel B. Luten against the Kansas City Bridge Co. for the infringement of the patents of falsework for concrete bridges. These patents, as is well known, involved the use of falsework struts too weak in themselves to support the required load, but made strong enough by braces or wiring. The special feature in the design is the fact that the arch may be struck by cutting the braces or the wiring, thereby throwing the load onto two or more separate members instead of the composite member; the separate members, being weaker, deflect sufficiently to strike the arch.

Judge Van Valkenburgh stated that it is but an obvious departure to substitute for a large timber a smaller one and to supply the difference in sustaining strength by the addition of braces. "Patentable invention," he said, "cannot be made upon well known inherent qualities, attributes and functions of natural substances, such as wood, iron or steel. It is quite obvious that a timber too small in itself to support a given load, and raised to the required strength by the addition of braces, will buckle or bend if the braces are removed. . . . I am unable to perceive in either of the patents evidences of inventive genius as distinguished from mechanical and engineering skill stimulated by ordinary technical study and experience. . . . Being of opinion that the devices in question do not embody patentable novelty and invention, the plaintiff's case must fail. The motion to dismiss is sustained."

Belle Isle Bids Again Rejected and New Bids Asked

Acting upon the recommendation of the commissioner of public works, Joseph A. Martin, the Detroit city council has instructed the department to reject all bids opened on April 23 for the construction of the Belle Isle bridge, including the bid submitted by the department itself, and to advertise for the fourth time, bids to be opened May 21. This action was taken when it was found that the bid of the Arundel Corporation could not be trimmed to come within the bridge fund. Bids are now asked on the same quantities and plans as for the bidding of April 23, conforming with the revised plans as worked out by Esselstyn, Murphy & Hanford, engineers in charge of the design and supervision of the bridge, but the quantities are grouped into four groups and a total cost limit is included.

Group A covers the substructure (wet and dry excavation, wood piling, concrete pier footings and abutments, cofferdams and the removal of existing piers). Group B includes structural steel and bronze bearings, erected. Group C comprises the concrete in the bridge superstructure, reinforcing steel, roadway work and waterproofing. The metal handrailing constitutes Group D. The total limit of cost is placed at $2,401,672, this being the sum remaining of the $3,000,000 bridge fund voted by the people. A subway approach to the bridge has already been constructed at an approximate cost of $400,000, and this amount has been paid out of the bridge fund.

By asking for separate bids for the four groups, it is hoped that the construction of the bridge can be gotten under way without further delay as there is a possibility of letting a contract for at least part of the structure such as the substructure or foundation, in event a bid is received which comes within the engineers' estimates. The city is hopeful of receiving satisfactory bids because of the decreasing costs of material. The letting of a contract for part of the bridge would be in line with the policy Mayor Couzens advocated when the first bids were opened. The council took an opposite position at that time since the low bids indicated that the bridge could not be completed with the money available.

Canadian Government Takes Over Control of Grand Trunk

The bill introduced in the Canadian House of Commons on April 19 by Premier Meighen to take over control and operation of the Grand Trunk Ry., as a condition to proceed with arbitrating compensation to be paid stockholders and to continue to absorb the operating deficits of the property, was passed by the House, April 26. There was very little opposition to the bill, which outlines further terms upon which the government will proceed in

its undertaking and provides that the directors of the Grand Trunk and its subsidiaries are to resign when requested to do so, to be succeeded by a board named by the government. The board may carry on the business of the company without reference to the shareholders. It allows the company until May 16 to accept the terms offered. A committee representing the shareholders will be appointed to present their case in a continuation of hearings before the Board of Arbitrators, the powers of which are now extended.

The arbitration board had withdrawn officially April 9, discontinuing the proceedings, since the original agreement between the government and the Grand Trunk R.R. provided that the arbitration should be completed by that date. It was charged by the government that the railway company had dragged out the arbitration proceedings unnecessarily and it was argued that the only recourse now would be to assume actual control of operation.

Minnesota Valley Drainage and Conservancy District Formed

Ten district court judges, sitting in bank at Mankato, Minn., April 25, ordered the formation of the Minnesota Valley Drainage and Conservancy District. The district is to consist of all valley lands adjacent to the channel of the river from the upper end of Big Stone Lake (the continental divide) to within about 15 miles from the confluence with the Mississippi at St. Paul, embracing about 272,000 acres.

The action of the court resulted from a series of hearings, covering a period of four months, on a report submitted to the state commissioner of drainage and waters by Adolph F. Meyer, consulting engineer, of Minneapolis. A chief engineer and a consulting engineer will be appointed by the district as soon as formed. The Minnesota Legislature has made an appropriation of $35,000 to enable the comissioner of drainage and waters to prepare necessary plans for the structures for this project. The commissioner also has an appropriation of $25,000 with which to prepare plans for the Red Lake River drainage and navigation project. Congress, at the last sesion, also appropriated funds for the latter.

Railroad Hearings Start Before Senate Commerce Committee

The Senate Interstate Commerce Committee, acting under the Cummins resolution passed by the Senate April 19, to investigate the railroad situation of the country, with special reference to the causes of high operating expense, began its hearings May 10. Railway executives will be the first witnesses to be heard. In the meantime the railway labor unions have publicly charged the railroad managements of wasteful practices amounting to more than $1,000,000,000 a year.

Public Roads Report on Arkansas Situation Is Submitted

Supported by transcripts of records, financial accounts, engineers' reports and other data, the findings of E. W. James, assistant engineer, Bureau of Public Roads, on the Arkansas road situation have been made to the chief of the Bureau, Thomas H. MacDonald. (See *Engineering News-Record* April 7, p. 611, and April 21, p. 699.)

The government investigation reveals that whereas its interest have been fully protected, though with some difficulty, a continuation of the present system of taxation for road improvement will become, in many cases, burdensome. The report also charges that the state highway department is not equipped to carry on so large a program as is outlined for the state, and that "the administration of road matters is open to serious criticism," especially in some of the improvement districts.

The report concludes with the recommendation that "no further progressive payments on Federal-aid projects be made in Arkansas until the existing conditions are corrected and that all payments be witheld until the completion of the projects."

Michigan Port Bill Fails to Pass

The resolution introduced into the Michigan Legislature to amend the state constitution, authorizing the incorporation of port districts with power to engage in work of internal improvement, to take advantage of the proposed St. Lawrence waterway, failed to pass in the regular session of the legislature and will be brought up again at the coming special session. If passed then, the question will go to the voters in time for an enabling act to provide for starting port development work in the summer of 1923. Particular interest attaches to the bill in Detroit since it is assumed that its introduction was primarily to affect that port.

To Build Railroad for Construction of Power Development

For the purpose of serving construction work of the Pit River (Cal.) project, plans have been completed by the Pacific Gas & Electric Co. for the construction of a broad gage railroad 32½ mi. in length. The line will start at Bartel, at the end of the present system of the McCloud River Railroad Co., and will run east through Cayton Valley to the sit of Pit River Power House No. 1. The new line will distribute construction materials for all of the power houses on the Pit River project, and will be built to reduce the cost of hauling by truck. Analysis showed that the rail line, with maximum grades of 4 per cent, would be cheaper than to a continuation of the use of trucks. Fifty-pound rail is being used.

Wallace Discusses Engineering Federation's Work

L. W. Wallace, executive secretary of the Federated American Engineering Societies, has returned to his office in Washington after a visit to Milwaukee, Detroit and Chicago. At Milwaukee, he addressed the Society of Industrial Engineers on industrial leadership. At Detroit, he spoke at the annual banquet of the local engineering societies. In Chicago, he attended a meeting of American Engineering Council's committee dealing with the licensing of engineers. This committee, in view of recent legislation, has made certain changes in its model bill. These changes will be laid before the executive board of the council at its June meeting.

San Francisco Water Front Still Under State Control

The bill before the California legislature which proposed the transfer of control of the waterfront at San Francisco from the state harbor commission to the city of San Francisco, has been defeated after a long fight on the floor of the senate.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York. Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J. June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa. Annual Convention, New Haven, Conn., June 28-July 1.

American Society for Testing Materials.—A tentative program for the annual meeting at the New Monterey Hotel, Asbury Park, N. J., June 20-24, has been issued. Monday afternoon and evening, June 20, are to be devoted to committee meetings. Three sessions will be held Tuesday with the presidential address and a dinner and smoker at night, two meetings on Wednesday, with committee meetings in the afternoon, three meetings on Thursday and two on Friday, with the golf tournament in the afternoon. Cement, concrete and road materials come on Wednesday, lighting and oil products on Thursday, and the metals on Friday.

The nominating committee has named for president, C. D. Young, general supervisor of stores of the Pennsylvania R. R.

The American Society of Safety Engineers has made application for charter membership in the Federated American Engineering Societies.

The Engineers' Club of Philadelphia, at its luncheon meeting, May 17, will be addressed by Axel Malm on "Business Methods of European Engineers Compared With Those of American Engineers." On the evening of May 17 the annual meeting will be held, with election of officers. The meeting will be addressed by Guilliaem Aertsen, the retiring president, and after the regular meeting a film, "The Story of Asbestos," will be shown.

Personal Notes

JAMES V. KARRICK, formerly with the Hughes-Keenan Co., Mansfield, Ohio, as assistant engineer on structural steel work, is now bridge designer with the Kentucky Highway Commission at Frankfort, Ky.

ROSS EVERLEY, for a number of years engineer and inspector of construction on government projects for the Bureau of Yards and Docks of the Navy, is now superintendent of construction with the Magic City Building Co., Miami, Fla.

CLARENCE B. MYERS, formerly with the Pennsylvania State Highway Department, has been appointed assistant engineer Philadelphia Bureau of Highways.

H. G. SHULDE has been appointed district engineer Pennsylvania State Highway Department, with headquarters at Bedford, Pa.

CHARLES SMITHLEY has been appointed county engineer of Geary County, Kan.

J. O. CORWIN, JR., has been appointed engineer of Travis County, Tex.

R. N. KINNAIRD, formerly with the Des Moines Water Co., has opened an office as consulting engineer in Des Moines.

STANLEY M. MCKEE has been appointed consulting engineer for the Republic Iron & Steel Co., Youngstown, Ohio, to succeed C. C. Shackelford, resigned.

J. M. R. FAIRBAIRN, chief engineer of the Canadian Pacific Ry., and R. A. Ross, member of the Administrative Commission of Montreal have been awarded the degree of Doctor of Science by the Senate of the University of Toronto.

C. R. MEE has been appointed chief engineer of the Louisiana Railway & Navigation Co., with headquarters at Shreveport, La.

GEORGE W. BOSCHKE, assistant chief engineer Southern Pacific Co., Pacific System, was appointed chief engineer effective May 3 last, succeeding William Hood, who has retired from active service, as noted on page 824. Mr. Boschke was born in San Francisco in 1874. He began his railway engineering work in 1886 for the Southern Pacific Co. From 1890-1900 he served as axeman, chainman, rodman, timekeeper, material clerk, inspector, and instrumentman with the Southern Pacific, and during the following three years as officeman and assistant engineer with the Texas & New Orleans R.R. and the Southern Pacific Terminal Co. of Texas. From 1903-1906 he served as assistant engineer with several of the Southern Pacific subsidiaries and then became engineer of construction for the Pacific Engineering Co. He entered the service of the Oregon-Washington Railroad & Navigation Co. in 1905 and in 1913 resigned as assistant general manager to become chief engineer. He was later appointed assistant chief engineer of the Southern Pacific Co., Pacific System.

ALDRICH DURANT, formerly of the board of governors of the Associated Pennsylvania Highway Contractors, has gone to Peru in connection with extensive port development work for which the Foundation Co. of New York holds the contract.

H. A. VON SCHON, consulting engineer, recently of Washington, D. C., has accepted appointment of court commissioner to regulate water power operations on the St. Joseph River, with office at South Bend, Ind. He will continue his consulting practice in hydroelectric engineering, public utility valuations, underwriters reports, water rights and public service legal issues.

BERNARD C. HARVEY has been appointed city engineer of Rockford, Ill.

WILLIAM L. ROCKWELL, consulting engineer for thirty years in hydraulic engineering, including irrigation development, water supply and power development, has just returned from two years in the West Indies, and has resumed his consulting hydraulic engineering practice at Austin, Tex.

L. L. BATEMEN, formerly resident engineer for the Michigan State Highway Department, in charge of trunk line construction in Cheboygan and Otsego Counties, has been appointed assistant county engineer of Huron County, Mich.

GEORGE F. CATLETT, formerly sanitary engineer for the Consolidated Board of Health of New Hanover County in Wilmington, N. C., has been appointed principal assistant engineer Bureau of Engineering, North Carolina State Board of Health, and in this capacity will have charge of the water supply division of this bureau.

CHESTER H. LOVELAND, chief hydraulic engineer of the California Railroad Commission, has resigned to enter private practice as consulting engineer to participate in the development of the state's water resources. He has been with the commission for seven years, and during that time has been active in matters relating to domestic water and irrigation projects throughout the state. During the water shortage of last year, it was largely through his efforts that the "Emergency Water Conference" formed of state and federal officials, was organized.

A. G. MOTT, for nearly twelve years connected with the Southern Pacific Co., has resigned as assistant engineer to accept a similar position with the California Railroad Commission, San Francisco.

W. V. TAYLOR of Gananoque, Ont., has been appointed city engineer of Sarnia, Ont.

D. S. MCCALMAN has resigned as state highway superintendent of Wyoming.

FRANK P. SCHADE has been appointed city engineer of Cudahy, Wis.

A. C. BRADLEY, recently division engineer Chicago, Rock Island & Pacific Ry., with headquarters at Colorado Springs, Col., has been transferred to the Chicago Terminal division, with headquarters at Chicago.

THEODORE LANCTOT, who has been assistant engineer in the public works department, and superintendent of the Canadian Highway's Engineering Co., Ltd., Montreal, has been appointed city engineer of Hull, Que.

CARLOS E. ELLERBROOK, formerly highway engineer and inspector, Michigan State Highway Department, is now with the Iowa State Highway Commission as highway engineer and will have charge of a 17-mile paving project starting from Sioux City.

EDWARD G. ELLIOTT, formerly with the Illinois State Highway Commission and with the New York State Highway Commission, is now county road engineer, Randolph County, W. Va.

S. R. BATSON has resigned as county engineer of Jefferson County, Ala., to enter private engineering practice.

C. J. ROGERS, formerly assistant county engineer, Jefferson County, Ala., has been appointed county engineer.

WILLIAM H. HULL, for many years associated with the T. A. Scott Co., Inc., New London, Conn., and Boston, Mass., in their engineering department, has been elected vice-president in charge of engineering and construction.

HOWARD M. RAYMOND, dean of engineering, Armour Institute, since 1903, and connected with the institute for twenty-six years, has been made acting president to fill the vacancy caused by the recent death of Dr. F. W. Gunsaulus.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Federal Reserve Banks Report Increases in Building

In analyzing the reports of its member banks, the Federal Reserve Board, in discussing conditions as of May 1, has the following to say of interest to the building industry: "Building operations showed increased activity during March, which is a normal condition for this season of the year. Number of building permits, value of building permits, and value of contracts awarded all registered marked increases as compared with February. This increase is particularly large in the case of number of permits, as a result of the continued increase in the building of residences. Contracts awarded in the New England states amounted to $13,262,000 during March, an increase of 84 per cent over February."

Following are the reports from districts:

District No. 2 (New York)—Contracts amounting to $29,846,000, an increase of 40 per cent over the February figure, of which 59 per cent were for residential buildings, as compared with 48 per cent in February and 40 per cent in January. The increase in residential construction has been confined almost entirely to the least expensive apartments and small homes.

District No. 3 (Philadelphia)—Large increase in the value of building permits issued during March in comparison with the February. Funds for mortgages have been difficult to obtain, but there has been a steady increase in number of houses bought through the building and loan associations.

District No. 4 (Cleveland)—An increase in value of building permits issued during March, but there still seems to be a tendency to wait for lower costs before commencing construction.

District No. 5 (Richmond)—Reports from 23 cities show 1,718 permits issued for new construction during March, in comparison with 894 permits issued in February. [illegible] for any month since February, 1920.

District No. 6 (Atlanta)—[illegible] worthy increases in activity occurred in Atlanta, Birmingham and Tampa.

District No. 7 (Chicago)—There was an increase in value both for building [illegible] as compared with February figures.

[illegible] noted in value of building permits for three leading cities in March, as compared with February, but these figures are very much [illegible]

[illegible] valued at $2,647,666 were issued in the reporting centers in March, as compared [illegible]

[illegible] 18 per cent over the total of March, 1920 [illegible] and value of building permits issued in [illegible]

[illegible]

Wholesale Costs—Construction and Living

General Construction Costs Compared with Wholesale Prices of All Commodities and Special Groups

The relation between general wholesale prices and the basic cost of construction in the United States is indicated by Fig. 1, in which the well-known index numbers of R. G. Dun and of the United States Bureau of Labor Statistics are plotted with a construction-cost estimation compiled by *Engineering News-Record.* The Labor Bureau figures were already on the basis of 100 for the year 1913, and Dun's figures and *Engineering News-Record's* have been made to agree with this same basis. *Engineering News-Record's* figures and those of the Labor Bureau are yearly averages, whereas the two Dun curves show conditions in January and July, respectively, of each year. The agreement of the four curves is close, except as regards the decline in 1921. General wholesale prices have fallen sharply, while construction cost is lowering conservatively, as happened after the Civil War.

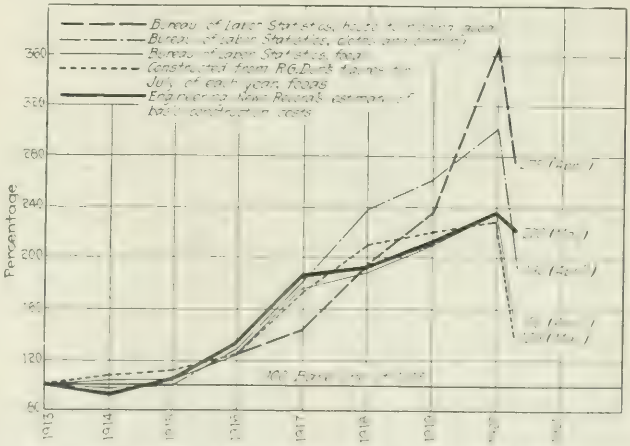


FIG. 1—RELATION OF GENERAL WHOLESALE PRICES AND CONSTRUCTION COSTS

Intelligent study of the chart necessitates [illegible] of what each of the curves means. The "All Commodities [illegible]" of the Bureau of Labor Statistics is the summation of nine classes: Farm products, food, [illegible] metals and metal products, building [illegible] Dun's Index Number is the total of [illegible] dairy and garden, including butter, eggs, vegetables and fruits; fish, condiments, sugar, rice and tobacco; clothing; metals; and miscellaneous, embracing lumber, lath, brick, lime, glass, turpentine, hemp, linseed oil, paints, fertilizers and drugs.

Engineering News-Record's figures take into consideration the rate paid common labor, and the price movement of the three construction materials least influenced by local conditions: steel, lumber and cement. The base prices of structural shapes at Pittsburgh, Southern pine (3 x 12 to 12 x 12) in New York, cement (without bags) f.o.b. Chicago, and the daily wage of common labor, were carefully weighted according to their relative importance and then combined so as to give 100 as the 1913 estimation of construction cost. The percentages for the ensuing years are as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
1920	237
[illegible]	[illegible]

It [illegible] either hung fire—according to the Labor Bureau figures—or advanced, as shown by Dun's calculations. It is in[illegible]

the spring of 1913 and 1914 structural shapes, Pittsburgh mill, fell from $1.62 to $1.13, reinforcing bars at Pittsburgh mill from $1.50 to $1.17, Dun shows that metals dropped from $16.512 to $15.691.

Fig. 2 shows construction cost compared with the wholesale prices of food, clothing and house-furnishing goods. The Dun food curve was constructed by reducing the index numbers for breadstuffs, meat, dairy and garden products, etc., to a 100 per cent basis for 1913, and then averaging them.

Since 1920, prices of both raw materials and manufactured products, and in many sections the rates paid labor, have fallen more or less sharply. Construction materials have lagged behind living necessities, as is to be expected of materials whose output can be limited to the demand. There is only a slight control over the production of food products, and output is chiefly dependent upon the abundance or scarcity of crops and live stock. House furnishings soared to a prohibitive peak and are now descending rapidly. In fact, the wholesale prices of foods, clothing and house furnishing goods appear to be declining at about the same rate, with construction materials following at a more conservative pace.

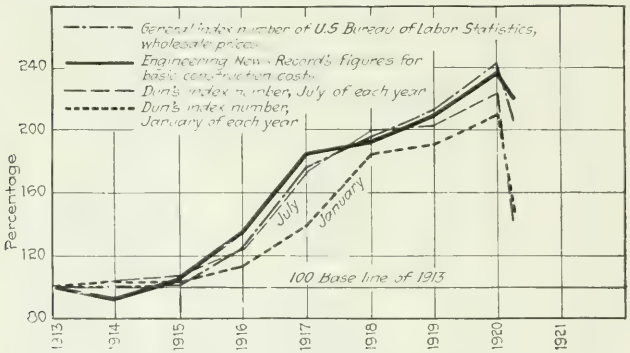


FIG. 2—COMPARISON OF CONSTRUCTION COST AND WHOLESALE PRICES OF FOOD, CLOTHING AND HOUSE-FURNISHING GOODS

Conditions in the Common Brick Industry

As indicating the trend in the price of common brick, a composite price taken from the reports of 142 members of the Common Brick Manufacturers' Association on Feb. 1, gave $18.05 as the per-thousand price. From the reports of 132 members on March 1, the price was $17.40, and the composite price of current reports from 126 members reduces the figure to $16.97 per thousand, according to a recent digest of the association. The actual range is from $12 to $25 throughout the country. The lowest price quoted is that of Chicago.

The general condition of the industry is shown by the fact that current reports show only 84 plants closed, whereas a previous monthly report showed 115. The quantity of burned brick on hand has in thirty days been reduced from 331,940,000 to 264,697,000, and orders during the month have increased from 111,182,000 to 114,875,000. Of the plants reporting as being closed, about one-fifth have so adjusted their stock that they plan early resumption of operation. The digest predicts much greater activity in the brick industry during the coming month.

Drive On To Lower Freight Rates

Railway executives, Interstate Commerce Commission members, and producers and shippers of building materials are to meet in Washington tomorrow in conference to discuss the proposition of lower freight rates on building material. The meeting was arranged after representatives of the principal material producers on May 3 conferred with Chariman Winslow of the House Interstate Commerce Committee, with Chairman Clark of the Interstate Commerce Commission, and later with President Harding. At that time it was suggested a joint conference be arranged, the meeting tomorrow being the result. Material producers generally feel that construction stagnation is due in a large extent to high freight rates on building material. Organizations represented at the meeting May 3, and which will probably be represented at tomorrow's conference, include the National Association of Sand and Gravel Producers, National Paving Brick Manufacturers Association, American Face Brick Association, Hollow Building Tile Association, National Lumber Manufacturers Association, National Crushed Stone Association and the Gypsum Industries Association.

Bond Decisions Slow Up Street Work in Columbus

Two recent decisions of bond houses changing the method of disposing of municipal bonds in Ohio have resulted in delays in the Columbus street-improvment program. The first of the decisions declares illegal the practice of sinking-fund trustees selling bonds for other than sinking-fund purposes. This prevents the sale of bonds in order to buy other bonds, thereby changing the usual method of having the sinking fund immediately absorb street improvement bond issues. The other decision advised against the purchase of bonds for street, alley and sewer improvements until the assessments on property owners had actually been made. The former procedure had been to authorize bonds and sell them in anticipation of the assessments and then go ahead with the work.

New York Lets Highway Contract Worth $2,900,000

Contracts for the construction and repair of highways were let during the past week by the New York Highway Commission aggregating in excess of $2,900,000. Bids for the construction and repair of these roads were received on May 3 and 4, 110 miles of new highways being involved. Of these 110 miles distributed among 21 projects in practically as many counties, the total estimate was $4,269,679, whereas the sum of the low bids was $3,905,167, a saving of $364,512.

There was an average of five bidders for each project, one project attracting twelve bidders and another eleven.

Southern Pine Orders Reach New High Mark

During the week ended April 29 orders received by members of the Southern Pine Association averaged 20 per cent more per mill than ever reported for the corresponding week of other years, according to a recent bulletin issued by the association. Orders represented an average of 694,049 ft.b.m. per mill, the next figure to this being in 1919 when orders for 576,409 ft.b.m. were received.

This high figure is also a larger amount than has been received in any other week in 1921, being nearly 50 per cent in excess of orders reported during the last week of March.

Ontario To Build Cement Plant

The Ontario, Canada, Legislature has appropriated $1,000,000 to provide for the construction of a provincial cement plan. According to the present plan the plant will have a capacity of 300,000 bbl. per year, the ouptput from the plant to be used for supplying cement to municipal and provincial construction work. During the past year the province has had to cancel important contracts owing to its inability to secure cement except at excessive prices. The government has no intention of competing in the open market with private concerns, its intention being to furnish a source of supply for municipal and provincial contracts.

Jail Term Asked for Building Material Dealers

Special Deputy Attorney General W. A. DeFord has urged that Justice Davis of the Supreme Court impose jail sentences upon the nineteen individuals, and heavy fines upon the thirteen corporations, members of the Association of Dealers in Masons' Building Materials, New York City, who pleaded guilty to conspiracy and violations of the Donnelly anti-trust law, following disclosures made before the Lockwood joint legislative committee on housing. Justice Davis, however, deferred imposition of sentence until he can more fully determine how culpable the defendants are, and how able to pay maximum fines. Sentence will be imposed before the trial of the eighteen other defendants in the case begins, which is scheduled for an early date.

Northwest Lumber Production Increases

Lumber production among the 112 mills reporting to the West Coast Lumbermen's Association increased four per cent during the week ended April 30, the output at that date being 29 per cent under normal. Total production amounted to 57,719,880 ft.b.m., and new business 63,287,331 ft.b.m. For the four months ended April 30 the production was but 47 per cent of that for the same period of 1920, says the association's bulletin.

Southern Pine Production 80 Per Cent of Normal

According to the Southern Pine Association's statistical statement for the month of March, 1921, 195 mills reported the production 79.39 per cent of normal. Orders for the month for 142 mills reporting were 79.38 per cent of normal, and shipments for the month, 79.86 per cent of normal. The stocks on hand March 31 were 101.98 per cent of normal. The March cut of the 195 mills was 387,958,529 ft. b.m.

Building Activity in Los Angeles Still at High Level

Building permits were issued in Los Angeles during the month of April for 2,904 structures estimated to cost a total of $7,250,511. This surpasses in value the highest previous record in the history of the city, which was made in September, 1920, with buildings valued at $7,231,000. In March, 1921, permits were issued for structures with a total cost of $6,915,698.

The present activity is chiefly in commercial and industrial buildings, a large percentage ranging from 50,000 to $100,000 in value. In the number and value of dwellings started as compared with September last, the month of April showed a decrease, falling under the September figure by about $750,000 in value and between 300 and 400 in the number of permits.

Providence Dam Contract Let

The water supply board of Providence, R. I., has let the contract for the construction of the main dam and dike at the Scituate reservoir, to Winston & Co., 240 Fair St., Kingston, N. Y. The successful bid was $3,499,-925. Bids for the construction of the dam and dike were opened on April 27, seven contractors submitting bids, the highest bidder being in excess of $6,000,000.

Construction Articles in This Issue

Bunkhouses Built in Sections For Convenience in Moving Page 800
New Concrete Arch Survives Washout of Centers Page 809
Levee Settlement Causes Seepage Under Pump House Page 814
Tunnel Building in Nicaraguan Jungles Page 821
Germany Returns to Adobe Building Page 823

Large Foreign Locomotive Order

The American Locomotive Co. has obtained an order for 42 locomotives of the Pacific, Mikado and Mallet types for the Pekin Kalgan Ry. of China. The total value of the contract is in the neighborhood of $2,600,000. The Pekin Kalgan Ry. is owned by the Chinese Government and the payment for these locomotives is financed jointly by the American Locomotive Co. and Mitsui & Co.

Slight Increase in Car Loadings for Week Ending April 23

Reports just received from the railroads of the country by the car service division of the American Railway Association showed another slight increase in the number of cars loaded with revenue freight during the week which ended on April 23. The total for the week was 704,527 which was an increase of 631 cars over that for the previous week. It was, however, a decrease of 13,000 compared with the corresponding week in 1920 and 10,500 compared with the corresponding week in 1919.

Compared with the preceding week, increases were reported in the loading of coal, coke, ore and live stock while there were decreases in the number of cars loaded with grain and grain products, forest products and merchandise and miscellaneous freight which includes manufactured products. Coal loading totaled 138,576 cars which was an increase over the previous week of 2,900 cars. It was, however, a decrease of 17,000 cars compared with the corresponding week in 1920 and 700 compared with the corresponding week in 1919. Loading of merchandise and miscellaneous freight totaled for the week 440,637 cars, which was a decrease of 4,[illegible] cars over the previous week.

Semi-Monthly Estimates for Ohio Road Contractors

The Ohio Highway Commission has worked out a plan whereby contractors doing state work will be able to receive their money at least once a month and if the amount is high, two times monthly. One of the chief difficulties met by contractors has been the getting of estimates through and vouchers drawn. Now, vouchers are sent out the tenth of the month for all work done up to the first of the month and if the amount done by the fifteenth of the month is $5,000 or more, another voucher will be mailed out on the twenty-fifth of the month, covering such work. The new plan is receiving much praise from contractors engaged on highway work.

Three Large Contracts Included in Record Total of $35,000,000

Due to the letting of three contracts during the week each calling for the expenditure of $3,000,000 or more, the past week eclipsed all previous weeks for the year in contracts let, as reported in *Engineering News-Record*. The total for the week was $35,749,872, of which miscellaneous building represented $17,058,847, and streets and roads $9,652,345.

The three large contracts let were for the Providence dam, noted elsewhere in this issue, and two $3,000,000 buildings in New York City, one an office building of twenty-three stories and the other a structure to be erected for the Society for the Prevention of Cruelty to Children.

Pennsylvania and Ohio together let road contracts valued at $4,445,808. Ohio is to receive bids for the construction of over forty projects May 27.

Strikes Follow Proposed Cuts in Building Trade Wages

Strikes have been precipitated in many cities due to the proposed reduction of building trade labor, which varies form 10 to 25 per cent. As a protest against a 24 per cent reduction in Philadelphia between 40,000 and 65,000 men have struck, employers reporting the former number out and the building trades council naming the latter figure. In Cleveland between 25,000 and 30,000 men employed on projects operated by contractors affiliated with the building trades employers' association struck May 2, after reporting for work. Union leaders demand a continuation of the wage scale which came to a close on May 1 and employers are insisting upon a general 20 per cent reduction. Labor leaders in Cleveland are not despairing of securing separate agreements with employers on the old basis.

In Newark, N. J., practically all trades struck on May 2, the job struck being those carried on by members of the Building Trades Employers' Association. According to union agent

most of the men in the trades have lined up with independent contractors who, it is reported, are willing to continue the old scale. The situation in Boston remains practically the same, the building trades employers in that city having several weeks ago announced an open shop policy due to the fact that the opposing factions were unable to come to any sort of an agreement upon wages.

In Kansas City some progress has been made toward arbitrating the differences between building trade labor and employers. However, not all of the trades in St. Louis are willing to arbitrate the question, the following being among those willing to abritrate. Carpenters, building laborers, hod carriers, engineers, iron workers, lathers, and cement finishers. In upstate New York strikes are reported from various localities, the worst trouble being experienced in Albany.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4.00	$3.75	$3.23	$3.51	$4.65	$4.35	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	7.05	4.88	5.30	6.25	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.85	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	49%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	45%	5%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.20	64.10	67.80	70.00	85.90	72.00	75.00
Concreting Material:									
Cement without bags, bbl	2.90 (del.)	3.00	2.85	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	1.75	2.75	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	1.75	2.75	1.00	1.10	1.65	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	3.20	2.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	38.00	45.00	55.00	38.00	47.00	27.00	24.00	120.00
Lime, finished, hydrated, ton	21.00	22.50	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	2.50	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.50	25.00	12.00	18.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	14	21	12	.10	.09	12½	.11	.19
Hollow partition tile 4x12x12, block	....	.15	19½	.09½	.10	.10	.16	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.70	.67	.88	.82	.83	.90	.92	.79	.72
Common Labor:									
Common labor, union, hour	.75@.80	.35	.60@1.00	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non-union, hour	.....	.25	.40@.60	.50	.50	.37½@.50	.50@.55	.40@.45	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

The adjustment of steel prices at warehouses, to agree with the recent reduction by the United States Steel Corporation, is now practically complete. Latest information quotes rivets at $6.25 in Denver, against the former price of $6.90 per 100 lb., while structural shapes are down 10c. per 100 lb. in San Francisco. Wrought pipe in Seattle is five points cheaper. Cast-iron pipe is down $1 per ton in Seattle, and $5 off in Montreal, being most expensive in San Francisco, where the price is $85.90. The Seattle quotation is $72; Montreal, $75.

Atlanta reports that prices in that city are not stable, owing to a "price fight" between dealers. We show lime and sand in Atlanta apparently higher than on Apr. 28, but the 10 per cent discount for cash makes up for the difference. Finished hydrated lime sells for $22.50 per ton, common hydrated for $18.

Common brick in Minneapolis is still quoted at $18 per 1000, although a large dealer reports that clay brick may be bought for $17. Fire brick dropped $5 last week. Cement costs $2.60 net delivered, $2.41 f.o.b. city.

For several weeks we have been calling attention to the steady decline in the price of linseed oil. Apparently the bottom has been reached. Five of our nine cities report a stronger market and higher prices.

New York quotations are practically the same as they were two weeks ago, although there is an interesting situation that renders sand and gravel attractive materials for immediate purchase. The formal price of gravel is still $2.50 per cu.yd., but it is reported that gravel can be had for as low as $2.

As regards labor — Minneapolis reports that the situation in that city is a case of "bluffing" on the part of both employers and unions. The reduced scale covering all the building crafts was effective May 1, but none of the unions has officially accepted the new scale, and the painters are on strike. Employers assert that sufficient non-union men are available and that many union men are employed at the new rates. Chicago reports: "On account of strike, everything is dead." A telegram from San Francisco states that the board selected by contractors and unions has decided that 17 crafts be reduced 7½ per cent instead of being granted the increase asked. The unions have rejected the finding, and the contractors assert that on May 9 they will put the board's scale into effect. Denver reports a slight increase in employment.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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The A.A.E. Convention

THE present condition of the American Association of Engineers has been likened to that of a machine which has passed through the period of initial wear and is undergoing readjustment. This was apparent at the convention in Buffalo last week. The time was devoted mainly to constitutional revision and a discussion of chapter activities. The meeting made no contribution to the constructive work of the association. Its accomplishments must be measured solely by the progress in improving the internal mechanism. Apparently still more experimentation and adjustment will be necessary before stabilization can be expected. There is divergence of view regarding the functions and importance of headquarters as against the local chapters. The latter are now to get 60 per cent of the dues. At the same time doubt is expressed regarding thes afety of chapter autonomy by taking from some of them the right to collect dues. The results of its experiments should yield valuable lessons, for its practice is in sharp contrast with that of the older engineering societies.

The German Settlement

LAST WEEK'S acceptance by Germany of the reparations terms and of responsibility, without reservation, for carrying out the provisions of the Treaty of Versailles is the most important step in the peace of the world since the signing of the Armistice. If Germany takes her pledge seriously, it will remove the menace of world disintegration that has been hanging over us since Nov. 11, 1918. Our declaration that we would stand by our war allies was a big factor in bringing Germany to a decision. She had hoped that the United States would favor more moderate terms than had been offered. When we signified unmistakably that we would not do so her last hope for modification of the terms disappeared. Just what Germany can pay, no one, not even the cocksure French financial specialists, can determine. It is certain, however, that if she goes to work with a will the fair-minded people of England and of America, if not of France, will be inclined toward leniency if a day should come when it is unmistakably demonstrated that the last 64,000,000,000 gold marks, which may be considered a sort of third mortgage, cannot be paid without serious detriment to Germany's necessary financial and commercial relations with the rest of the world. The first step, however, in setting the whole world back toward peace was Germany's acceptance of the terms. She has now done so without reservation. We can only hope that her acceptance was sincere and that it will be followed by an earnest effort to carry out the terms of the agreement. That course is the only one that will insure for Germany ultimate restoration to a satisfactory place in the family of nations.

Interesting the Young Men

ONE of the most promising attempts that have come to our knowledge to interest the young men in engineering society work has been under way for more than a year in the Boston Society of Civil Engineers. It will be found described elsewhere in this issue. It proceeds on the very sound principles, first, that the subjects must be those in which young men have an interest because of their every-day contact with them in their professional work, and, second, that the young men are thoroughly capable of running their own show. We go entirely counter to human nature when we plead with the young men to come to society meetings which discuss engineering problems always from the standpoints of their elders. The elder men themselves would quickly desert a program designed always from the viewpoint of the juniors. The second, and possibly the strongest, feature of the Boston Society program, is the placing of the management of the Designers Section in the hands of the young men themselves. Young men are energetic and full of life. They want to do things. They want to exercise initiative. They are a little resentful of being placed in leading strings. The Boston society has wisely recognized these fine qualities of youth and has expressed its confidence in the young men by encouraging them to form their own section, run by themselves and for themselves. Obviously, they may need guidance from time to time. At Boston they have shown also that they *want* such guidance. They have asked the older men to come in as counselors, but the show is their own. As a result they have risen to the responsibility placed upon them and are doing a noteworthy work in interesting the young engineers. The two principles upon which this section of the Boston society is founded may well be taken to heart by engineering societies throughout the country. Youth is a tremendous asset. By and large we are not capitalizing it in our engineering societies. Boston has set us all a very good example. In saying that we do not want to belittle some good work that has been done with the younger engineers in other centers, but we do believe that the work at Boston is rather the most hopeful of which we have heard.

Canada's Railroads

THE PROPOSAL of Lord Shaughnessy, chairman of the Canadian Pacific, that the Canadian Government buy the lines of his corporation and then turn over the entire Canadian railroad system, excepting the Grand Trunk and a few small lines, to the Canadian Pacific for operation, injects a new and interesting consideration into the troubled Canadian railway situation. The Canadian Pacific has long been a thorn in the side of the Canadian government's handling of the railroad prob-

lem, not because of any fault of that railroad but rather because of its efficiency and the soundness of the business lines along which it has been developed. In contrast with it are the over-extended government-backed Canadian National and Grand Trunk Pacific systems, which have demanded rate assistance that would have meant great opulence for the privately backed competitor.

Lord Shaughnessy's proposal would at least remove the main controversial element in the Canadian situation. There would then be no question of giving large profits to one company in the effort to enable the others to barely keep afloat. The Canadian Pacific's skillful operating policy extended to the entire Canadian system would undoubtedly result in a fairly rapid reduction of the annual deficit which piles up on the present nationally owned lines, while the opportunities for further operating economies by the use of the most economical routes in the combined systems and the elimination of competitive service would result in further large savings. The danger in the situation lies in the fact that if the government made a compact now for private operation it might, in a few years, decide to assume the operation itself. If that should come Canada would have in its fulness all the evils of government operation of a huge business undertaking. Under present conditions, the people of Canada have constantly before them the example of an efficiently operated system which affords an excellent basis of comparison with the government operated lines. In saying this we are not losing sight of the fact that the nationally operated lines have not the heavy tonnage which make for low operating costs. If the details of the purchase agreement are made with fairness to the Canadian people, Lord Shaughnessy's proposal would seem to be advantageous to Canada, provided always that the operation be kept in the hands of the Canadian Pacific or an equally competent private organization.

Railroad Operating Costs

A DESPERATE situation confronts the railroads of the country. Operating costs must be reduced, if conclusions may be drawn from last week's proceedings at the Senate inquiry, in spite of the fact that net earnings reported for March show a substantial increase. Senator Cummins and Julius Kruttschnitt agreed that the railroads, in their present status, are "almost in death throes" and that reduction in operating expenses is vital. Almost at the same time, the "consulting economist" of the railway labor unions was charging that the carriers waste $2,500,000,000 annually, indicting the managements on counts impossible to sustain in whole, but partially based on actual opportunities for economy. Aside from the unions, it is generally agreed that the present railroad crisis, threatening to bring private ownership and operation, is due to a combination of lessened traffic with the burdens inherited from federal control.

However, the unions' charges should not be dismissed merely by saying that they are groundless. Most of them are. But some of them, even though exaggerated, are well founded, such as those with reference to terminal operation, freight handling methods, and loss and damage. Here the field is full of opportunities for those who are in possession of exact knowledge and the ability to apply it to problems heretofore solved by rule of thumb.

Many improvements that would result in economies cannot go forward because they require construction programs for which money is lacking. As a result the railroads' engineering departments have been reduced and their problems are not so much in new construction as in routine work and maintenance. Heretofore, railroad managements have too seldom called in their engineers in matters of operation. Is this not an opportunity for broadening the functions of engineering departments by applying exact knowledge to many of the intricacies of railroad operation long governed by custom?

However discouraging the present railroad outlook, there is good ground for hope that the bottom has been reached and that a way out will be found. The net operating income of the carriers for the month of March has just been reported as $30,894,065, following a deficit of $7,378,307 in February. Nevertheless the utmost effort is still needed to operate as economically as possible. The managements ask that less be paid to labor than required by the onerous national agreements. Regardless of the fact that most of the unions' charges of wastefulness are fallacious, the managements must also pledge good faith by leaving no stone unturned to reduce expenses on their own account.

A New Plan for Contracting

SEVERAL months ago, following the annual meeting of the Associated General Contractors in New Orleans, we commented upon the high vision with which the work of the association is being directed. There stood out strongly, backed by a wealth of ability, the determination to build for contractors a reputation for "skill, integrity, and responsibility" which should place contracting among the most honored occupations in the country. As was then emphasized in our editorial, the determination was not that of mere visionaries, but of men who have big accomplishments to their credit.

The events and tone of that January meeting in New Orleans were recalled in Washington Tuesday night of last week when the executive board of the association closed a two-day meeting with a dinner, at which the guests were prominent members of Congress and of the press. Half a dozen brief addresses were made by members of the executive board, with the purpose of picturing the magnitude, the work, the responsibility, and the obligations of the contracting industry. The inspiration of those addresses may be somewhat lost when they appear in cold type, but we hope that the association will print them, and in such form that they can be put in the hands of every contractor in the United States. We do not expect that every contractor every day will recall the picture that these addresses painted, but if he will occasionally revert to some of the thoughts they contain and gradually come to guide his business by the ideals therein expressed the whole contracting profession will take on a new atmosphere and a new place in the public mind.

The A. G. C. stands for "skill, integrity, and responsibility." If the men who are now directing its activities continue their interest and their support those principles will before long pervade the entire industry We do not mean that a wholesale conversion is to come about, or is, in fact, required. The good lies in the industry on all hands. What the A. G. C. is doing is to mobilize it—to mobilize it not only for the good of the industry but for the good of the public as well.

At the same time it is helping to bring the delinquents to the desirable plane. Eventually its work will draw a sharp line of demarcation between the able, upright and responsible contractors, on the one hand, and the disciples of the doctrine of "get by," on the other.

All of which is reason why both engineers and contractors should give their support to the A. G. C., the engineers with their influence and confidence, the contractors by getting into the A. G. C. fold both in fact and in spirit.

A Sweeping Sewage Disposal Decision

SECOND in importance only to the decision in the Chicago drainage canal case is that of the United States Supreme Court against all the contentions of the State of New York in its suit for an injunction against the discharge of sewage by the Passaic Valley Sewerage District into New York Harbor (see p. 849). The New York-New Jersey case is rated as second to the Chicago-St. Louis case, among other reasons, because the main issue in the earlier suit was the alleged menace to public water supplies, particularly the supply of St. Louis, by the sewage of Chicago, whereas in the New York-New Jersey case the water that will receive the sewage from the Passaic Valley communities is so brackish as not to be potable, regardless of pollution.

Two significant points in both the present and earlier decisions are: (1) That the complainants fell far short of proving their allegations; (2) that while there is no question as to the jurisdiction of the United States over the pollution of interstate waters, the federal government will not attempt to control the actions of one state at the instance of another unless a grave danger can be proved. The importance of these two points is increased by the fact that in both cases the court was unanimous. Moreover, since the fresh water of a great river used for municipal supply was concerned in the earlier case and the tidal, brackish, non-potable water of a great harbor in the latter, but with allegations of serious menace to public health in each, the two decisions may be regarded as of broad general application throughout the United States.

The verdict, "not proven," in each of these two cases should not lead other cities or groups of cities to think that they can discharge their sewage haphazard into the handiest stream or other body of water. Unquestionably, one may conclude from its reasoning, the United States Supreme Court would not hesitate to enjoin sewage discharge into interstate waters if menace to health could be proved. But the gap between allegations and proof of health menace and other serious nuisance is forcibly illustrated in each case. The wideness of this gap, and the difficulties of bridging it, would afford material for a monograph, but the subject must be passed by here.

Contrasted with the court's conclusion that there was lack of sufficient evidence to support the allegations of menace to New York City from Passaic Valley sewage is the weight the court gives to the investigations and opinions of the engineers on whose advice the Passaic Valley Sewerage Commissioners acted in adopting plans —and on which the Federal Government also acted in agreeing to the stipulations under which it withdrew from intervention in the New York-New Jersey suit. No stronger testimony to the wisdom of getting the best available technical advice before adopting plans for sewage disposal could be asked.

In the Chicago-St. Louis decision the court laid stress upon the fact that Missouri's case was weakened because that state allowed her own cities to discharge sewage into the river. In the Passaic Valley case just decided, there is no direct application against New York of the doctrine that a plaintiff must come into court with clean hands; but the court takes cognizance of the fact that New York City itself discharges into the harbor untreated sewage many times in volume the effluent from the proposed treatment works of the Passaic Valley and that between 1906 and 1919 the population increase of New York City and suburbs exceeded 100,000 a year, making a total about equal to the estimated population of the entire Passaic Valley Sewerage District in 1940. And yet the court concluded that instead of plain evidence as to 1919 harbor conditions there was a conflict in the "testimony of trustworthy and competent scientists."

By way of fatherly advice the court well says, in its decision, that more in the way of pollution prevention may be expected from co-operation than litigation. Whatever opinion may be held as to past attempts to obtain co-operation, a get-together spirit is certainly desirable in the future. Whether any advances may reasonably be expected from the New Jersey side until New York City adopts and begins to execute a construction program is at least open to argument.

Although without bearing upon the sane and sweeping character of the decision, it should be noted for the benefit of those not familiar with the thirty years' events since agitation for cleaning up the Passaic River began that the original plan was for a trunk sewer to Newark Bay, with the discharge of untreated sewage there. Events that cannot be reviewed in limited space led to the adoption of a plan to carry the sewage into New York Bay, with little treatment, and finally to plans for considerable treatment, with the possibility that still more may be required by the Federal Government. The original argument for a trunk sewer was that it would make treatment unnecessary and when the New Jersey Legislature prohibited the discharge of sewage into Newark Bay the tunnel to New York Bay was predicated on practically no treatment. Without questioning the wisdom of the engineers, who acted under strict limitations, or the judgment of the United States Supreme Court, which is simply ruling on allegations based on the plans as adopted, it is questionable whether if the Passaic Valley sewage problem were to come up *de novo*, thirty years after its first consideration, some more local means of disposal would not be recommended by competent engineers—at the very least, disposal, after treatment, into Newark Bay, thus avoiding the great and still problematical cost of the tunnel from the Newark Meadows to New York Harbor.

Taking the Passaic Valley decision in view of all the governing conditions, combined with the findings of the U. S. Army Engineers at the time of the hearing on granting a permit for the outlet in New York Bay, and the stipulations under which the United States withdrew from the suit, it may be said to give the sanction of the highest engineering and legal branches of the Federal Government to the general principle of sewage disposal by dilution, to the dissolved oxygen test as an index of pollution (at least for non-potable waters), and, last and not least, to the principle that no one state has a monopoly on the use of interstate waters for sewage disposal.

Long Arch Bridge Built of Slag Concrete

At Bingaman St. Bridge, Reading, Pa., Wedge-Shaped Piers Give Square Spans on Curve—Slag Aggregate Reduced Dead Load and Construction Costs—Twin Cableway Handled All Materials

By W. C. Fry, Jr.
Engineer, Whittaker, & Diehl, Contractors, Harrisburg, Pa.

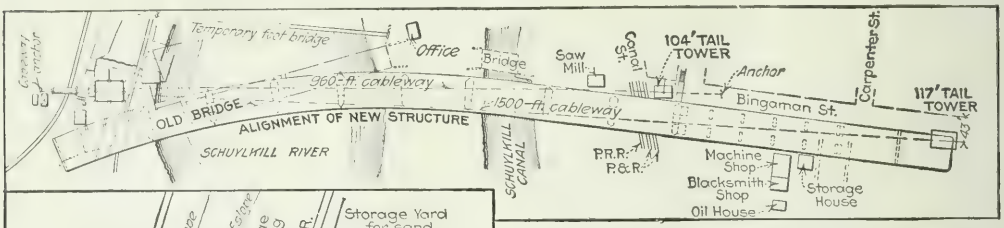
Slag concrete as a help to the contractor and span design studied to reduce formwork are outstanding construction features of the Bingaman St. Viaduct at Reading, Pa. The resulting advantages were a more workable concrete and very few sectional forms repeatedly used. All the facts are presented in the description which follows. In particular contractors will observe the evidence that slag concrete is more workable than concrete with a stone aggregate; there is less weight to be handled per unit volume of concrete and the mixture flows more readily through chutes and fills the forms with less labor. Incidentally it will be noted that this structure is probably the largest bridge ever constructed of slag concrete.—Editor.

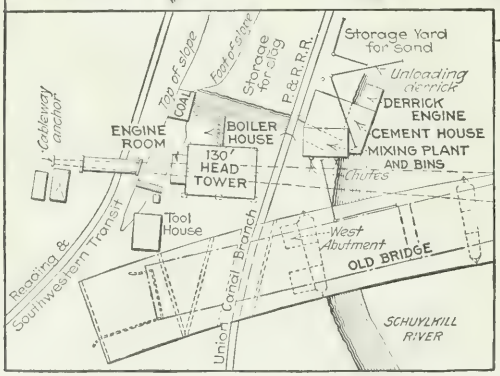
One of the large concrete bridges of the United States, now in progress at Reading, Pa., is being constructed of slag concrete. Economy in design and construction is secured by the uncommon material. This object of cheapening construction was also sought by giving careful study to span lengths and locations and to arch design which would simplify formwork. As the result a 1,600-ft. bridge on a curve is being built at uncommon speed, with a few sets of arch centers and deck forms repeatedly used, and with a plant of which a twin cableway is the only large unit of equipment. The structure is known as the Bingaman St. Bridge and is being built for Berks County, Pa.

Slag Concrete.—Because of the uncertain transportation facilities and the materials situation at the time the specifications were written (1919) it was considered advisable to broaden the field of acceptable materials so as to permit the use of slag.

Comparative tests indicate that slag concrete is fully the equal of broken stone concrete. Several advantages are derived from its use. Slag concrete is about 15 per cent lighter, and since in reinforced-concrete designing the dead load is an important factor governing the design, slag concrete permits of slightly lighter sections with the same live load, resulting in a saving of concrete. From the contractor's viewpoint also slag has its advantages. It is lighter to handle, flows more readily in chutes, and requires less spading. Again, in this locality it is cheaper than stone, and as it is lighter than stone a ton of slag will yield a larger yardage of concrete. Moreover, this advantage in weight reduces the freight charge in transportation per unit of volume. These are points to be considered by the contractor in so large a job as the one described.

On the other hand, for the same amount of coarse aggregate, slag concrete requires slightly greater volumes of sand and cement to produce the same quality of concrete.



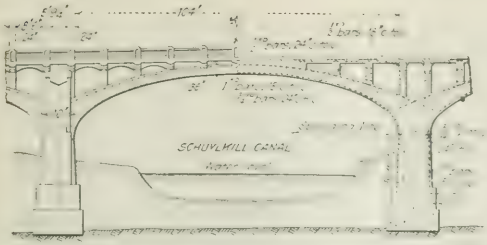


LOCATION OF BRIDGE AND LAYOUT OF PLANT

Specifications for this work required that the slag be air cooled and exposed to the weather for a period of several years. The minimum weight had to be 70 lb. per cubic foot. In size it had to conform to that specified for limestone. Compression tests with slag in concrete had to equal tests in compression for concrete in which limestone or trap rock are used as coarse aggregate. Rigid inspection of the slag insures that it is clean and free from dust.

The slag used on the Bingaman St. Viaduct is shipped from the Birdsboro plant of the Duquesne Slag Products Co., with a portion coming from the Hokendauqua plant of the National Slag Co.

Span Location.—The new viaduct crosses the Schuylkill River and the Schuylkill Canal, passing over the Union Canal Branch of the Philadelphia & Reading R.R., on the west bank of the river and a branch of the Pennsylvania R.R., on the east bank. In order to make the grade and pass over the tracks of the Pennsylvania R.R., giving a vertical clearance of 22 ft., the east approach of the bridge has a grade of 3.63 per cent, while the west approach has a grade of 2.43 per cent except for the last 60 ft., which descends on a 4.2 per cent grade.



DETAILS OF 104-FT. SPAN OF BINGAMAN ST. BRIDGE

In determining the alignment and the spans of the arches many features governed. First the center line of Bingaman St., on the east side of the river, and the center line of Lancaster Ave., on the west side, which streets the bridge will connect, meet at an angle of 31° 3′ 15″ over the river channel, therefore the new bridge is tangent for about 800 ft. and on a 3° 48′ curve for 800 ft. So that the contractor could use steel arch centering advantageously it was desirable that the arches over the river be made uniform in span. To accomplish this it was necessary to consider the relative positions of the two railroads, the Schuylkill Canal and its towpath, Water St., and the river. To complicate matters the railroads on each bank of the river converged, crossing the proposed alignment at an angle of about 25 deg. In addition, the railroad tracks on Canal St., over which the bridge was to pass, are on a 10-deg. curve. In order to meet these conditions it became necessary to select by trial a span which would clear the Pennsylvania R.R., giving a minimum of 22 ft. vertical clearance; span the canal and its towpath without offering any obstruction; clear Water St., and then follow a 3° 48′ curve across the river, placing the abutment clear of the right-of-way of the P. & R. R.R. on the west bank. A span of 114 ft. seemed to meet these conditions. This span was then divided into clear arch span and pier width by arch and pier analysis according to the elastic theory.

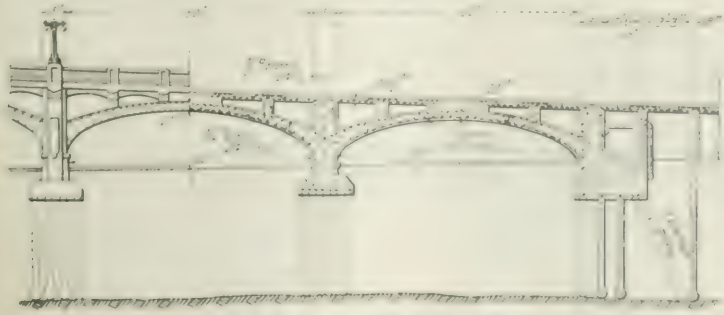
Pier Design.—Calculations proved that with a rise of 20 ft., and with the loading for which the bridge was designed, a 104-ft. span arch and a pier width of 10 ft. were necessary. Having settled upon a pier width the next problem to be considered was how the increased length of the outer curve of the bridge over the inside curve of the bridge could be taken care of. This difference amounted to 3 ft. 8 in. in 114 ft. of alignment; that is the difference in distance between the north ends of the center lines of the two successive piers and the south ends of the same piers was 3 ft. 8 in., the center lines of the piers being radial lines of the curve. This difference in distance was thrown into the piers themselves, making them wedge-shaped, and permitting a clear arch span of 104 ft. both on the outside and on the inside of the curve of the bridge.

The wedge-shaped piers were no more difficult nor expensive to construct than rectangular piers; on the contrary the construction and certain features of design were considerably simplified. This design permitted the steel centers for the arches to be interchanged, and to be shifted laterally, either up or down stream, after they had been lowered upon rollers. This was a distinct advantage, inasmuch as in the case of three spans it was necessary to move the centers out from under the arch northward, while in one case, on the curved portion of the bridge it was found advantageous to roll the centering southward from under the arch.

FALSEWORK AND CENTER FOR 104-FT. SPAN

Another advantage resulting from this method of taking care of the curvature of the bridge is that it permitted the building of rectangular sectional forms for the floor slab and interchangeable sectional forms for the panel railing.

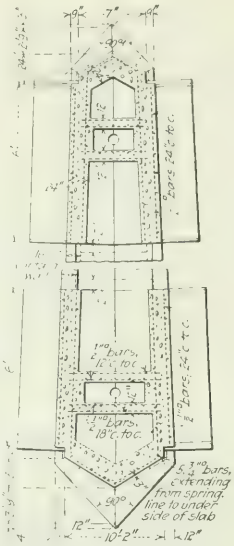
Again, had it been found economical to build one rib at a time this design would have permitted the contractor to pour one rib, and at the proper time lower the centers and shift them laterally into position under the proposed location of the second rib. This would not have been possible on the curve if the piers were rectangular. This possibility was not taken advantage of, as it was decided that more rapid progress could be made if the two ribs were placed simultaneously.



DETAIL OF 114-FT. SPAN OF BINGAMAN ST. BRIDGE

Arch Design.—The design of the arches is consistently the same; they are two-ribbed, open-spandrel arches, each rib being 16 ft. wide with a clear space of 16 ft. between them. The floor slab is carried on beams resting on 2-ft. spandrels 10 ft. 6 in. center to center. Expansion joints in the floor slab are provided at each pier. On the curved portion of the viaduct the floor system follows a true curve, while the arches are tangent at the curve. The sidewalks are carried on

heavy beams cantilevered 6 ft. beyond the outside faces of the ribs. This was done with a view to economy, shortening the length of the piers, which are solid only in the line of the ribs, and also thus providing a means of taking care of the curved alignment. Between the ribs and below the springing line the solid pier sections are connected by roofed 18-in. curtain walls, giving the appearance of solid piers below the springing line.



SECTIONAL PLAN OF PIER FOR 104-FT. SPAN

Railing Design. — The railing and posts, which will be composed of one part portland cement, two parts sand, and three parts granolithic grit will consist of a heavy top and a bottom rail with specially designed spindles. The rails will project into the posts 3 in., resting in a pocket provided in the posts. The rails will thus be entirely separated from the posts, permitting true expansion. The posts are cast first, and later when these have thoroughly set the rails and spindles may be cast.

The total width of the bridge is 60 ft., divided into two 10-ft. 6-in. sidewalks and a 39-ft. roadway. Two hundred feet of the eastern approach is beam and slab construction carried on columns, closed in on each side by an 18-in. curtain wall. Following this are five 52-ft. span elliptical arches with 5-ft. piers, eight 104-ft. elliptical arches with 10-ft. piers, and 160 ft. of beam and slab construction carried on light piers and columns where the bridge passes over the P. & R. R.R. tracks.

Loads and Stresses.—The bridge was designed to carry the following live-loads: Sidewalk, uniform live-load of 100 lb. per square foot.; roadway, two electric lines with 50 ton electric cars, together with a uniform live-load of 200 lb. per square foot over the remaining area of roadway. The load on each car track was assumed to be distributed over a width of 9 ft. The maximum allowable stresses in design were compression 550 lb. per square inch, tension in steel 16,000 lb. per square inch.

The above detail information relative to the design was procured from Charles F. Sanders, the designing engineer, who also has supervision of construction.

A rather elaborate plant layout has proved economical. A careful study of the site proved the necessity of a cableway and since the alignment is partly on tangent and partly on curve, in order to make a cableway practicable and serviceable it was necessary to use twin cables. Even the two cableways do not serve the entire job, for the western end for 200 ft. is without its service.

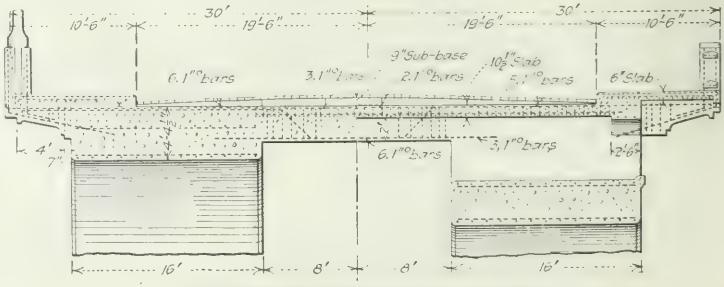
A single-head tower 130 ft. high, with a base 52 x 34 ft., has been erected on the western bank of the river about 60 ft. from the center line of the bridge. This tower is framed of 12 x 12-in. timbers 24 to 32 ft. long as posts, or legs, and braced with 4 x 12's, making a total of approximately 28,000 ft. of lumber. The tower was so designed that the resultant loads on the tower pass down the front legs, which have a batter of 3 on 1. The legs rest on sills which are supported on eight cinder-concrete bases. On the rear of the tower and elevated about 20 ft. above the base is the engine room. From this elevated position the enginemen command a good view of almost the entire job. The boiler room is directly below the engine room.

The two cables, one of 2-in. plow steel, with a span of 960 ft., the other 2¼-in. plow steel, with a 1,500-ft. span, pass over this head tower about 10 ft. apart, resting on a head block fastened rigidly to the tower. Making an angle of about 45 deg. with a vertical, they pass down from the head block and are anchored to a 20-in. oak log 18 ft. long which is concreted in a pit below the ground surface.

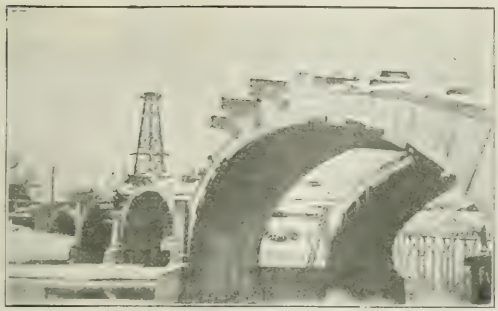
Two tail towers are necessary, one 104 ft. high at the end of the 960-ft. span, and the other at the end of the 1,500-ft. span, 117 ft. high. The cables diverge from 10 ft. at the head tower to 48 ft. at the end of the 960-ft. span. Behind each tail tower the cable is anchored to an oak log concreted in a pit.

While the erection of the three towers and the suspending and anchoring of the cables were a slow and costly operation, the cableways have proved to be an economical investment. Had the alignment of the bridge been such that one cableway would have served the entire job it would have been a mistake to have erected only one. There is rarely a time when the two cables are not in operation. Without them it would been difficult to move the steel arch centering for the 104-ft. spans.

There is one central mixing plant located about 50 ft. from the head tower, just off the line of the cableways. This plant comprises a pair of one-yard mixers, each with a capacity of 25 cu.yd. per hour. Directly above the mixers are storage bins with a capacity of approximately 200 cu.yd. of coarse aggregate and 100 cu.yd. of sand. In the rear of the mixer is the cement house, capable of taking ten cars of cement. A track running alongside the cement house permits rapid unloading. The sacks, picked up by hand, are carried to the door of the car and there dropped onto a belt conveyor which elevates and carries them to various



TRANSVERSE SECTION OF TYPICAL SPAN



COMPLETED RIBS FOR ARCH SPANS

parts of the cement house. Directly back of this cement house is a large unloading derrick, with an 85-ft. boom, equipped with a clamshell, the storage yards being located around it.

When concrete is being placed the concrete buckets are lowered from the cableways into a shallow pit in front of the mixing plant; from the mixers the concrete runs down a chute and thence into the buckets, which are of the drop-bottom type with a capacity of 48 cubic feet.

A completely equipped machine shop, a blacksmith shop, and a sawmill are indispensable parts of the plant. In the sawmill many sectional forms are built directly beneath the cableway, from which point they are picked up when complete and carried by the cableway to the place for which they have been built. Large sectional forms 50 x 12 x 12 ft., to be used for pier forms from footing to springing line, have been built at the sawmill in three sections and later carried out and placed carefully on the footings made to receive them. This method proved economical, since these forms were used over and over again.

Pier Construction.—The footings of all the large piers and abutments rest on good shale. All the river piers were built within a double dam, which was pumped dry before any excavation within it was made. The river in the line of the bridge averages about 6 ft. deep, with a bed of several feet of coal dirt or culm washed down from the Schuylkill coal districts, about 35 miles north of Reading. The practice in the construction of these dams was to frame the bracing for the dam along the bank of the river and then float this framework to its proper location surrounding the proposed site of the pier. The bed of the stream at this site was previously clamshelled from a derrick boat until the culm had been entirely removed and the gravel bottom exposed. Upon this gravel bottom the cofferdam framework was placed. Three-inch T. & G. sheathing was then driven about the double dam. The space between the two lines of sheathing, about 6 ft., was then filled with clay, which in some cases was puddled and packed tight by dropping a 2,000 lb. hammer into the clay. This method proved effective and very little pumping was required to keep the dams dry. After pumping out the water the interior was clamshelled out until rock was exposed upon which the concrete footings were placed.

In the case of the piers for the small arches it was considered economical by the designing engineer to rest the footings on 16-in. concrete piles, cast in place and driven to rock. In all a total of 408 piles were required. In the case of the east abutment 14 batter piles were driven at an angle of 25 deg. to the vertical to help balance the horizontal shear in the abutment.

Arch Centering.—The steel arch centers for the 104-spans weigh 43 tons per span. The contractor was required to provide centering for at least three contiguous spans, but the centers of the last arch constructed could not be lowered until the next two succeeding arches had been turned and properly keyed upon their centers.

The centers for each arch, consist of two 97-ft. steel trusses, on 9-ft. 2-in. centers, under each of the two ribs. These trusses are rigidly braced to one another and supported at five points on timber piling driven to resistance. Each pair of trusses is made up of six different units bolted together. Each unit with its 2-in. lagging attached is light enough to be readily picked up with the cableways. The operation of lowering and moving the centers ahead is simple. After

COFFERDAM AND EXCAVATING EQUIPMENT ON ONE OF THE RIVER PIERS

drawing the oak wedges and allowing the centers to be lowered upon 8-in. wooden rollers the steel trusses are rolled out laterally from beneath the concrete arches on timbering previously erected until the centers are entirely clear of the arch. The trusses are then separated into their six units, and one unit at a time, with the lagging and joists still in place, is raised and moved by the cableway to the third span ahead, where it is lowered into place on piling and bents previously erected to receive it. The heaviest section, with its joists and lagging, weighs about 6½ tons.

The problem of pulling the piling after the removal of the steel centers was a difficult one. Many of the piles were driven to quite a depth and pulling them was no easy task. It was impossible to draw them directly with the unsupported boom of the derrick boat. Finally a simple A-frame was built with two five-sheave blocks suspended. This A-frame, carried on the end of the boom of the derrick boat, was swung around over the pile, lowered by its side until it rested on the bed of the stream, and then with the aid of the hoisting engine on the derrick boat the pile was readily drawn.

Progress.—The bridge when completed will contain approximately 21,000 cu.yd. of concrete, and 500 tons of reinforcing steel. On May 1, 1921, 11 months after the placing of the first yard of concrete, 16,000 cu.yd. had been poured, an average of more than 1,500 cu.yd. per month, with a maximum monthly pouring of 2,100 cu.yd. and a maximum weekly output of 700

cu.yd. The plant is equipped to place concrete in the coldest weather, steam jets being run through the sand and the slag piles, and a steam coil through the water tank. The recent winter having been rather mild excellent headway was made. The contracted time within which the bridge is to be completed is 400 working days. Considering the fact that some time was lost last summer because of the irregular shipments of cement the progress has been satisfactory.

The work is being carried out by Whittaker & Diehl, of Harrisburg, Pa., under the superintendency of I. J. Reighter. The total cost of the bridge including street improvements and property damages will exceed one million dollars.

Residual Aluminum Compounds in Filter Effluents

New Conceptions of Chemical Reactions Based on Recent Developments in Chemical Field

IN A number of respects orthodox conceptions of the action of alum in water seem to require some modification and extension. Such changes in viewpoint may be particularly desirable at this time, when discussion in water-works fields has again reverted to the problem of residual alumina in filter effluents. For this reason Abel Wolman, division engineer, Maryland State Department of Health, and Frank Hannan, Toronto Water Filtration Plant, have considered it a fruitful task to attempt in *Chemical and Metallurgical Engineering*, April 27, 1921, p. 728, to develop an understanding of the mode of action of alum as a coagulant. In such a development the causes of certain associated phenomena, such as disappearance of floc, positive reaction for alumina in filter effluents and imperfect coagulation with low alkalinity, may also appear. In the discussion, of which the following is an abstract prepared by Mr. Wolman, the passage, through filters, of undecomposed aluminum sulphate due to insufficient alkalinity or of flocculated hydrate through breaks in filter beds is not under consideration. In other words the discussion refers to difficulties inherent in natural processes and not to those resulting from unintelligent application of chemicals or operation.

Aluminum Sulphate Reactions

Usual Conception—The general conception of the reaction of aluminum sulphate with the natural alkalinity of water is given by the following typical equation:

$$Al_2(SO_4)_3 + 3CaCO_3H_2CO_3 = 2Al(OH)_3 + 3CaSO_4 + 6CO_2$$

or

$$Al^{+++} + 3HCO_3^- = Al(OH)_3 + 3CO_2$$

This rigid transformation is usually accepted as approaching the average state of affairs when "normal" conditions obtain. The simplicity of the reaction has been so frequently emphasized that the impression has been gained that, when the coagulum, $Al(OH)_3$, is not instantly and continually formed the treatment is either careless or faulty.

It is probable that ineffective floc formation and residual alumina in filter effluents, even with plenty of raw water alkalinity, is due to causes other than poor control. When a study of alum reactions is undertaken two important hypotheses appear, which are in conflict as to the nature of the compounds resulting from such reactions. They are, however, in complete agreement as to the absence of rigidity of state of any particular aluminum compound. From this viewpoint the formation of an insoluble coagulum, as $Al(OH)_3$, becomes a desirability but not necessarily an eventuality. The problem becomes one of determining those factors which regulate the reactions in such manner that the desired result, an insoluble complete coagulum of $Al(OH)_3$, is obtainable.

Recent Interpretations — The important characteristic of recent conceptions of $Al_2(SO_4)_3$ reactions is to be found in the realization that the formation of $Al(OH)_3$ is a reversible progressive reaction dependent upon a number of conditions, the most important of which is probably the hydrogen-ion concentration or P_H value of the solution with which one is working. The nature of the solutions obtained when $Al(OH)_3$ is dissolved in the presence of acids or bases, has been the subject of much discussion. The underlying hypotheses of these discussions may be divided into two classes. In the first case the solution of $Al(OH)_3$ is ascribed to processes of peptisation or change in physical structure of $Al(OH)_3$, but not change in chemical composition. The second school of thought bases its understanding of the processes entirely upon the hypothesis that the changes taking place when $Al(OH)_3$ is formed and redissolved are due to variations in chemical combination. The contrasting viewpoints emphasize changes in physical state as against changes in chemical combination. The salient features of each conception are outlined at some length in the original paper in order to demonstrate that, whatever viewpoint is accepted, one must reach the conclusion that the complete formation of the insoluble $Al(OH)_3$ in water is by no means as frequent an accomplishment as it has been tacitly assumed to be.

It is well to emphasize the ephemeral character of the insoluble $Al(OH)_3$, whose re-solution may be due to a change in its physical structure (peptisation) or to chemical changes. Whatever the nature of these changes, it is clear that they are predicated upon some effect of hydroxyl or hydrogen ions. For the particular subject with which we are now concerned, experiments are taken from the literature which demonstrate beautifully that the amount of $Al(OH)_3$ held in a given alkaline solution is *a function of the alkalinity of the solution.* This conclusion cannot be stressed too greatly, since it appears to the writers to be the basis of a better understanding of the mechanism of alum coagulation.

It is pointed out that in the case of amphoteric hydroxides, such as $Al(OH)_3$, an excess of base is to be avoided. It becomes desirable, therefore, to select that degree of alkalinity which will insure most nearly complete precipitation and at the same time avoid re-solution of the precipitate. Certain data are presented from the experiments of other workers which show quantitatively that the precipitation of alminum hydroxide by ammonium hydroxide is complete when the P_H of the solution is between 6.5 and 7.5. What is this point of optimum precipitation in our water supplies? Have we ever paid any attention to it? We must expect certainly that there are numerous points in coagulation in which re-solution of $Al(OH)_3$ is always taking place. The occurrence of aluminum compounds in filter effluents should be as common as it is now considered rare. Chance, and not mischance, in the past seems to account for its failure to appear.

Practical Application to Water Problem—Aluminum compounds may exist in three states, defined by their hydrogen-ion concentration, as (1) non-ionogenic or isoelectric $Al(OH)_3$, (2) metal aluminate, eg., Na or Ca aluminate, and (3) alumino-acid salts, e.g., aluminum chloride, aluminum sulphate, etc. Thus, in practically every water treated with alum, at any point other than the isoelectric point (which has not yet been determined for varying waters), an equilibrium may exist between hydrogen ions, metal aluminates and non-ionogenic or isoelectric $Al(OH)_3$. (If the P_H were lower than the isoelectric the Al ion would replace the aluminate. In water practice, however, such cases would be rare.) It is reasonable to suppose that, just as often as not, the P_H of a water is not correct to permit the complete formation of $Al(OH)_3$ only. For this reason the occurrence of other aluminum compounds should not surprise one in filter effluents, for such compounds are soluble and need not be removed by the sand.

At this point, also, it is important to suggest that *not only low alkalinity may be fraught with danger but too high hydroxyl-ion concentration may not be so desirable* for

proper and successful coagulation and for the complete elimination of soluble aluminum compounds. It seems, as a preliminary theory, that as one departs from the point or area of favorable hydrogen-ion concentration, in coagulation processes, one passes, in either alkaline or acid direction, into fields of re-solution of aluminum hydroxide. This conception, it is clear, is independent of the causes of such re-solution. It is important, therefore, to keep in mind the ever-present possibility of missing the favorable threshold area of coagulation and passing into the unfavorable dissolution areas.

Does the literature of water purification disclose any data in confirmation of the above hypothesis of equilibrium conditions of alum reactions? It should be difficult to obtain such material, since it is only recently that determinations of hydrogen-ion concentration have been made in water. Hitherto only potential alkalinity and acidity have been determined because of current methods of titration, while actual alkalinity or P_H values have remained unknown. It is these latter conditions which are usually operative in conditioning our water supply reactions. Preliminary experiments are described in which it is demonstrated that the alteration of P_H conditions by acidification of a water of too high alkalinity results in more complete precipitation of $Al(OH)_3$, more successful filtration and elimination of alumina from filtrates. Variations of these laboratory experiments lead to the same conclusions as indicated above. It is easy to see why this fact of optimum P_H for precipitation has escaped observation. We have always been told that deficiency of alkalinity was the thing to be avoided. No one would be likely to try adding acid.

Conclusions—Theoretical considerations, supported by experimental results obtained in water work and elsewhere, appear to demonstrate fairly completely that the reaction of aluminum sulphate with the natural alkalinity of a water is a complex mobile transformation. The reaction seems to be delicately dependent upon the actual alkalinity of a water, its hydrogen-ion concentration, rather than upon its potential alkalinity. The hydrogen-ion concentration in turn is regulated to a large degree by carbon dioxide equilibria. Evidence so far accumulated seems to indicate that complete precipitation of $Al(OH)_3$ takes place at a hydrogen-ion concentration somewhere near the neutral point, P_H 7.0, unless disturbing or buffer influences are operative. Outside of this zone of favorable alkalinity re-solution of insoluble floc occurs to a greater or less degree.

It seems clear from the above considerations that the appearance of aluminum compounds in filter effluents should not be accepted as due to faulty operation, according to orthodox interpretations, but to failures due to misunderstanding of the reactions involved. This statement is given in the nature of an hypohesis to be substantiated by further experimental evidence. If the hypothesis is found to be true, the problem of residual alumnia, not only in filter effluents, but in all coagulated waters, may be attacked from a new angle.

The writers have studiously voided any reference to the sanitary, physiological or economic implications of the passage of soluble aluminum compounds through filters. That the phenomenon has a great practical importance, however, the little data we now have apparently confirm.

Proposed Improvement of Chicago Railway Terminals

Intensive Development of New Site Air Rights—Would Abandon Old Facilities, Straighten River and Open New Streets

RAILROAD TERMINAL improvements, south of the Chicago Loop District, including the straightening of the Chicago River and intensive development by erecting high buildings over the new freight houses, are outlined in a recent report submitted to the mayor and city council by John F. Wallace, chairman of the Chicago Railway Terminal Commission. This report marks the closing of Mr. Wallace's services in connection with this work, as he has resigned from the commission.

The southern terminal area, in which are grouped the terminal facilities of fourteen railways, presents the most complicated problem of any part of the Chicago railway terminal system, since it includes a large area of railway property which is of high value but has only low-grade occupancy. This area not only forms an obstruction to the natural development of the city but also interferes seriously with street traffic between the central district and the southern part of the city. Its real estate value alone is considered too great to justify its continued use for railway purposes exclusively.

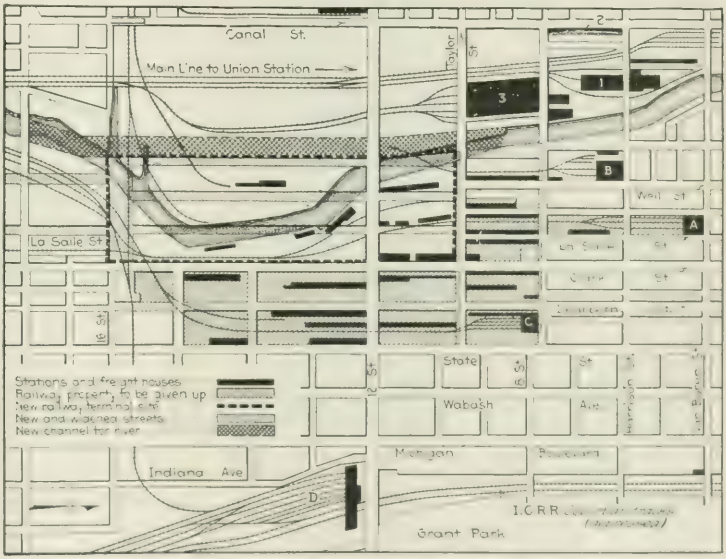


FIG. 1 CHICAGO RAILWAY TERMINAL REVISION

Passenger stations: A, Dearborn; B, Grand Central; C, Dearborn; D, Illinois Central (new). Freight stations (new): 1, Chicago & Alton; 2, Chicago, Burlington & Quincy; 3, [illegible]

In the western terminal area along the west bank of the river and the eastern area along the lake front, the terminal facilities are being reconstructed in accordance with the ordinance for the New Union station and for the new Illinois Central R. R. station and lake front development. The terminal areas along the north bank of the river and the west bank of the North Branch do not offer serious interference with street traffic to and from the central business district.

Obstruction to traffic and commercial development in the southern terminal district has been a source of complaint for several years. An eastward loop of the river cuts off some of the north and south streets and others are blocked by railway property, so that there are only four thoroughfares and one of these is a boulevard from which commercial traffic is excluded. Much of the railway property consists of open yards and one-story freight houses, but although the land is potentially of great value the railways have been reluctant to consider relinquishing it owing to the lack of suitable alternative sites and the cost of reconstruction. Both of these objections are considered to have been overcome by the present project, which is shown in the map, Fig. 1.

Property adjacent to the river is cut up in an awkward and uneconomical manner by the loop in the river, but by building a new channel as a chord to the present arc, there will be made available a site convenient and sufficient for all the railway facilities now grouped between Clark St. and State St., besides affording opportunity for opening four new thoroughfares to the south side. The ground elevation would be lowered to 5 ft. above water level, so that the streets could be carried over the site on viaducts and thus leave practically the entire area available for railway purposes. This arrangement will provide for double-deck terminals, having the team floors at the street level and all tracks at the lower level. Above the freight houses, the air rights might be developed by the erection of buildings for commercial purposes. Inclined approaches would connect with existing streets at the lower elevation. This double-deck arrangement is considered impracticable on the present site, as it would necessitate the raising of the grade of State St. and adjacent property, involving enormous expense.

Removal of three passenger terminals is included in the project: the LaSalle station of the New York Central and the Rock Island Lines; the Grank Central station and the Dearborn station, the two latter being old structures used by groups of railways. The LaSalle station is large and modern, and borders on the loop district. It is proposed to transfer the business of these three stations to the large new station which is to be built on the lake front at 12th St. by the Illinois Central R.R., as provided by an ordinance passed last year and accepted by the railway company (see *Engineering News-Record* of July 31 and Aug. 21, 1919, pp. 216 and 360). Land at this site is very much cheaper than that at the present stations.

An advantage to the railways in thus concentrating at the lake front site, in addition to the release of their own more valuable property, would be the avoidance of electrification on the numerous lines to the present stations. It is true that plans have been made for reconstruction of the Dearborn station on a large scale, but in view of the public demand for electrification it is reasonably certain that this would be made a requirement for any permit for improvements. With this arrangement carried out, all the main-line passenger traffic would be concentrated at three large terminal stations: the Chicago & Northwestern Ry. station, northwest of the business district; the Union station on the west side, and the Illinois Central R.R. station in the southeast. A suburban station for all lines from the south is planned on the site of the present LaSalle station, on the south side of the loop, and the Illinois Central R.R. already has a separate suburban terminal at Randolph St., near the northeast corner of the loop.

In straightening the river there would be practically no disadvantage to offset the great advantages. The new channel would be cut almost entirely through railway property, and though it would necessitate some trackage rearrangement on the west side it would give a new and commodious site for terminals and remunerative commercial development on the east side as noted above. Railways owning 50 per cent of the new frontage have agreed to co-operate in the river straightening. As the new channel would improve navigation it is not likely that any objection would be made by the U. S. Government, although the Government would not undertake this work, since it is essentially a municipal improvement. There are contrary opinions as to whether the city now has power to change the river channel, so a bill has been introduced in the Illinois legislature to permit cities to undertake such work when required for public improvements.

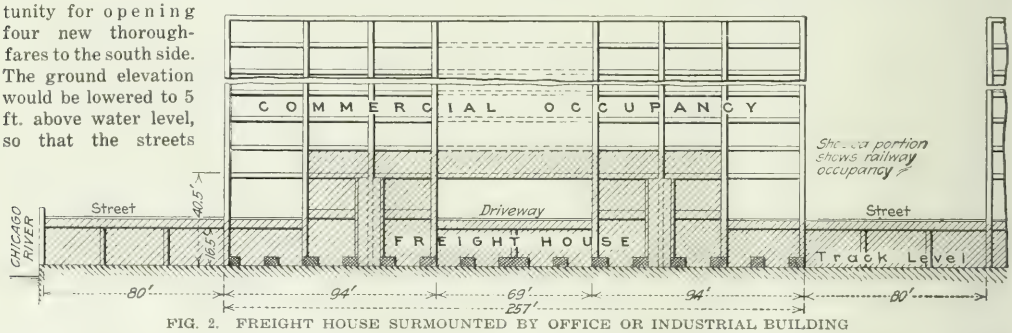


FIG. 2. FREIGHT HOUSE SURMOUNTED BY OFFICE OR INDUSTRIAL BUILDING

As to the important question of cost, it is estimated that sale of the present high value property occupied would more than cover the cost of reconstruction on the new site and that sale of air rights above this site would make an attractive investment. The combined project of river straightening and terminal improvement has been under consideration for several years and has been discussed by representatives of the city and the railways. Problems of site and cost have been a difficulty, as noted above, but the air development is a new feature which changes the conditions materially and is believed to make the removal a matter of economy rather than of expense.

In this respect the project follows along the line already taken by the New York Central R.R. in intensive development over the site of its New York terminal, as described fully in *Engineering News-Record* of Sept. 9, 1920, p. 496. The possibilities of air development at Chicago are shown by Fig. 2, which represents one of

the freight houses and in which the shaded area shows the portion that would be used for railroad occupancy of two or three stories. Around and above this is the structure available for commercial purposes, offices and warehouses.

A special feature of this arrangement is that the railway facilities are provided with a separate driveway, so that the commercial occupancy would have a street frontage independent of the railway. This separation of railway and commercial occupancy is an important feature which is not embodied in any of the existing two-level freight houses at Chicago. Construction and management of the commercial portion of the structure might be undertaken by private interests in co-operation with the railway companies, whose charters would not permit of their undertaking an enterprise of this character.

The construction cost of the new terminals is estimated at $43,000,000, of which $20,000,000 would be paid by the city. This is distributed as follows: straightening the river and altering bridges and tracks, $3,000,000; viaducts and street connections, $17,000,000; railway facilities, freight houses, track changes and suburban station, $23,000,000. Railway property released would be 3,000,000 sq.ft., valued at $20, or $60,000,000. Air rights on the new site are estimated at $10 per square foot, or $25,000,000, so that the return from these or interest therefrom should be sufficient to finance the $23,000,000, which is the railway share of the expense. Therefore, the railways would secure a new site of the same area as that relinquished, with double the present car capacity and an investment of $85,000,000. Ten-story buildings over the railway freight houses are estimated to cost a total of $95,000,000, which would be provided by private capital.

The investigations and plans for this combined railway and municipal improvement have been prepared under the direction of John F. Wallace, chairman (now resigned), and Edward J. Noonan, chief engineer of the Chicago Railway Terminal Commission.

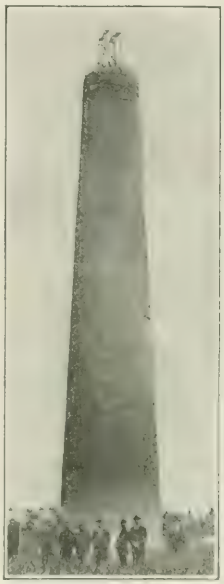
New State Administrative Code for Washington

Under a state administrative code passed by the last session of the Legislature seventy boards, bureaus, and commissions in the State of Washington were superseded on April 1 by ten departments, as follows: (1 Public Works; (2) Business Control; (3) Efficiency; (4) Taxation and Examination; (5) Health; (6) Conservation and Development; (7) Labor and Industry; (8) Agriculture; (9) Licenses; (10) Fisheries and Game. The act also provides for nine administrative committees to have charge of constitutional and statutory duties not in conflict with the administrative consolidation program. Among these committees is one on highways and another on state parks. The Governor and the directors of the ten departments constitute an administrative board, of which the Governor is chairman. This board has certain powers in the way of systematizing and co-ordinating the duties of departments, classifying subordinate employees, and other matters more or less common to all departments. Appointees to the positions of department directors of most interest to readers of this journal are: Public Works, E. V. Kuykendall, of Pomeroy; Efficiency, L. D. McArdle, Olympia; Health, Dr. Paul Turner, Seattle; Conservation and Development, Dan [illegible] Reitzville

Concrete Wireless Tower 672 Ft. High in Japan

Highest Masonry Structure Is Coniform in Shape and Follows Chimney Construction and Design in Details

A REINFORCED-CONCRETE tower 660 ft. above ground level and 672 ft. above the bottom of footings has been built as a wireless telegraph station at Tokyo for the Imperial Japanese Government. This is the highest masonry structure on record, surpassing by seventy or more feet the record-breaking chimney. A view herewith shows the structure completed to the 360-ft. level and the drawings give the important details of design.



672-FT. CONCRETE WIRELESS TOWER AT THE 360-FT STAGE

The tower is coniform in shape and follows chimney practice. At ground level it has a shell thickness of 33 in. and a center diameter of 55 ft. There is a straight taper to a shell thickness of 6 in. and a center diameter of 4 ft. Reinforcement consists of vertical rods and hoops. At the base there are 200 1-in. vertical rods with ¾-in. round hoops on a 4½-in. pitch; at the 100-ft. level, where the reinforcement is heaviest, there are 285 1⅛-in. verticals and ⅝-in. hoops on a 5½-in. pitch; at the top there are 25 1-in. verticals with ¾-in. hoops on a 7-in. pitch.

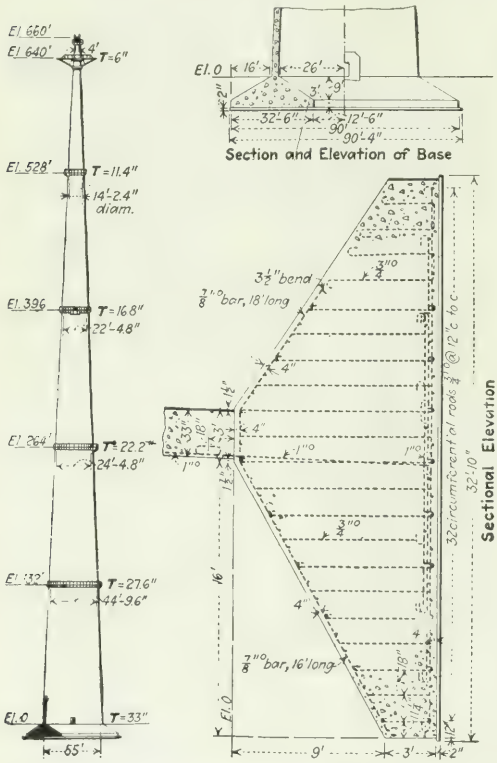
The base consists of an annular ring of triangular cross-section, 12 ft. high and 32 ft. 10 in. wide, leaving a central opening not covered with any footing. This base rests directly on a firm gravel and clay formation; it is heavily reinforced as shown in the accompanying drawing. As the base is about 50 ft. above the water the top of the tower is approximately 720 ft. above sea level.

A wind pressure of 30 lb. per sq.ft. of projected area and temperature stresses due to a range from 20 to 100 deg. F. were factors in the design, which was checked by Professor Shibata of the Imperial University of Tokyo. Further, the tower is designed to withstand earthquakes, which are numerous in Japan. The pressure on the base is about 4,200 lb. per sq.ft., exclusive of wind load. Gravel concrete of 1:2:4 mix is used, made with Japanese portland cement and mixed to a fairly wet consistency. There are approximately 4,420 cu.yd. of concrete in the shaft and 1,640 cu.yd. in the foundation, together with 425 tons of American steel.

All construction work and hoisting of material was done from a central timber tower. Three 5-ft. lifts of wood forms were used, each lift being bound with wire cables. As soon as the 2nd or third form was filled the first form was released and erected on top

Progress ranged from 88 cu.yd. per day at the bottom to 1.2 cu.yd. per day near the top. All the work was done by native labor.

In the center of the shaft is a steel stairway leading to an open platform at the top and having landings to exterior galleries at intervals. At the top are steel arms for the inclined wire antennæ, which are led to the ground. It is expected that the plant will give direct wireless communication with San Francisco, Cal.



DETAILS OF BASE AND GENERAL DIMENSIONS OF HIGH CONCRETE TOWER IN JAPAN

The tower was designed and erected according to the patented system of the Weber Chimney Co., Chicago, the work being executed under the supervision of the Oriental Compressol Co., Tokyo, Japan.

Railways in Japan

A report of the government Railway Department of Japan with statistics for the year ending March 31, 1919, gives a total of 6,932 miles of line, of which 5,269 miles were single track, the total trackage being 9,503 miles. In addition there were about 1,800 miles of private and light railways, but all the important private lines were purchased in 1907, as noted in *Engineering News-Record*, Aug. 19, 1920, p. 364. In that article, however, the date was erroneously given as 1917. An important work still in progress in 1919 was a relocation near Kozu to replace the Hakone pass summit and grades of 2½ per cent by a line with maximum grades of 1 per cent requiring a 4½ mi. tunnel.

Interesting the Young Men in the Boston Society

DURING his presidency of the Boston Society of Civil Engineers Leonard Metcalf, among his efforts to better the service of the society to its members, gave much consideration to methods of interesting the young men in the work of the organization. Conferences were held with the young men, resulting in the conclusion that discussions of designs and designing methods would likely prove of most interest and value. It was further determined that the management of the new activity should be in the hands of the young men themselves.

Accordingly a nucleus of about forty young members, largely designing engineers in the leading offices of the city, was brought together and after maturing a plan the Designers Section of the Boston Society of Civil Engineers was formerly inaugurated.

Method of Operation

The section being designed to interest only the young men, the method of conducting meetings is fitted to their needs and wishes. The meetings start at 6 o'clock and last about two hours. About an hour is devoted to the initial presentation of a subject and the remaining hour to discussion. The sessions are entirely informal. It has been found that it is difficult to get speakers if the papers must be written in advance and if there is a stenographic record of the proceedings. Consequently manuscripts are not demanded and there is no stenographic report. The meetings are held in the library with blackboard and stereopticon available. The asking of questions is encouraged and it is distinctly understood that any one present may interrupt the speaker in order to have him clarify a point, solve a difficulty, or meet an objection. In order to promote better acquaintanceship it is intended that each man upon rising to speak shall give his name and the office with which he is connected.

Experience has indicated that the best meetings are those in which actual designs, rather than mere theory, are discussed. It is preferred that the speaker select a design that has been developed recently in the office in which he is engaged and upon which he personally has been employed. He gives the conditions which must be met, the stress and other assumptions, the reasons why certain designs were chosen, describes alternative designs that were considered and states the reasons for their rejection, etc. As a rule others present have had experience with constructions of a similar kind and they ply the speaker with questions, tell why they used different assumptions and different details, and, in general, by exchange of experience try to open up the subject in all its aspects.

Foundation design furnished interesting discussions for two meetings. The first evening began with a description of a very difficult foundation the design of which had just been completed in one of the Boston consulting offices. One of the young men who had been engaged on the work presented the subject. This led, naturally, to a subsequent discussion of the design of the foundation of the Boston army base.

The theory of flat slabs and a flat slab which had been designed in a Boston office furnished the subject for another meeting. Other subjects have been: Small concrete highway bridges, borings, concrete ship con-

struction, methods of waterproofing, concrete road construction, practical designs from the contractors' point of view and rigid concrete frames.

While the older members of the organization have refrained from coming to the meetings, the section itself has taken the initiative of inviting one or two older men when it was desired to get maturer judgment or greater breadth of experience on a difficult problem. In some cases the older men thus invited participate in the presentation of the subject; at other times they act as counselors after the young men have explained a design and discussed its theory.

Success of Section

The work of the section is considered by the young men themselves and by the officers of the society to be a great success. At the initial meeting twenty-three were in attendance. The average attendance now is about forty, and the mailing list of those who have attended one meeting or another is fifty. In other words, a very large percentage of the section membership attends the meetings. There are no membership dues and no qualifications for membership other than that one must be a member of the Boston Society of Civil Engineers. Not only has the section drawn together the young men who were already members of the society, but at least twelve young men have joined within the last year on account of the activities of the section. It is believed that the membership of the section could be quite considerably increased if active efforts were made to recruit members, but it was considered better to allow the section to grow gradually as a result of its good work, rather than to drag in many who might prove indifferent and later drop out.

The first year's officers were: Chairman, Ralph W. Horne, of the office of Fay, Spofford & Thorndyke; vice-chairman, Ralph E. Rice, of the staff of Simpson Bros. Corporation; clerk, Arthur L. Shaw, of the staff of Metcalf & Eddy.

The officers for the present year are: Chairman, Ralph E. Rice; vice-chairman, E. S. Parker, of the staff of Burr & McLaughlin, architects; clerk, Arthur L. Shaw.

The three officers with three additional members of the section and the president of the Boston Society *ex officio* form the executive committee of the section.

Pennsylvania System Maintenance Costs

According to estimates of 1920 expenditures, new rails and cross ties used to replace old and worn-out trackage cost the Pennsylvania Railroad approximately $11,990,000. This amount is the approximate net cost of the new material and represents a saving in the salvage of the replaced rails amounting to some $2,400,000. About 95,000 tons of new steel rails and 5,300,000 new cross ties were used last year. Of the 95,000 tons of new rail laid in 1920, 82,500 tons, or 87 per cent, was heavy 130-lb. rail. The use of heavier than 100-lb. rail was commenced by the Pennsylvania Railroad in 1915. Steel rails for 1920 use cost approximately $48 a ton, an increase of $8, or 20 per cent over the previous year's cost and 63 per cent more than the cost of rails ten years ago. Cross ties cost the Pennsylvania Railroad 32 per cent more in 1920 than in 1919 and 153 per cent more than ten years ago. Since 1910 the Pennsylvania Railroad has laid 1,347,289 tons of new rail and 56,230,904 new cross ties.

Passaic Valley Sewage Decision Against New York

U. S. Supreme Court Refuses To Enjoin Discharge of Treated Jersey Sewage Through 150 Deep Outlets Into New York Bay

THE DENIAL by the United States Supreme Court on May 2 of the application for an injunction against the discharge of sewage from the Passaic Valley Sewerage District into Upper New York Bay (the people of the State of New York, complainants *vs.* the State of New Jersey and the Passaic Valley Sewerage Commissioners) was noted briefly in our issue of May 5, p. 785. The decision ends litigation begun over twelve years ago. The court holds as *not proven* the various claims of New York State that the discharge of Passaic Valley sewage into New York Bay would, in the language of the decision, "create a public nuisance by causing offensive odors or unsightly deposits on the surface, or that it would seriously add to the pollution of" the bay. The court lays stress upon the stipulations between the federal government and the Passaic Valley Sewerage District in 1910 as being in effect a guarantee of the protection of the waters of Upper New York Bay from pollution by sewage from the Passaic Valley. The suit is dismissed without prejudice, thus leaving it possible for New York State to renew an application for an injunction if it deems it necessary to protect its interests after the disposal works have been put in use. The decision recognizes sewage disposal by dilution and the percentage of dissolved oxygen in water receiving sewage as an index of pollution.

In passing it may be noted that the decision has been printed as a pamphlet of about 13 pp. and may very likely be obtained on application to the clerk of the United States Supreme Court, Washington, D. C.

The decision points out that the first commission created by the New Jersey Legislature to investigate the Passaic Valley sewage disposal problem took up its duties in 1896, though the subject had been dealt with by legislative committees prior to this. A second investigating commission was created in 1897 and a third in 1898. In 1902 the Passaic Valley Sewerage District was created by the Legislature, but it was not until April, 1908, that the plan for a trunk sewer as an outlet into New York Bay was adopted by the commission. An earlier plan, not mentioned in the decision, provided for the discharge of untreated or virtually untreated sewage into Newark Bay, but opposition from Bayonne led the Legislature to prohibit discharge at this point.

The court states that the act authorizing the construction of the sewer required the commissioners to make further investigations as to whether the discharge of sewage into New York Bay would be likely to cause a nuisance to persons or property within the State of New York and to submit the results of the investigation to the Governor of New Jersey. This was done, the decision says, and upon consideration the Governor concluded that the proposed discharge of sewage would not cause such a nuisance and the Attorney General of New Jersey also gave as his opinion that the State of New York "could not have any valid legal objection to the use of the sewer as proposed." The court also pays tribute to the character and ability of the various commissioners who investigated the Passaic Valley sewage disposal problem and to the sanitary engineers, chemists,

and bacteriologists employed by the sewage commission.

Reference is made to the creation by the Legislature of New York of a commission to investigate the pollution of New York Harbor, with power to co-operate with the authorities of New Jersey in finding a solution of the problem. Although various conferences were held between the New York and New Jersey commissions, yet "for some reason, which does not clearly appear, no mutually satisfactory course of action was arrived at." In October, 1908, the suit for injunction was begun. Subsequently the Federal Government filed a petition of intervention and was granted permission to join in the suit on the ground of protection to navigation, interstate commerce, and of government property and the life of federal employees upon New York Bay. Before the suit came to trial conferences were held between representatives of the Federal Government and the Passaic Valley Sewerage Commission, and on May 16, 1910, a stipulation was signed under which the Federal Government withdrew from the suit and the commissioners agreed to construct works of a character and capacity and to produce results named in the stipulation. The commissioners also agreed to build additional works if that were decided necessary by the Federal Government after the works went into operation.

The sewage-treatment works on Newark Bay called for by the stipulation include coarse screens, grit chambers, self-cleansing mechanical screens with openings of not more than 0.4 in., and sedimentation basins, the latter of specified sizes and holding or detention. (For the stipulation in full see *Engineering News*, May 12, 1910, p. 566; for editorial comment see p. 561 of the same issue.) The stipulation also provides for the discharge of the sewage near Robbins Reef Lighthouse in 40-ft. depth of water from 150 multiple outlets distributed over an area of 3½ acres, arranged to discharge horizontally across tidal currents. The terms of the stipulation were in accord with "advice of army engineers of high rank" acting for the government and "distinguished sanitary engineers" acting for the sewerage commissioners. Operating results, as already stated, were laid down in the stipulation, besides which the right of government inspection was provided with the right to order additional treatment works. After stating these facts the court declares: "It is obvious that if the conditions of this stipulation are realized and maintained, there will be no occasion or ground for such an injunction as was prayed for."

At this point in the decision the court rules that the agreement between the federal government and the Passaic Valley Sewerage Commission is a valid obligation, within the authority of the Attorney General of the United States on the one hand, and the Passaic Valley Sewerage Commission on the other, the New Jersey Legislature having specifically authorized the commission to enter into the agreement.

After the federal government withdrew from the case, the other parties continued it. The taking of testimony was not concluded until June, 1913, and it was not until the October term of the United States Supreme Court in 1918 that the case was argued. Subsequently it was decided that in view of "the rapid advance in sanitary science then in progress, suggested in the record" additional testimony should be taken to show the present state of the art, whether there was any practicable plan or arrangement for sewage disposal which would lessen the polluting effect of the New York City sewage, and also the "present degree of pollution of the waters of New York Harbor and the change in this respect since the taking of testimony." Accordingly, "much additional testimony was taken." The remainder of the decision is given in full, as follows:

With the record in this state we come to consider the evidence introduced, but subject to the rule that the burden upon the State of New York of sustaining the allegations of its bill is much greater than that imposed upon a complainant in an ordinary suit between private parties. Before this Court can be moved to exercise its extraordinary power under the constitution to control the conduct of one State at the suit of another, the threatened invasion of rights must be of serious magnitude and it must be established by clear and convincing evidence. *Missouri vs. Illinois and the Sanitary District of Chicago*, 200 U. S. 496.

The water of New York Bay is such a brackish combination of salt sea and fresh water that it could not, under any circumstances, be used for drinking or other domestic purposes and, therefore, the reasons given in the bill to justify the injunction prayed for are restricted, as we have seen, to the claims that the addition of the Passaic Valley sewage to the already polluted waters of the bay would result in odors offensive and unwholesome to persons bathing in them or passing over them in large vessels or in small boats or living and working upon the adjacent shores, in causing unsightly deposits on the surface of the water and chemical action injurious to the wood and metal of vessels navigating the bay, and in rendering fish and oysters taken from such waters unfit for consumption.

The evidence introduced as to increase of damaging chemical action upon the hulls of vessels by the proposed addition of sewage, and as to danger from air borne diseases to persons using the water in boats and vessels or working or dwelling upon the shore of the bay, is much too meager and indefinite to be seriously considered as ground for an injunction, and when it is considered that for many years all of the sewage from the great population of New York City and its environs and from the large cities on the New Jersey shore (estimated, in 1912, at 900 m.g.d.) has been discharged for many years into the harbor, quite untreated, the evidence does not justify the conclusion that persons bathing in or that fish or oysters subsisting in such waters can sustain much further damage from the addition to them of the sewage of the Passaic valley, after it has been treated in the manner proposed in the stipulation with the government.

There remains to be considered, therefore, only the offensive odors, and unsightly deposits on the surface which it is claimed will be caused by the addition of the putrescible matter to the water and it is to this claim that a large part of the evidence introduced by the complainant is directed. Much evidence was introduced tending to prove that sewage collected from so great an area as that of the Passaic Valley Sewerage District would be stale, if not septic, when it reached the treatment plant at Newark Bay and that it would, therefore, hold in solution much organic matter which would not be removed by the screening and sedimentation processes proposed, with the result that it would cause disagreeable deposits on the surface of the water—"oily and sleek fields"—and offensive odors near the place of discharge and upon the wharves and shores adjacent to the bay.

On the other hand witnesses of seemingly equal candor and learning, and with large practical experience, called by the defendants, testified that they were confidently of the opinion that the treatment of the sewage provided for in the stipulation with the United States would cause such purification of it that the results guaranteed therein would be fully realized.

It is much to be regretted that any forecast as to what the effect would be of the treatment and deeply submerged discharge through multiple outlets proposed for this large volume of sewage must depend almost entirely upon the conflicting opinions of expert witnesses, for experience with such treatment and dispersion under even approximately like conditions seems entirely wanting. It is, however, of

much significance that the authorities of the City of New York, after many years of investigation of the subject of sewage disposal, in their latest plans propose to adopt a treatment of screening and sedimentation and dispersal in deep water very similar to, but not so extensive and thorough as, that provided for in the stipulation between the defendants and the United States.

There is only one point upon which all the experts called for the opposing parties agree, viz.: that in the present state of learning upon the subject the amount of dissolved oxygen in water is the best index or measure of the degree to which it is polluted by organic substances, it seemingly being accepted by them all that upon the oxygen content in water depends its capacity for digesting sewage—that is for converting organic matter into inorganic and harmless substances by direct oxidation and by sustaining bacteria which assist in such conversion.

The witnesses agree that so long as there is sufficient dissolved oxygen in the water the process of digestion of the sewage will go forward without producing offensive odors and that when it sinks below a required percentage of saturation such odors will appear, but, unfortunately, there is a wide divergence of opinion among them as to what the required lower percentage is. The opinions of seemingly well qualified experts vary in giving from 25 to 50 per cent of saturation as the amount of oxygen necessary to prevent the appearance of such offensive odors from decomposition of organic matter.

Measured by this dissolved oxygen standard, the evidence of the complainant is that as early as 1906 the water adjacent to New York City, especially in the Bronx and lower East River, was much polluted by sewage, but that the water in other parts of the bay, especially near Robbins Reef Light, was somewhat, but not greatly, contaminated. This condition, the evidence shows, continued with no very pronounced decrease in the oxygen content of the water until 1911 when the investigations embodied in the first testimony taken were concluded. And the evidence taken under the order of the Court in 1919 shows an irreconcilable conflict in the testimony as to the then condition of the water, especially near Robbins Reef Light, and as to the probable condition of it to be anticipated in the future. In the interval from 1906 to 1919 the estimated growth of the population of New York City and its suburbs draining sewage into adjacent waters was in excess of 100,000 a year—an increase of population in the aggregate much greater than the total population of the Passaic Valley Sewerage District at present and approximately equal to its estimated population in 1940—and it is undisputed that this New York sewage, untreated, was discharged from over 450 sewers directly into the adjacent waters, for the most part at or above the line of low tide, and that only in a few instances was it carried even to the pier heads.

It would seem, therefore, that if the anticipations of the experts for the complainants, as to the results likely to be produced by the effluent from the sewer of defendants, were well founded, that by the year 1919 conditions in the harbor should have become so pronounced and plain that there could not have been such conflict as the record shows in the testimony of trustworthy and competent scientists as to its then existing condition.

Considering all of this evidence, and much more which we cannot detail, we must conclude that the complainants have failed to show by the convincing evidence which the law requires that the sewage which the defendants intend to discharge into Upper New York Bay, even if treated only in the manner specifically described in the stipulation with the United States government, would so corrupt the water of the Bay as to create a public nuisance by causing offensive odors or unsightly deposits on the surface or that it would seriously add to the pollution of it.

The evidence taken in 1919 also discloses that other means than those specifically described in the government stipulation may be resorted to, if needed, for the purpose of improving the character of the effluent from the sewer, viz.: slower and more prolonged sedimentation processes; additional screening; the aeration of the sewage before it reaches the treatment plant and again after treatment and before discharge into the tunnel conveying it to the bay; and finally, if required, chemical treatment.

Having regard to the treatment of the sewage prescribed in what we regard as a valid contract on the part of the defendants with the government of the United States, to the specific agreement therein for protection of the waters of Upper New York Bay from pollution, and to the means which the government will have to secure further purification, if desired, by refusing to permit the discharge of sewage into the Bay to continue, we conclude that the prayer for injunction against the operation of the sewer must be denied.

We cannot withhold the suggestion, inspired by the consideration of this case, that the grave problem of sewage disposal presented by the large and growing populations living on the shores of New York Bay is one more likely to be wisely solved by co-operative study and by conference and mutual concession on the part of representatives of the States so vitally interested in it than by proceedings in any court however constituted.

The Court, recognizing the importance of the ruling which it is making to the great populations interested, as well in the State of New Jersey as in the State of New York, will direct that the decree denying the relief prayed for shall be without prejudice to the instituting of another suit for injunction if the proposed sewer in operation shall prove sufficiently injurious to the waters of the Bay to lead the State of New York to conclude that the protection of the health, welfare or commerce of its people requires another application to this Court.

It results that the bill of complainants will be dismissed but without prejudice to a renewal of the application for injunction if the operation of the sewer of defendants shall result in conditions which the State of New York may be advised requires the interposition of this Court.

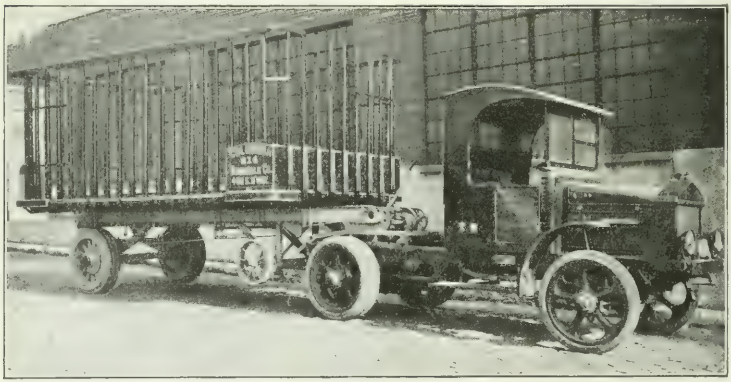
Two Record-Breaking Concrete Arch Bridges

At present the largest span reinforced-concrete arch in the world is under construction across the Mississippi River in Minneapolis, on the line of Franklin Ave. This has a central span of 400 ft. According to an article by M. A. Mesnager in *Le Genie Civil* of Jan. 15, 1921, there will be built soon in France two reinforced-concrete arches which surpass the Minneapolis bridge. One of these, the viaduct across the valley of Bernand in the Loire district, will have an arch of 542 ft. (165 m.) clear span, and a span of 558 ft. (170 m.) center to center of the springing line. This span is a single arch rib 13 ft. wide at the crown and 21 ft. wide at the springing line, and the rise is 96 ft. The rib has a thickness at the crown of 8.2 ft. The whole bridge, which carries a meter-gage railway, consists of the central arch with concrete girder viaduct approaches. It was started in 1913 and the foundations were all placed when the war broke out. On account of the death of the contractor, the work has been suspended for the time being. However, M. Mesnager states that the Minneapolis bridge will be surpassed by a new concrete arch to be constructed across the Seine at Saint-Pierre-du-Vauvroy, near Rouen. This is a reinforced-concrete arch of 410 ft. (125 m.) clear span with a suspended roadway, whose level crosses the arch very near the abutment. This will consist of two parabolic arches of rectangular section to carry a roadway 19 ft. wide with two 5-ft. sidewalks. The same article refers to a project for a bridge at Arstad, Sweden, where there is to be a reinforced-concrete arch, of the general outlines of the Hell Gate bridge, that is, with a roadway halfway up the arch, in which the central span is 558 ft. This bridge, however, has never been started, though there has been a competition for its design.

Tractor-Trailer Freight Transfer at St. Louis, Mo.

Motor Units with Detachable Semi-Trailers Handle L. C. L. Traffic—Railway and Private Stations—No Fixed Plant

TRANSFER of less-than-carload freight by means of a tractor-trailer system is employed at St. Louis, Mo., operating between the freight houses of the numerous railways and between private freight stations operated by the transfer company. The railways running west and east from St. Louis have their wards and freight houses in St. Louis, Mo., and East St. Louis, Ill., on the respective sides of the Mississippi River, About 80 per cent of the less-than-carload freight interchange between them is handled across the river by wagon transfer, in addition to the interchange or transfer between different stations in each of the two cities. Trap cars are used only to a limited extent for the transfer across the river, on account of the great delay in such movements and the switching and per diem expenses incurred by the originating line, the intermediate carrier and the delivery line.



TRACTOR-TRAILER UNIT FOR FREIGHT TRANSFER AT ST. LOUIS, MO.

A considerable proportion of the l.c.l. transfer business in and between the two cities is carried by the Columbia Terminals Co., which handles an average of 3,000 tons daily, of which 1,000 tons consist of through freight transferred from one railway to another. This company acts also a receiving and delivery agent for all the railways, and maintains private or off-track terminal stations in the business district at which it receives freight from shippers, assembles it for shipment and delivers the consolidated loads to the respective railways. Inbound freight is also collected at railway freight stations and transported to the company's local stations, where it is delivered to the trucks or wagons of the consignees. In this way the teaming of individual shippers to and from distant freight houses is reduced materially.

The railways have 13 freight stations in St. Louis and 12 in East St. Louis, Ill. The Columbia Terminals Co. has one off-track station in the latter town and eight in St. Louis, besides a station at a railway siding of the Missouri Pacific Ry. in St. Louis where it specializes in the handling of pool cars. About 1,500 tons of freight are received daily at the company's stations for delivery to the railways.

A tractor-trailer service was inaugurated by the Columbia Terminals Co. nearly two years ago to improve and expedite its transfer business, with results so satisfactory that the equipment is being increased steadily. One of the units is shown in the accompanying view. At present this service is confined to the long trans-river movements, about 80 per cent of the general business being handled by 200 horse-drawn vehicles and 75 motor trucks. For the short hauls the motor trucks have not been found satisfactory, owing to the large proportion of time consumed in standing idle for loading and unloading. The tractor-trailer equipment now comprises 10 tractors and 24 trailers, but 15 additional tractors and 48 trailers have been ordered. Each tractor averages 20 miles daily, with an average trailer load of 6 tons. The maximum distance between two freight stations is about two miles and the speed is limited by law to 10 m.p.h.

One of the principal reasons for the adoption of the tractor-trailer system is that the independent tractors can be kept at work in hauling, which is their proper service, while the trailers are waiting to be loaded and unloaded. Another reason given is that a tractor can pull a load considerably heavier than that which could be placed upon a motor truck. As to the saving in time, on trips for which a horse-drawn vehicle averages an hour a tractor-trailer unit requires only 18 minutes.

From the accompanying view of a tractor-trailer unit it will be seen that the trailers have open bodies with side stakes, the load being covered with waterproof canvas as a protection against damage and loss. Closed bodies which can be locked and sealed have been considered but not adopted, principally on account of the heat of the enclosed body in summer and the reduction in load capacity. Transportation of freight under lock and seal is not considered necessary for protection against loss, as the transfer company's men load and check the freight and give a receipt for it to the delivering line; they also unload the freight and secure a receipt from the receiving line.

Detached trailers at the delivering freight house are loaded by the transfer company's check clerks, who also sign the receipt given to the railway. At the receiving freight house, the tractor remains attached to the trailer and the unloading is done by the driver and his helper, who obtain a receipt for the freight from the railway, the transfer company's responsibility then ceasing. In this respect the system differs from that employed at Cincinnati, as noted below, where closed bodies are loaded and locked by the freight house employees of the delivering line and then unlocked and unloaded by the employees at the freight house of the receiving line, the only duty of the employees of the transfer company being to drive the motor trucks from one freight house to another.

The semi-trailer system is used, in which the forward end of a two-wheeled trailer is carried directly by the rear end of a four-wheeled tractor, the paying load thus serving to increase the adhesion of the driving wheels of the trailer. Trailers of 9 tons load capacity are hauled by 3½-ton tractors. To facilitate the work at the freight stations the trailers are of a type which can be moved around when detached from the trailer. For this purpose, a hinged frame fitted with small wheels is attached to the underside of the forward end of the frame. Before the tractor is detached this frame is lowered to support the free end of the trailer, being secured in its vertical position by a brace.

Automatic operation of the coupler and hinged frame facilitates the work materially. As the trailer is backed against the trailer the coupling is engaged, the auxiliary wheeled frame is raised clear of the ground and locked in position under the body, and at the same time the brake on the main wheels of the trailer is released. Inclined rails on the rear of the tractor engage small wheels on the trailer sills, raising the frame and guiding the coupler into engagement. In detaching the trailer, the driver of the tractor operates a lever which releases the coupler, the same movement causing the auxiliary wheeled frame to drop into its vertical position and the brake to be applied to the rear wheels of the trailer as the tractor moves away.

An advantage claimed over the system of motor trucks carrying demountable sealed bodies, as employed at Cincinnati and described in *Engineering News-Record* of March 11 and Dec. 16, 1920, pages 508 and 1,194, is that the tractor-trailer system requires no mechanical installation at the freight houses and can thus be put in operation without trouble or expense to the railway. In the Cincinnati system, overhead crane equipment is used to transfer demountable bodies between truck chassis and freight house platform, as well as to shift them to position on the platform. The Columbia Terminals Co. states that in the St. Louis system, the time thus required for handling the bodies is saved and the trailer causes no obstruction upon the platform. Detached trailers can be parked at a convenient place and moved to and from the platform by a team as required, but a French railway which uses a similar system for its parcel delivery service at Paris employs a small tractor for thus shifting the trailers at the station.

By the dispatching system of the Columbia Terminals Co. it is possible to know at any minute where a trailer is located and where both the loaded and empty trailers are located. A certain number of trailers are placed at a railway freight station, according to the volume of business. Check clerks are provided by the company to check the freight as it is loaded onto the trailers and to sign for it to the railways. This is called an affirmative loading plan. As far as the railways are concerned their responsibility ceases after the freight is loaded onto the trailers and they obtain a clear receipt from the check clerk, to guard against claims between carriers for error or loss in transfer.

The service rendered by the Columbia Terminals Co. at St. Louis is different from that in other cities, so that comparative costs of operation are not available. For the convenience of shippers and consignees the company has provided extensive terminal facilities in the heart of the business district.

Rates for transfer vary with the character of service. Between one of the Columbia company's stations and a railway freight house the rate is 11 and 13 per 100 lb. if between the two cities, or 7 and 9c. if in St. Louis, the lower rate in each case being for outbound movements. For interchange, or transfer between two railway stations, 9c. if the movement is between the two cities. If the movement is between two stations in one city, the rate is from 4c. for loads up to 10,000 lb. to 6c. per 100 lb. for loads of 15,000 lb. and more. For various specific classes of freight there are special rates ranging from 13 to 37½c. per 100 lb. In most cases a minimum rate of 27c. per load is provided.

Tractor Speeds Delivery on Hauling Job

IN GETTING the Kerckhoff hydro-electric plant ready for service on the San Joaquin River in California a large amount of heavy freight was handled expeditiously by the use of a tractor to which a string of trailers was attached. With the tractor shown in the accompanying illustration and three 5-ton trucks 1,000 tons of freight were moved in seven days from the railroad station at Auberry over the five miles of construction road to the Kerckhoff power plant.

This road had grades up to 12 per cent and curves with a radius of 50 ft. The accompanying illustration shows the tractor train with six [illegible] transformer cases rounding one of the sharp curves. [illegible] Starr was construction engineer in charge of the work.

HAULING HEAVY FREIGHT ON THE KERCKHOFF PROJECT

Local Gravel Plant Experiences in Road Building

Analyses of Three Pit Installations Point to Four Main Reasons for Failure in Roadside Gravel Production

By H. T. Tuthill

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ROADSIDE gravel plant equipment and operation call for good engineering judgment if satisfactory economic results are to be secured. In general, lack of complete success and often total failure can be traced to one or more of four causes:

(1) Insufficient preliminary examination of the working site to determine the character and volume of material available and its accessibility.

(2) The mistaken economy on the part of the contractor of utilizing second-hand machinery, which he can buy cheap, but which is not adapted to the work.

(3) The attempt to operate where the percentage of gravel is not fairly high—30 per cent or over. As a live contract requires from 150 to 200 cu.yd. of material each day anything less than 30 per cent gravel is not a paying proposition—too much material has to be handled and the problem of spoiling the waste sand is difficult.

(4) Failure to wash the gravel—not only actually to clean the gravel, but to remove the sand. This is a more or less expensive process, but it is good economy in the end and is the only way to insure the best results.

The preceding conclusions are based on rather extensive observation. In the past six years in eastern Long Island there have been eight projects by various contractors to obtain local coarse aggregate for the construction of concrete roads under contract for the state—six being upland bank gravel plants and two being beach gravel plants. In addition, gravel from the huge windrows piled up on the shore of Fort Pond Bay at Montauk was used by the Federal Government in constructing a concrete highway from the Long Island R.R. terminal at Fort Pond to the seaplane and dirigible hangars about a mile away. These operations have all come under observation and of three of them the knowledge is intimate. Analyses of the three best-known operations follow:

Farmingdale Plant

This plant, in operation 1914 to 1920, is the most successful of those observed. The site of the pit, the machinery used, the high gravel content, and the cleanliness of the material were all factors in this success.

This pit was developed to supply gravel and sand for 9,500 cu.yd. of 1:1½:3 concrete pavement. It is situated on virgin ground, covered with low scrub oak brush. The contour of the land is flat; the water level is 12 ft. from the surface of the ground, and the top soil varies from 0 to 18 in. in depth. Thirty acres of land were purchased for development at $30 an acre. The pit was adjacent to the road under construction and the total average haul for the work did not exceed two miles. Borings made by the contractor to the depth of 80 ft. showed that from 0 to 15 ft. the gravel ran 40 per cent; 15 to 30 ft., 45 per cent; 30 to 50 ft., 60 per cent; and below 50 ft., 80 per cent.

Careful determination of the pit conditions was followed by a careful selection of equipment, which is catalogued briefly as follows:

(1) A 100-hp. boiler furnishing steam for the entire plant.

(2) A 35-hp. double drum Ligerwood hoisting engine, with 18-in. drums, set 125 ft. from the base of the mast.

(3) One Sauerman dragline, bucket (1 cu.yd.) and a 97-ft. mast. Bucket operated on a track line cable 600 ft. long, fastened to a bridle at the lower end.

(4) One 8-hp. Worthington-Dean pump 7½ x 7 x 12 in. duplex, for wash-water supply, furnishing 250 gal. per minute.

(5) One No. 4 Nye sand pump for boosting sand onto the spoil bank from the sump at the end of the gravity sluice discharge.

(6) One Austin-Western rotary screen, 4 x 16-ft., in four sizes: ⅝ in., ¾ in., 1½ in. and 2¼ in., with a ⅜-in. sand jacket. Height of screens above foundation, 30 ft.

(7) One 10-hp. Wicks engine for driving the screens—chain drive to flywheel and belt drive from flywheel to screens. Screens charged from overhead hopper and feed delivery controlled from hopper to screens by a small gate set on the base of the hopper.

The capacity of the bins was 800 cu.yd. They had no floors, the material resting on the ground. The available loading capacity was 500 cu.yd. Five men operated the plant including loading. The hauling was done by 7-ton trucks, and the daily output of gravel averaged 150 cu.yd.

Smithtown Plant

This plant, built in 1918 to furnish 4,500 cu.yd. of coarse aggregate, was a contrast in all respects to the Farmingdale plant. The site selected was on the side bank with light timber growth and three to four feet of top soil. It was located almost a mile away from the nearest end of the road contract. The daily output averaged only 35 cu.yd. and the cost of the gravel at a time when labor was comparatively cheap was $1.49 per cublic yard.

It is notable that the plant equipment was meagre, consisting of a small portable Austin bin, with a rotary screen and bucket conveyors, together with a small jaw crusher, an outfit commonly used on up-state work as a crushing plant. The screen was 3 x 10-ft. with 1¼-in. and 2-in. openings surmounted with a sand jacket. There were a 30-hp. Farquhar boiler; one Case 65-hp. tractor with Maney-Baker 1-cu.yd. wheel scrapers for stripping; 500 ft. of 2-ft. Koppel track and 3 cars for spoiling waste sand, and a single-drum steam hoist for hauling cars. This outfit required an operating force of ten men and three teams. No wash water was used and considerable trouble was experienced with damp sand which clogged the ¼-in. sand jacket. Finally, it became necessary to devise a shaker which jarred the screens so as to keep the openings clear.

Noyack Plant

This plant, operated during 1919-1920, is on a beach and the layer of gravel averaged 12 ft., of which 8 ft. was under water. The percentage of gravel was high. The 4-ft. layer above water averaged 50 to 60 per cent and the 8-ft. layer below averaged from 60 to 80 per cent. The gravel ran small in size and there was no waste in tailings. Everything above ¼-in. was utilized, but all the sand was wasted and the output per day for a six-day run averaged only 70 cu.yd. A tabulation of the equipment follows:

(1) A small Acme portable bin and rotary bucket conveyors, capable of 100 cu.yd. output per day.

(2) A 3 x 10-ft. rotary screen with ⅜-in. sand jacket.

(3) One Haiss wagon loader, capacity 1 cu.yd. per minute.

(4) Two 1-cu.yd. Koppel cars and 500 ft. of light track, 2-ft. gage, 16-lb. rail.

(5) About 200 ft. of incline trestle for hauling cars up onto dump; grade about 6 per cent.

(6) Four 2-horse scrapers.

(7) One 6-hp. gasoline hoisting engine (single drum) for hauling cars up incline.

(8) One Gould Triplex pump (1[illegible] gal. per min.) for supplying wash water, a jet being sprayed into the screens.

An operating force of 14 men was required. About 20 gal. of gasoline and 2 qt. of oil were used per day to run the engines, including pump, hoisting engine, loading machine and the engine furnishing power for the screen and bucket conveyors. Motor trucks of 3-cu. yd. capacity made six round trips per day on an eight- to nine-mile haul. These were engaged at $35 per day.

This method of operation was continued until the beach was stripped to the water level. Then, as it became necessary to contrive some other method to secure the rich deposit of gravel below, a 6-in. centrifugal pump was brought into play as a possible solution. Briefly the equipment assembled was as follows:

(1) One 6-in. centrifugal pump (Morris dredging pump) set in a position to have a 100-ft. suction line, with 12 ft. of suction hose for depth range, and a 45-ft. discharge, with 15 ft. rise; pump, pumping directly into the rotary screen.

(2) One 35-hp. locomotive type boiler with a Blake duplex feed pump for feeding the boiler with water from a driven well on the site.

The Gould Triplex pump was used in connection with this outfit to supply water for a jet to loosen the gravel for the suction intake.

The plant required seven men to operate. It had been in operation only a short time when the rotary screen broke down and gravity screens were installed, the gravel being pumped over them. Baffle boards and grizzlies were set at the upper end of the screens so as to break up the force of the water with a sand and gravel content. This greatly facilitated the clearance of sand from the gravel; waste sand, which was caught in a sump, was sluiced away through a 12-in. pipe. The gravel was delivered to the bins perfectly clean. The centrifugal pump, however, was too small. Nothing less than an 8-in. pump should be used for gravel where the total lift averages from 15 to 25 ft. A 6-in. pump chokes up under the strain. The ouput ran about 8 cu. yd. per hour and the cost of operation was comparatively small.

Drilled Plugs Replace Strainers in Terre Haute Filters

TWO pressure filters of the Terre Haute (Ind.) Water-Works Co. were fitted up in 1916 with drilled plugs instead of the conventional strainer screens which had given more or less trouble from "blow-ups" allowing the sand to pass into the city mains. Dow R. Gwinn, president of the company, described the experience in a discussion of a paper by W. W. De Berard on "Perforated Pipe Underdrains" presented recently to the Indiana Sanitary and Water Supply Association.

At the time the change was made the filters were fitted with a new set of extra heavy 1½-in. Buyers pipe laterals spaced on 6-in. centers and tapped 6 in. c. to c. to receive ½ x ⅜-in. brass bushings, which were soldered in. Into the bushings were screwed ⅜-in. cast-iron plugs. Three sizes of orifice were drilled to give uniform washing and filtering over the bed. Of the 308 plugs in each circular tank 100 have 5/32-in. orifices 170 [illegible]-in. orifices and 38 ⅜-in. orifices. A deep [illegible] cut across the top of the plug is made to prevent gravel from blanking the orifice. An 18-in. gravel bed supports a 23-in. bed of Portsmouth (Ohio) sand. Mr. Gwinn stated that results after 4 years' operation have been so satisfactory that the other filters eventually will be equipped with orifice plugs.

Felling Four Steel Chimneys Lined Outside with Concrete

DUE to the rapid corrosion in a battery of self-supporting steel stacks of the Walworth Manufacturing Co., at Kewanee, Ill., and later to difficulties arising from unequal expansion when the steel stacks were surrounded by concrete shells, the stacks will have to

STACK CUT 25 FT. ABOVE GROUND FELLED IN PREDETERMINED SPACE

be felled and replaced in rotation. Felling them in the restricted space is difficult. Originally the company had four self-supporting steel stacks rising 165 ft. above the base and 6 ft. in diameter at the top. After 3½ years of service the stacks had corroded to such an extent that it was necessary to take some action. A contract was let to surround the steel stacks with a concrete shell, 6 in. thick for the lower half and 5 in. thick throughout the upper portion. The concrete was heavily reinforced with vertical and horizontal rods from ⅝ to ⅞ in. in diameter and with wire mesh.

Sufficient consideration was not given to the difference in expansion between the steel in the old stack and the surrounding coating of concrete. The greater expansion of the steel soon started cracks in the concrete even when the boiler plant was operating at ordinary ratings and with the usual coal. When coal became scarce during the war, oil burners were installed and as the load was unusually heavy, it was necessary to force the boilers. Stack temperatures became so excessive that flames appeared at the top of one of the stacks. The steel work became red hot and weakened to such an extent that the stack began to tilt until it was 4 ft. 8 in. out of the perpendicular. In this bending, part of the concrete shell broke away. One of the engineers happened to notice the dangerous condition of the stack and immediately turned off the fuel on the boilers it was serving. After the shut-down the stack came back toward normal about 2 ft., but it remained 3 ft. 6 in. out of plumb.

This stack was taken down immediately and at the same time a contract was let to fell the other three stacks later on. The first stack had to be taken down in six 25-ft. pieces which were dropped in a space 30 ft. square between the railway tracks and the power house. Each piece weighing about 35 tons was dropped accurately into the allotted space.

The outside stack at the opposite end of the row was the next to be taken down. Space was available to drop this stack in nearly its entire length, the cut being made 25 ft. above the ground to avoid damaging a stairway and pipe tunnels near the base of the stack. After chipping off the concrete, the reinforcing rods were burned off with an acetylene torch and the steel shell was burned through. Including the base the entire stack weighed 300 tons. The dropping was so skillfully done that neither stairway nor pipe tunnels were damaged.

With the two end stacks out of commission, the two middle ones are serving the boilers until two radial brick stacks can be erected in the place of those removed. It will then be necessary to throw the two middle stacks in a restricted place between the new stacks and the buildings, the clearance on either side being not much over 6 in. Felling replacing is being done by Peter Drolshagen, chimney expert, Chicago.

Report on Chicago Garbage Reduction Plant Shows Poor Results

HIGH operating costs and inefficient results of the Chicago municipal garbage reduction plant are due to failure on the part of the city to carry out recommended improvements, to an unnecessary amount of labor with little control of its efficiency, and to lax methods of disposal of the products, according to a recent report made to a council committee by I. S. Osborn, consulting engineer, Cleveland, Ohio.

The quantity of garbage treated has declined steadily under municipal operation, from 152,892 tons in 1915 to 80,132 tons in 1920. The percentage of tankage to weight of garbage (17 to 18 per cent) is higher than in most cities and the grease recovery is only 40 lb. per ton as compared with a usual average of 60 lb. or more; while the quality and price of the grease are lower than in other cities. For the six years 1915-1920 there was a net profit in only one year, but the Cleveland plant, which is nearly comparable, showed a net profit every year. At Chicago, the income per ton of green garbage has averaged $3.46, while at Cleveland it has averaged $5.40, the operating cost per ton ranging from $5.78 to $8.67 at Chicago and from $2.43 to $5.48 at Cleveland for the six years mentioned.

In addition to improvements to the plant and methods of operation, the report recommends reduction in labor and staff, closer supervision of labor, efforts to improve the quality and quantity of product, sale of by-products on the basis of analysis and by competitive bids, and discontinuance of the chemical laboratory. It is suggested also that unless the present cost of operation is reduced the city will benefit by leasing the plant to a company under contract to dispose of the garbage. As to cost of operation in relation to results the report says: "Although the cost is secondary to the social service to be rendered, yet experience demonstrates that a successful solution of the commercial aspects is attainable without sacrificing the quality and character of the benefits due the public."

Swiss Technical Notes

Tests of Large Hydraulic Tunnels One of the Leading Engineering Studies Now Under Way

By Engineering News-Record's Swiss Correspondent

Introductory—In the notes given herewith, and in subsequent installments that he hopes to send, your correspondent desires to place his American colleagues in touch with the state of engineering construction in Switzerland, and the factors which it involves. He hopes that such reports and the publication of more formal technical discussions by Swiss engineers on their outstanding constructions may tend to induce an exchange of experiences from the one side and the other. Our constructions in general will prove not to be notable for their size—the small proportions of our country are to be considered—but possibly these small structures will yet be found to contain many noteworthy features in construction or design, tending to stimulate further development.

Engineering Education and Opportunities

Engineering Education—The current academic year, which began in October, 1920, for the first time in years showed retrogression in the attendance at the highest technical institution of Switzerland, the Eidgenössische Technische Hochschule," or Federal Technical College. The 2,237 students of the year 1919-20 have decreased by 271 to 1,966 at the beginning of the current semester. The different departments of courses are represented in the total attendance register as follows:

Mechanical engineering (including heat and electrical divisions, separate beginning with the fifth semester)	772
Civil engineering	399
Chemical	331
Agricultural	147
Architectural	117
Forestry	70
Pharmacy	56
School for teachers of mathematics	26
School for teachers in natural science	23
Military school*	13
Landscape architects and surveyors	12
Total number of students	1,966

*Intended for the training of instruction officers of line troops The course includes three consecutive semesters (1½ years) Lectures, seminars and exercises are tuition-free.

The prime reason for the reduction of the number of students is the fact that Swiss money is at a premium as compared with that of the surrounding countries, so that the attendance of foreign students, which in past years has been quite large, is rendered difficult. While during 1919-20 24 per cent of the students came from foreign countries, this ratio has gone down to 17 per cent. The foreign students come largely from European states; of non-European countries only South America sends to Zurich a considerable number (35 in 1919-20) as against only 3 from the United States. Moreover, the rate of exchange also promotes a movement of Swiss students to foreign, particularly German, technical colleges, the effect of which is already perceptible.

Among the significant changes in courses of instruction the lengthening of the civil engineering course from seven to eight full semesters (four years) is noteworthy. Besides the civil-engineering course, the schools for teachers in mathematics and natural sciences

have eight-semester courses, whereas the other departments have only seven semesters. The development of the civil-engineering arts in the last three decades, the endeavor to avoid premature specializing of the students, and the difficulty of developing capable engineers suitable for responsible work in the previous course of seven semesters led to this lengthening of the course. Perhaps the step may be surprising just at present when in all other countries the opposite tendency—shortening of the course—prevails. Which way is the right one is subject of divided opinion even in Switzerland. Your correspondent believes that only a thorough engineering education, which keeps pace with the development of the art and at the same time takes account of the increasing demand for completeness of education, in the several branches can meet the requirements placed on men of leadership today. Those who consider this course too long still have numerous technical schools of middle grade open to them.

Opportunities for Civil Engineers—Just at present the market for civil engineers in Switzerland is very unsatisfactory. While even at the beginning of the past year lively activity in power-plant development seemed fairly certain, this prospect has been eliminated by the temporary postponement of construction work on the large Aare power plant on the Grimsel, at Böttstein-Gippingen and at Rupperswil. Further, since one of the largest employers in the country, the Swiss Federal Rys., has been forced to retrenchment by the tight financial situation, and since, in part voluntarily and in part of necessity, many Swiss engineers have returned home from other European and foreign countries, there is at present a large excess of available men.

Strength of Hydraulic Tunnels

Several high-pressure hydraulic power plants with storage reservoirs are at present under construction in Switzerland, or are merely deferred on account of difficulties in getting money. At the Ritom power plant, recently placed in operation, which will serve mainly for supplying winter current for the electrical operation of the St. Gotthard Ry., the trial operation under pressure (a head of about 35 m. of water) resulted in a break in the tunnel which involved a fairly large loss of water. For a considerable part of its length the tunnel showed cracks in the concrete lining, mainly near the junction of side wall and invert, and in minor degree also at the junction of side wall and arch. The cracks in this oval tunnel-shaped section were exclusively longitudinal cracks. The cause of the break could only be found in the yielding of the surrounding rock strata. To investigate the question of responsibility, and to clear up the physical phenomena in the construction and operation of such pressure tunnels, the owning company, the Swiss Federal Rys., called in a commission of experts. This commission has already completed the first part of its work, dealing with the break of the Ritom tunnel, and has submitted to the authorities a detailed report, which will be dealt with more fully at a later time. The second part of its task, which is awaited with much interest by a large circle of engineers concerned with the construction of pressure tunnels, is at present actively in hand.

To begin with, the yielding of a rock shell under the hydrostatic pressure exerted in operation is to be determined for various rock formations. These tests are to be made in the pressure tunnels of the two power plants of the Federal Railways now under construction—at Amsteg and on the Barberine. They will be made by closing off the tunnel section under study by steel bulkheads and placing it under pressure; especially built instruments with remote indication will measure the give of the rock shell. These tests, it is hoped, will show whether the yielding of the rock is of plastic or elastic character. Preliminary experiments in a test tunnel of the Ritom plant, where pressure was applied to the tunnel walls by hydraulic jacks, showed very considerable plastic deformations in the rock there encountered, a rather weak and fissured material. The tests would further show, in case of elastic deformations, the magnitude and change of the elasticity. Only on the basis of the results will it be possible to determine to what extent they give sufficient data on which to base the design of the tunnel lining.

Besides this principal question of the magnitude and kind of deformation it is apparent that data on other allied questions will result from these studies, such, for example, as the problem of securing a close, solid contact of the lining with the surrounding rock by aid of mortar or cement injection (on which interesting information is given in a report, "Grouting Operations, Catskill Water Supply," in the *Proceedings* of the American Society of Civil Engineers.) The importance of the entire case unquestionably justifies the relatively high costs of the tests.

The commission itself comprises a tunnel expert, an engineer experienced in high-pressure power plants, the professor of applied mechanics and bridges at the Federal Technical College, and two geologists.

Air Blowers Unload Bulk Shipments of Light Commodities

MOTOR-DRIVEN fans have been installed at the Parr terminal in Oakland, on San Francisco Bay, to unload by a so-called air-conveyor or vacuum system, bulk cargoes of copra, sulphur or other commodities not too heavy to be picked up by a current of air. Advantages claimed for this method are that it decreases by about one-third the time which a copra-laden ship must lie at the dock for unloading and that it reduces the cost of unloading as well as the number of men necessary to carry on the work.

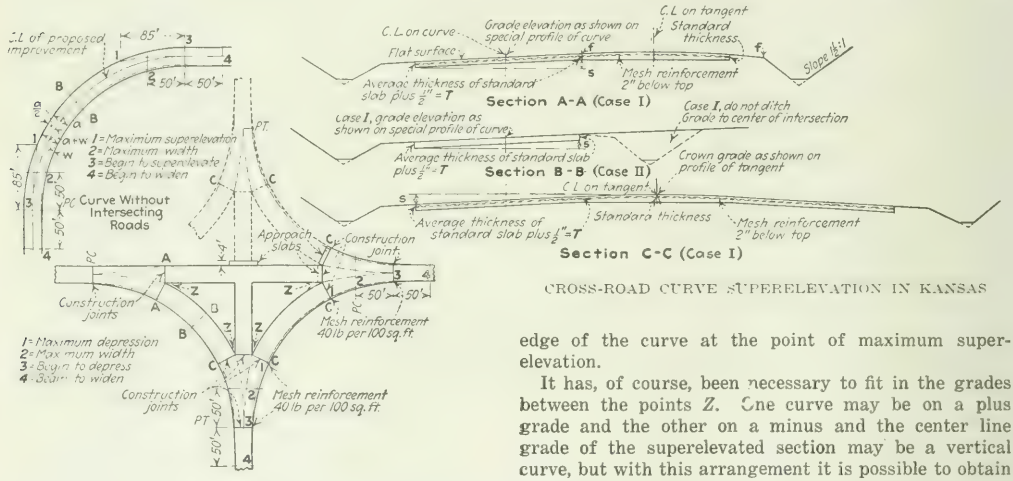
The plant consists mainly of two air blowers operated by 75-hp. electric motors and serving two separate air lines; one creates a suction which draws the copra out of the hold of the vessel, and the other builds up air pressure in a second line which drives the copra through the delivery pipe to railroad cars on the wharf, or bins in the terminal warehouse. The nozzles or intake ends of the line running into the ship's hold are 8 in. in diameter and are made flexible so as to facilitate working in corners and in cleaning up.

In the system as installed at the Parr terminal two such nozzles can be operated simultaneously. The 8-in. lines from these nozzles run to a bridge over the railroad tracks where they unite in a single 12-in. line delivering to a conical shaped separator tank on top of the wharf shed. At the base of this tank a patented gate transfers the copra from the vacuum to the pressure system by which means it is conveyed through the delivery pipe. The average length of pipe-line from the hold of the ship to freight car at this terminal is approximately 135 ft.

Superelevation of Curves at Cross-Roads

By W. V. Buck,
Assistant State Highway Engineer, Topeka, Kan.

THE problem of curve widening and superelevation at cross-roads has been solved by the engineering department of the Kansas Highway Commission in a manner which presents features of interest. In developing the standard solution, particular attention was given to (1) the method of superelevation; (2) the method of and point of beginning widening; (3) the point of beginning of superelevation; (5) the amount of superelevation; (6) the desirable radius and (7) the cross-section of the superelevated section. All these features, as determined, are indicated on the accompanying drawing, for cross-roads and also for single turns.



CROSS-ROAD CURVE SUPERELEVATION IN KANSAS

All curves are required to have a radius of at least 200 ft. When the exterior angle is greater than 45 deg. and the radius is 500 ft. or less, the curve is widened according to the accompanying table. Curves of greater radii than 500 ft. are not required to be superelevated or widened; but all curves of 500 ft. radius or less are required to be superelevated ½ in. per foot of width. Other general rules of practice are indicated by the plans or are brought out in the special explanation which follows of cross-roads practice.

As most highway curves in Kansas are at cross-roads particular attention is given to this condition. Having a cross-road it is necessary to carry a grade across the intersection and take off two curves from one place. Therefore it is not possible to secure the superelevation before reaching the P. C., but it must be worked out with the crown line as a dividing point. Also, if the grade is to be properly handled straight across the intersection, it is impossible to superelevate the outside of the curves. Therefore, referring to the cross-road plan, this procedure is followed:

Begin to widen 50 ft. in front of the P. C. and reach the maximum width at 50 ft. beyond the P. C. (widen in 100 lin.ft.). As the first section of the superelevation is one-half the crown of the standard section, start at the P. C., and proceed to depress the inside of the curve and above the crown line out until the maximum depression is reached at a point radially opposite the point where the standard section again shows up, on the tangent leaving the two curves. In doing this a desired superelevation has been obtained and satisfactory grades have been maintained all ways in the crossing roads.

The amount of superelevation used on all curves of 500 ft. or less radius, is ½-in. per foot of width and the minimum width on all curves of 200 ft. or less radius is 20 ft., regardless of the width of roadway up to that width. The cross-section of the superelevated section shows a flat surface between the points of maximum superelevation and is secured by gradually shoving the crown of the roadway over until it reaches the outer edge of the curve at the point of maximum superelevation.

It has, of course, been necessary to fit in the grades between the points *Z*. One curve may be on a plus grade and the other on a minus and the center line grade of the superelevated section may be a vertical curve, but with this arrangement it is possible to obtain satisfactory grades and superelevation without the sacrifice of either. On the curves, where there is no intersecting road, much the same practice is followed, although it is possible on this curve to put in an easement or even obtain the maximum superelevation at the P. C., and the more elaborate design will work out very satisfactorily.

With the minimum radius of 200 ft. on curves there is also required a minimum length of 200 ft. on vertical curves and a 300-ft. unobstructed view of the road from the seat of any vehicle.

STANDARD CURVE WIDTHS ON KANSAS HIGHWAYS

Radius, Ft.	Width on Tangent, Ft.	Width on Curve, Ft.	Width on Tangent, Ft.	Width on Curve, Ft.
200 or over	16 or 18 ft.	20	10	20
150	16 or 18 ft.	22	10	20
100	16 or 18 ft.	24	10	20
75	16 or 18 ft.	26	10	20
50	16 or 18 ft.	30	10	22

In constructing roads of gravel or macadam, where the project turns at a corner, at cross-roads, the cross-roads are constructed to the center of the intersection. If the construction is hard surface it is built only along the line of the improvement and an apron is constructed on the tangent which allows traffic more easily to get on the pavement, and provides for the joining on of future construction in the other direction. A small concrete approach slab is constructed at the end of the apron to protect the edges of the pavement where the traffic comes onto the slab from the dirt roads.

Rehabilitation Requirements of the Denver Water-Works

Additional Conduits from Mountains, New Filter Pumps and a Strengthened Distribution System in Program

IMMEDIATE needs of the Denver water-works require an expenditure of nearly $500,000 according to a report made recently by Burton Lowther, chief engineer and general superintendent. Bonds for $10,000,000 are to be voted on at the municipal spring election, the additional money going for developing sources of supply and reservoir sites. Six major items are included in the recommendations: (1) conduits, (2) more reservoir capacity in the city, (3) an extended and strengthened distribution system, (4) 45-m.g.d. rapid filters at Marston Lake, (5) modernization of pumping stations, (6) acquisition of additional water for future use.

From 1910 to 1918, the Denver Union Water Co., because of uncertainties as to its future status, was not able to make many needed extensions and betterments although it did spend an average of $266,000 annually. Since the city bought the plant, Nov. 1, 1918, it has spent for extensions up to Dec. 31, 1920, $919,000, all taken from earnings. This amount is about equal to the surplus revenues. The bond issue involves no increase in rates but is to be paid for out of the surplus.

Capacity requirements are based on maximum consumption, 86 m.g.d. in 1919 and 96 m.g.d. expected in 1922, as the rate of increase is approximately 5 m.g.d. annually. Under favorable conditions it is estimated that 90 per cent only of the total conduit capacity, equivalent to 77.4 m.g.d., can be counted on safely to bring the water from the mountain foothill sources to the city reservoirs. With storage within the city of 54.5 m.g.d. the stored supply would be exhausted in six days. In 1922 the period of extreme consumption will only need to be prolonged three days to exhaust the stored supply. A new 54-in. reinforced-concrete conduit was started in 1920. About 25,000 ft. were made and 14,000 ft. laid, as described in *Engineering News-Record*, Sept. 16, 1920, p. 551. Completion of this line from Platte Cañon to Wynetka, 23,000 ft. and a new conduit of the same size to Capitol Hill reservoir in the city, 12½ miles, will bring in 50,000,000 gal. a day.

The only unfiltered supply furnished Denver is that from the north end of Marston Lake; the water being passed through 60- and 80-mesh screens to remove some of the vegetable organisms and larger crustacea. The original screen plant built six years ago was described in *Engineering Record*, Sept. 4, 1915, p. 291. A certain number of the organisms pass on to the city reservoirs where they increase in number and cause tastes and odors. A 45-m.g.d. rapid sand filter plant is projected.

Extensive repairs are needed on the outlet of Cheeseman Lake where there is excessive leaking due to the eroding effect of the high velocities. The work will be undertaken under a pressure of at least a partially filled lake and a seamy granite formation must be sealed against the water pressure.

Approximately 1,500 city blocks have inadequate water pressure, chiefly due to lack of large enough mains. Several hundred blocks have no service and urgently need it.

Roofs over the Capitol Hill reservoirs, 6.9 acres in area, are of wood and have so many holes in them that the percolating sunlight causes algæ growths. At each cleaning several truck loads of decayed lumber are found in the bottom. Every snow entails heavy repairs. Removal of an earth embankment between two of these basins and replacement by two concrete walls, making three basins, will increase the capacity by 5 m.g. Asphalt paving on Ashland Ave. reservoir sides and bottom has almost entirely disintegrated, leaving the earth exposed in many places. This makes cleaning difficult. Lack of circulation, together with algæ growths under a portion of the roof where the wood needs replacing, cause objectionable tastes and odors.

The estimates are distributed as follows: $1,670,000 for completion of 54-in. concrete conduits; $1,750,000 for filters and $1,580,000 for distribution system, reservoir repairs, new pumps, and other improvements.

Structural Engineering Research Problems

LARGE-SCALE reesarch in problems of structural engineering was discussed by Prof. W. M. Wilson of the University of Illinois in a paper presented before the Western Society of Engineers May 9. He proposed eight specific problems covering matters in which our knowledge is insufficient for best results in design and construction. They are: (1) The effect of reversed stresses on riveted connections; (2) experimental comparison of the rigidities of different types of wind-bracing connections in high buildings without diagonals; (3) stress distribution among the rivets of large gusset plates; (4) end restraint of bridge stringers; (5) structural value of fitted ends of intermediate stiffeners of plate girders; (6) development of practical rules or formulas for calculating secondary stresses; (7) measurement of secondary stresses in the field; (8) study of the inter-action between floor system and bottom chord in a through truss bridge. Some of these subjects have been studied to a certain extent before this, but nevertheless large uncertainties surround all of them. With respect to tests of the effect of reversed stresses on riveted connections, it is stated that a few such tests have been carried out recently at the Illinois Engineering Experiment Station, with the result of showing that connections designed in accordance with present specifications are likely to develop loose rivets when subjected to stress reversal. Determination of safe unit stresses on such riveted connections and of study of various methods of driving with regard to rivet resistance under stress reversal would be the objects of further tests. In the matter of wind-bracing connections in skeleton buildings, a spliced gusset-plate connection and a connection by knees or end connection angles on the bracing girder have been compared in a limited number of prior tests at Illinois, but these and other types require to be studies by additional tests. With respect to secondary stresses, Prof. Wilson insisted quite strongly on the importance of clearing up the existing doubts as to the need for taking secondary stresses into account in design. The author suggested a co-operative arrangement between a research institution and manufacturers and users of steel, for the purpose of carrying out researches.

Another City-Owned Garbage Reduction Plant

New Bedford, Mass., joined the cities owning and operating garbage reduction plants by taking over the Colwell reduction works from a private company at a price of $156,400. Some improvements to the plant are being made.

Personnel Board Keeps Close Tab on Contractor's Field Forces

Movements of Chief Employees Scattered Over Active Jobs Extending From Newfoundland to Cuba Graphically Shown

By M. A. Darville
Office Manager, Construction Department, Turner Construction Co., New York City

In order to keep in close touch at the home office with superintendents, assistant superintendents, timekeepers, material men, etc., and all foremen on active jobs maintained by the Turner Construction Co., New York City, the personnel board, a section of which is shown in an accompanying view, has been developed.

FIG. 1. SECTION OF BOARD SHOWING DETAILED DATA ON LARGE AND SMALL CONTRACT

With this board it is possible to tell immediately what each man is doing and where he is located, whether he is married or single, white or colored, and where his home is located, who is employed on any one of the fifty-one operations scattered from the Island of St. Pierre, near Newfoundland, to Cuba, with a point in Texas as the western limit.

Though this territory is divided up into sections, with headquarters at one of the branch offices of the Turner Construction Co., and with each territory having its own office personnel and in a general way its own construction organization, it is necessary that the home office have complete details as to the movement of all the men in its organization.

"This job must be complete and ready to turn over to the owner in four months," is the demand often made upon us and to get a construction organization on the job at the earliest possible moment is essential. This means that a superintendent, timekeeper, a carpenter foreman and a labor foreman, must be sent to the job right away, an assistant superintendent, material clerk, and other foreman soon to be assigned.

On account of unusual location a new job often presents problems as follows: (1) Total lack of accommodations for families of married men; (2) excessive distance from home; (3) unusual labor conditions—race prejudice; (4) foreign countries; and (5) extreme temperatures.

Many of these obstacles have to be met but once in establishing a factory organization, as the location is permanent, but in construction work all or some of these difficulties are constantly recurring. Where a job is miles from a railroad and there are no accommodations or conveniences of any kind single men are preferred. With a glance at the board, the single men for any trade can be noted.

It is always desirable to keep men near home so, in organizing a new contract, jobs in the territory in question are first studied for available men, and then the other territories are investigated. This information is evident from the color of pins in each man's name slip. Labor conditions may be such that it is not advisable to include colored foremen on this work, and any slips with such marks can be readily dropped out of consideration.

To keep an organization going for years, as this company has done, requires that the construction force be at home, or near home, for some part of the time, as in most cases the novelty of traveling around wears off after a few years. The construction man is always working himself out of a job with small chance of his next one, if any, being in the same place. When a man is married and has family responsibilities, the moving around creates a certain amount of hardship. As the more experienced men are generally in that class a study of the proper distribution among jobs will yield good returns in keeping the older and more experienced men with the company. The following table shows how such a policy has worked out in the Turner Construction Co.:

Position	No.	Average Length of Service	Maximum Length of Service
Timekeepers	47	1 yr. 1 mo.	4 yr. 5 mo.
Material Clerks	22	1 yr. 8 mo.	4 yr. 0 mo.
Engineers	19	1 yr. 9 mo.	3 yr. 3 mo.
Asst. Supts.	33	2 yr. 5 mo.	9 yr. 1 mo
Supts.	41	7 yr. 0 mo.	18 yr. 1 mo
Carp. Fore.	49	7 yr. 3 mo.	16 yr. 3 mo.
Con. Fore.	30	9 yr. 7 mo.	18 yr. 0 mo.
Labor Fore.	33	7 yr. 8 mo.	17 yr. 0 mo.

Description of the Board

The board is composed of a number of wooden strips, each either $1\frac{3}{4}$ in. by 26 in., or $3\frac{5}{8}$ in. by 26 in., suspended vertically from a group of racks on the wall. Each rack holds thirteen small, or six large and one small, board, and a space of $\frac{1}{8}$ in. is allowed between the boards. Each board represents a job. Narrow boards are used for small and medium-sized contracts, and wide ones for large operations. Each board is divided into nineteen spaces for different occupations and trades, and all contracts handled by one general superintendent are hung together. Where more than one general superintendent operates out of the same office, the jobs are hung together in order. This arrangement allows for expansion limited only by wall

space, and at the same time permits adjacent jobs to be kept together.

At the top of each board a slip of white bristol board containing the name of the contract in plain heavy single-stroke lettering is fastened with two glass-headed pins, the color of which denotes which general superintendent handles the work. Immediately below, on a much smaller slip, is the superintendent's name. In the next space, the assistant superintendent's name is given and so on through the list including all foremen. No journeymen are listed. Spaces on the job boards are large enough to allow three name slips to be placed one above the other, so that there is room on the narrow boards for three men and on the wide boards for six men in any one space.

FIG. 2 PERSONNEL BOARD—EACH VERTICAL STRIP REPRESENTS A JOB

Slips for job names are white and those used for the men are on colored paper. In the case of foremen, a color has been selected to suggest as far as possible his trade, as follows:

Trade	*Color*	*Representing*
Carpenter	Light yellow	Fresh lumber
Stripper	Dark yellow	Used lumber
Concrete	Light green	Fresh concrete
Cement Mason	Dark gray	Cement finish
Reinforcement	Dark blue	Steel
Steel laborer	Light blue	Steel
Brick mason	Terra cotta	Brick and tile
Hodcarrier	White	Lime
Laborer	Brown	Sand and dirt
Plasterer	White	Lime
Miscellaneous	White	Trade designated

In the case of stripper foremen, who are carpenters by trade, a small patch of light yellow is pasted on their dark yellow slips, distinguishing them from such foremen as are of the labor type. There is often considerable difference in the scale of wages of these two classes of foremen. In the upper right-hand corner of a man's slip, which is $1\frac{5}{8}$ in. x $\frac{7}{16}$ in., a small block indicates that a man is single; if inked in solid it shows that he is married. Widowers get both symbols.

When there is no mark at all in that corner it is an advertisement of the fact that information is not as yet complete from this man. A black square in the upper left-hand corner indicates that a man is colored. These slips are held in place by glass-headed pins, the color of each pin representing the territory in which his permanent home is located. For example: A man working in the Boston territory, but having a home in the Philadelphia section would have the color of pin corresponding to the Philadelphia territory. Where the location of his home is not known a black pin is used; this is a noticeable reminder that more information is lacking.

The arrangement is such that all men engaged on any particular branch of work are on a horizontal line. For example: By looking across the board all the carpenter foremen in all districts in charge of such work can be easily noted. This is facilitated by inserting a small-sized board between every ten or fifteen jobs containing the names of the different positions and trades in large letters on name plates of the trade color as wide as the board and nearly as high as one space. In picking out men it is of course necessary to be familiar with the stage of operation of each job, whether it is just starting, half complete and how long to go, or practically finished. It is, of course, preferable to transfer men from completed work.

A card index kept in conjunction with the board shows the man's name, permanent and temporary addresses, position, jobs on which he is and has been located, his past and present rates of pay, and any remarks as to ability and special qualifications. As a man is shifted from job to job that fact is noted on the card, and his name is moved on the board accordingly. This means that the information is "up to the minute."

A schedule of rates on each job is kept up to date on the bottom space of each board, and such information is used as a guide for establishing rates for any foremen and journeymen sent to the work. By scanning the job payrolls each week headquarters knows just where each man is, how much he is earning, and also whether the job is working excessive overtime.

In the main office a job record book is kept with an organization sheet for each job, showing what men are there in each capacity, when they started, and when they finished. These three—the board, the card index, and the record book—give the "where is he," and the "who was there," for any man and any job at any time.

The board practically speaks for itself, and those from any other departments desiring the location of any particular person need not bother a half dozen people to get it, but can come and see for themselves. For convenience of such people a large name plate with the city in which the office is located, and the name of the general superintendent, is fastened with the proper colored pins above the jobs handled by this man. For example: Boston has red for a job color, red pins in the men's names whose homes are in Boston territory, and red pins in the label showing job names. A red pin in the Atlanta territory is a danger signal that this man will probably be kicking to get back home.

At one end of the frames a set of boards is labeled for each of the offices. This furnishes a place to put men who are on vacation, sick, or otherwise not assigned. If a man is employed on a straight-time basis his name will appear somewhere on the board.

Engineers Active in Study of Colorado River Problems

Overenthusiastic Newspaper Publicity Leads Many to Believe That Large Dams Will Be Built at Once

ENGINEERING potentialities in the valley of the Colorado River are very great, greater perhaps than for any other river in the country. While there are no navigation possibilities, there must be built sooner or later flood prevention works and structures for the development of power and storage and distribution of irrigation water. Engineers from all of the states watered by the river are busy studying the possibilities and engineering requirements of the future, and have banded together in these investigations in order to co-ordinate their work. It is unfortunate, therefore, that overenthusiastic publicity men have flooded the country with a number of reports which by no means give the present status of the Colorado River investigations and which furthermore have led a great number of engineers all over the country to think that immediately there will be started on the Colorado somewhere a number of dams of record-breaking proportions.

The requirements of flood prevention, irrigation, and power development are so interwoven on the river that it was thought necessary by those interested that the problems be studied together. To this end a so-called League of the Southwest, an organization whose nucleus is the Governors of the States of California, Nevada, Arizona, New Mexico, Utah, Colorado, and Wyoming, was formed some time ago. This league has formed a Colorado River Engineering Commission to gather and put into shape data that can be used as a basis for recommending steps that will lead to the best development of power and irrigation resources on the river. In addition to the engineering commission there is also being formed a treaty commission, consisting of a representative from each state, which will work with the engineering commission to formulate laws relative to the use and division of water in the interstate streams. In the league the United States Reclamation Service is also represented, because that service has built a number of structures along the Colorado River Valley and has studied and is studying a number of others. F. E. Weymouth, of Denver, Col., chief engineer of the Reclamation Service, is serving as secretary of the league.

Report on Imperial Valley

Definite progress in the study of the river was made by the United States Reclamation Service in its investigation made under the Kinkaid Act, which required the director of the Reclamation Service to examine and report on the condition and possible irrigation development of the Imperial Valley in California. The preliminary report pursuant to this resolution was made by Director A. P. Davis in January, 1921, and has been printed as a congressional document. This report states the basic problems of the Imperial Valley under the following heads: Water supply for irrigation, protection from the floods of the Colorado River, available land for irrigation, and canal systems necessary to reach these lands. The report, however, is merely a preliminary one and is to be followed soon by a more elaborate statement of the case.

As a part of this investigation the Reclamation Service has been examining the structural possibilities of the Boulder Canyon site for a dam on the Colorado River. In this connection the report says:

> It was demonstrated for several years that for several reasons it is desirable to have a reservoir below the Grand Canyon of the Colorado, which would intercept most of the drainage of the Colorado River and therefore be a more complete solution of the flood control problems. Such reservoir would also be more valuable in the irrigation of the lands on the lower river on account of its greater proximity to them, and the consequent possibility of regulating its flow more nearly in accordance with fluctuating needs. Incidentally it would furnish a large amount of power.
>
> For these reasons a reservoir site has been surveyed in the Boulder Canyon, on the northern boundary of Arizona, below the mouth of the Virgin River. The surveys show a basin of large capacity, provided a high dam is constructed. But investigations so far have not shown favorable foundation conditions. These investigations are still in progress and it has been impossible to complete them in time for the incorporation of an estimate in this report approximating the cost of storage at this point.

Hydro-Electric Possibilities

It may be stated that the Boulder Canyon dam would be from 300 to 500 ft. high and its feasibility depends largely upon the finding of bedrock at a reasonable depth. This is the dam which is so generally reported in the newspapers as about to be built. Obviously there is no basis for any such statement. Power development at this site could be used (1) to pump water for irrigation on the area above gravity flow lines, (2) for municipal purposes in the cities and towns served by the project, and (3) for the use of other municipalities and for sale to private and enterprises.

Some confusion exists in the minds of a number of engineers because of the reports on other dams in the river. There have been applications made to the Federal Power Commission, for instance, for several other dam sites on the Colorado River, notably those made by the Southern California Edison Co. for approximately 4,000,000 hp. power development. These applications are for sites extending from Diamond Creek, at the western boundary of Arizona, to Lee Ferry, just above the Grand Canyon. In fact, the whole district covered is approximately coterminous with the better known part of the Grand Canyon, whereas the Boulder Canyon project is below the celebrated gorge. The Southern California Edison project is purely a power project with transmission possibilities into southern California, and especially to Los Angeles. The company is studying the construction possibilities of the various sites, but no action on the application for licenses has been taken by the Water-Power Commission. In contradistinction to this there have been a number of negotiations between the city of Los Angeles and the federal government regarding the possibility of the city developing for municipal use the power generated at the Boulder Canyon dam, and these negotiations are reported fairly fully in Director Davis' report. The special bond committee of the Los Angeles city council recommended that a special election be held next fall at which time there may be submitted to the voters a bond issue providing $25,000,000 for the development of hydro-electric power in conjunction with other interests at the Boulder Canyon site.

Meanwhile any definite action on Colorado River projects of whatever sort is being held up pending agreement between the various interests concerned, and certainly until the final report pursuant to the Kinkaid act is made.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Little Known Biographies of Engineers

Sir—The favorable attention recently given in your "Engineering Literature" section to books of a biographical character would imply that a presentation of other and little known works of this nature would not be amiss.

It would probably be best to mention first Robert Louis Stevenson's "Record of a Family of Engineers," and "Memoir of Fleeming Jenkins." The memoir portrays the life of a notable English engineer of the last century. Although it does not give the attention to technical detail that engineers would desire, the time expended in reading it is well used. The "Record,' a history of Stevenson's immediate ancestors, contains a portion of his grandfather's diary, written during the building of the Bell Rock Lighthouse, and an excellent analysis and portrayal of an engineer's character and methods.

Another interesting work is the "Autobiography of Sir John Rennie" (London, 1875), which is admirable from the engineering reader's point of view because it gives such detailed, historical knowledge of the many and varied projects in which this distinguished engineer was interested.

Smeaton's biography and collected reports, published in three volumes by the Institution of Civil Engineers, is also characterized by a wealth of detail. In this category may also be mentioned the "Life of Robert Stevenson," by J. C. Jeoffreson (London, 1866), which is rich in historical material.

Another worthy title is the "Life and Labors of Mr. Brassy," by William Helps (Boston, 1874). This concerns the life of the first of the railroad contractors. The life of James B. Eads, by Louis How (New York, 1900), gives in small compass a remarkable amount of information concerning this nationally known engineer. Other books deserving consideration are four collections of short sketches of the lives of prominent pioneers of the profession: "Great Engineers," by J. F. Layson (London, 1880); "Lives and Works of the Civil and Military Engineers of America," by C. B. Stuart (New York, 1871); "Lives of Eminent Mechanics," by Henry Howe (London, 1844), and "Eminent Engineers," by Dwight Goddard (New York, 1906).

"An Appreciation of Two Great Workers in Hydraulics," by Kent (New York, 1912), an account of the lives and contributions to science of Venturi and Herschel, rises above the ordinary, while the "Life of Richard Trevithick," by E. Harper (London, 1912); "The Memoir of H. A. Harvey," by E. A. Harvey (New York, 1900); "Reminiscences of a Railroad Engineer," by W. H. Wilson (New York, 1896), may be included here.

Some recent books by engineers, autobiographical in character, are chiefly accounts of travel and contain only general impressions of the country and people visited and little or nothing of professional life and experiences. Outstanding examples are: "Adventures of a Civil Engineer," by C. O. Bridge (London, 1909), and the recently published books by McCarty. These have nothing to distinguish them from the autobiograhies of travelers, statesmen or others without the fold.

Fulton, Ericsson, Watt, De Lesseps and Edison, whose exploits attract the public to a greater degree than those of most engineers, have been the subject of one or more biographies which have not, like most of the other titles, been relegated to the back shelves of the libraries.

Cyclopedia for Railway Men

MAINTENANCE OF WAY CYCLOPEDIA: A Reference Book Covering Definitions, Descriptions, Illustrations and Methods of Use of the Materials, Equipment and Devices Employed in the Maintenance of the Tracks, Bridges, Buildings, Water Stations, Signals and Other Fixed Properties of Railways—Compiled and Edited by E. T. Howson, Western Editor of the Railway Age, and Editor of the Railway Maintenance Engineer, E. R. Lewis, Formerly Chief of the Duluth, South Shore & Atlantic, and K. E. Kellenberger (Signal Section), Editor of the Railway Signal Engineer, Assisted by Homer Hughes, Associate Editor, Formerly Assistant Field Engineer, Interstate Commerce Commission. In Co-operation with the American Railway Engineering Association. New York: Simmons-Boardman Publishing Co. Cloth; 9 x 12 in.; pp. 860; illustrated. Cloth; $10; Leather; $15.

Earlier railroad cylopedias have been confined to the mechanical departments of railroad engineering. This one is notable as the first successful attempt to issue under a single cover such a large mass of information valuable to the railroad maintenance engineer, to roadmasters, and to purchasing departments, despite some elementary and obvious matter and some minor inexactness in definitions. The book has two general sections: the illustrated text, covering 550 pp., and the catalog section, which lists equipment, materials and devices alphabetically by manufacturers' names. The illustrated text is separated into sections devoted to track, bridges, buildings, water service, signals, wood preservation and "general" information, the latter including construction and camp equipment, and a large number of tools and devices.

Parts of the cyclopedia were prepared in collaboration with a committee appointed for the purpose by the American Railway Engineering Association and with several railroad engineers mentioned in the acknowledgments. It includes the last revisions of specifications adopted by the American Railway Engineering Association, the American Railway Association, the Railway Signal Association, the American Wood Preservers' Association, and the Manganese Track Society.

The treatment is generally accurate and comprehensive, with a wise selection of illustrations. Some of the material seems unnecessary. For instance, a sketch is included "showing location of chimney in frame building" with the statement that a chimney is "that portion of a building which contains the smoke flues, especially an upright masonry tube or flue usually extending through the roof and having flue openings for smoke pipes to enter at any convenient height." In the chapter on water service it is not made clear why a dam, defined, in part, "as a bank or mound of earth," should be located "preferably on the railway right of way," nor why "numerous watersheds" make masonry dams necessary in mountainous country. The section on water service is generally comprehensive, but no serious attention is given to the sanitary quality of water.

A general subject index gives references to the illustrated text and the catalog section. There is also an alphabetical index of catalogs, a trade name index, and a directory of products, with alphabetical lists of firms, trade names, and products with manufacturers' names.

The cyclopedia shows an immense amount of painstaking work by the editors and will be of undoubted value to railway maintenance engineers.

The Lay-Out of Small Water Mains

REVIEWED BY ROBERT E. HORTON
of Horton, Barker & Wheeler, Engineers, Albany, N. Y.

THE LAY-OUT OF SMALL WATER MAINS: Notes and Tables Dealing with Various Problems in Simple, Compound, Double and Ring Mains—B. H. H. Hellins, M. Inst. C.E. New York and London: Isaac Pitman & Sons. Cloth; 6 x 9 in.; pp. 45; illustrated. $3.

Devoted exclusively to the solution of problems relating to compound and branching mains and circuits in water-works distribution, this little volume contains more complete and direct methods than are contained in most works on water supply or engineers' handbooks.

The problems are solved by the method of equivalent lengths of uniform pipe, in conjunction with a modified form of the Darcy formula. A table of friction coefficients is given, and the values are considerably greater than those obtained by Darcy, but are intended to apply to somewhat incrusted and tuberculated pipes. The formula itself does not appear until near the end of the text. For the solution of each specific class of problems, a factor or ratio table is given. These factor tables are on double folded sheets at the end of the book, in a form for convenient use and reference in conjunction with the text.

Examples show the application of the methods to various compound and branching mains, and to simple and compound circuits and to a gridiron circuit with a single cross-over. Quantities of flow are expressed in British imperial gallons, but the factor ratios are independent of units of discharge, and the methods of calculation can be readily applied to other units.

Friction heads are expressed in the British form of "inclination," or length of pipe per unit fall. This is the reciprocal of the slope or fall per foot of length as ordinarily used in American pipe flow formulas.

Except as its uility may be limited by the particular formula on which it is based, the book should prove very useful in the design of water main distribution systems, particularly with reference to securing effective gridironing and adequate fire protection.

British Tank Construction

TANK CONSTRUCTION: Relating Principally to the Design, Manufacture and Erection of Tanks in Mild Steel—By Ernest G. Beck, Wh. Ex., Assoc. M. Inst. C.E., Author of "Structural Steelwork," etc. London: Emmott & Co., Ltd. Cloth; 6 x 9 in.; pp. 265; illustrated. 12/6 net.

For a specialist on standpipe or tank work this book would be useful as showing how things are done in England, where the rectangular tank is prevalent. In fact, 134 of the 260 text pages are devoted to a type of structure practically unknown in this country. Circular tanks, according to the author, "vary from about 20 ft. to 200 ft. in diameter and from 15 ft. to 40 ft. in height," which leads one to say, "Other countries, other customs."

The author says he knows of no other book on the subject. Hazlehurst's "Towers and Tanks for Water-Works," *second* edition, a book of 325 pages, was reviewed in the Engineering Literature Supplement of *Engineering News*, April 14, 1904.

How to Use Red Lead for Paint

RED-LEAD AND HOW TO USE IT IN PAINT—By Alvah Horton Sabin, M.S., D.Sc., Author of "Technology of Paint and Varnish," "White-Lead," etc. Member of the American Chemical Society, the Society of Chemical Industry, etc. Third Edition, Rewritten and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 7 in.; pp. 139; illustrated. $2 postpaid.

The first edition of this useful little book was favorably noted in these columns June 21, 1917, p. 602. A second edition, with corrections and additions, appeared in 1919. Both editions were privately printed by the author. The present (third) edition, the author states in his preface, has been "rewritten and amplified to an extent so considerable as to make it almost a new book."

Some idea of the appeal of the present volume to engineers may be gained from the following paragraph from the preface:

The truth is that the last few years have seen a great increase of interest in the subject of [red-lead paint]; due, no doubt, to the rise in the cost of bridges and other metal structures, which makes their preservation more important; this incidentally leads to more discussion of it in the meetings of engineers; . . . This increase of interest [in red-lead paint] is partly due to the comparatively recent introduction of red lead in paste form, which, as is explained in the text, is made possible by improvements in the pigment, and increases its availability for more extensive use. The writer is willing to predict that the next step will be [the sale of red-lead] liquid paint, ready for use; and that this will so much promote its use as a finishing coat and for general repainting that the demand for it will be several times as much as now; perhaps will equal that for white-lead. Holding this belief, which is based on thirty years' experience and study of protective coatings, the writer has tried to give information as to the character of these liquid paints; for all paint must be reduced to this liquid form before it can be applied.

It is pertinent in conclusion to call attention to a review of the same author's "White-Lead: Its Use in Paint," reviewed by A. W. Carpenter, assistant valuation engineer, the New York Central Railroad Co., in these columns for Jan. 20, 1921, p. 126.

American Power Problems During the War

THE POWER SITUATION DURING THE WAR—By Col. Charles Keller, Corps of Engineers; with Appendixes Containing Reports on Conditions in the Several Power Districts. Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 300; illustrated.

Among the many things which two and three years ago we were told would "win the war" power was preeminent. This was not altogether the mere careless use of an advertising slogan; it was largely a fact that to speed up the demanded production a careful utilization of all existing power and an immediate production of as much new power as possible were required. No small part in this power campaign was playel by certain officers of the Corps of Engineers, United States Army, who were detailed to work in the regulation and allocation of electric energy in certain sections of the East. At the head of these officers was Gen. (now Col.) Charles Keller. This is Colonel Keller's report of what was done. Summarizing a prefactory paragraph, the report presents plans for interconnecting existing power systems so as to form a number of so-called power districts and for supplementing their power resources during the next five to seven years by the development of water power upon the greatest profitable scale at certain advantageous localities, the remaining neces-

sary power to be generated in steam stations of the super-power type. To this we may add that as a record of conditions at some of our large power centers, notably at Niagara Falls, the book is invaluable.

The Science of Human Engineering

HUMAN ENGINEERING: A Study of the Management of Human Forces in Industry—By Eugene Wera, M.E., E.E., Industrial Engineer; Assoc. M. A.S.M.E. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 378. $3.50.

We have become somewhat accustomed to the term "social engineering" and now have presented in this book what the author describes as the "first attempt to present human engineering as a science." Quoting again: "The object of human engineering is to attempt to disclose the laws that govern the life of industrial collectivities and to set forth the means by which their activities may be controlled for the expansion of life, which we identify with the promotion of progress."

The volume is divided into four parts: (1) Psychological Evolution of Industry; (2) The Outlook; (3) Elements of Human Engineering; (4) Applied Human Engineering. In the first part the author reviews co-operation, the evolution of industry, the attitudes of labor, capital and management, and also considers competition and monopoly, trade unions, socialism, state socialism, and the co-operative movement. The second part is a general review of the present industrial and labor situation. It contains a chapter entitled "Meaning of Democratic Management," one on "Functions of Co-operative Management," and another on "Committee Organizations." The third section, Elements of Human Engineering, goes into psychology and sociology, but in non-technical language.

The springs of human action entering into production, as concerns the individual and his family, groups, mobs, the public at large, the corporation or other modern production unit and its employees are here considered.

As the author sees it: "No fundamental transformation of industry or society is needed to attain a peaceful settlement of industrial problems. A logical development of our institutions can accomplish it." Again: "The theory of what we call human engineering is not intended for any particular country, though its application is best adapted to America *because this country is the most advanced in democracy.*" (Italics ours.—EDITOR.) In so far as the author proposes machinery, it is the committee system.

Much of the book is not new—and could not be and adequately present the subject. The author's distinctive contribution is in going farther than has been done before in the psychology of human engineering.

Railway Surveying, Track and Roadway

THE PRACTICE OF RAILWAY SURVEYING AND PERMANENT WAY WORK—By S. Wright Dewsnap, M.A.I.C.E., M.Inst. C.E., Professor of Civil Engineering in the University of Liverpool, and F. E. G. Badger, A.M.Inst.C.E., Director of Housing of the City of Liverpool, etc. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 293; illustrated. $10.50.

Although a work in which English practice in railroad surveying, from the reconnaissance to the final layout of roadway and track, predominates, this book contains much of value to American engineers in detailed methods of conducting surveys and in running location including complicated track layout. The book contains little on the economic theory of railroad location, except as introductory to general methods pursued in reconnaissance, preliminary and final location surveys, where detailed descriptions are given of field and office methods, equipment and organization of parties. The mechanics of running railway surveys are dealt with in detail. Some of the methods described will seem meticulous to American engineers who have run locations through rough country, but it should be remembered that the book is designed primarily to meet other conditions. The location of curves, spirals and complicated track work is described at length, as well as the details of setting out construction work. The book contains two long chapters on permanent way, including track and roadway. It carries appendices on barometric measurements, passing of big loads, and track tables.

New York Barge Canal Plans

NEW YORK STATE BARGE CANAL. Book of Plans Issued as a Supplement to the Annual Report of the Department of the State Engineer and Surveyor. Frank M. Williams, 1920—Albany, N. Y.: New York State Barge Canal, Dept. of State Engineer and Surveyor. Cloth; 19 x 13 in.; pp. 156; illustrated.

This appendix to Mr. Williams' 1920 report contains all the necessary structural records of the New York State Barge Canal work. The plates are large, but not too large for convenient filing, and the typographical work is excellent, so that the details of the structure may be read quite as readily as from the original tracings. There are included drawings of the locks, the dams, the movable bridges, the fixed bridges, the power plants, guard gates, aqueducts, culverts, terminal piers and dock walls, lighthouses, post lights, etc. The portfolio represents practically a symposium of modern navigation canal practice.

A Notable Technical Bibliography

THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT: A Bibliography of the Subject with Brief Abstracts, Patents, News Items, etc., Compiled Mainly from Current Literature—By J. Edward Porter, Consulting Chemical Engineer, General Filtration Co., Inc. Second Edition, 1921. Rochester, N. Y. The Author. Paper; 6 x 9 in.; pp. 117. By letter mail, $1.18.

Seldom does one see a technical bibliography so complete, satisfactory, and up to date as this one. It is much more than a reference list. About a hundred pages are filled with condensed abstracts of 606 articles, society papers, news notes, and British and American patents, chronologically arranged. Four indexes follow: (1) Locations of plants with some particulars; (2) names of authors; (3) patents, and (4) periodicals, these two being arranged chronologically and the periodical references giving names of authors. The Bibliography affords a bird's-eye view of the development and status of the activated-sludge process, besides being a guide to as complete a study of the subject as any one may care to make.

Nitrogen and Activated-Sludge

THE CONSERVATION OF NITROGEN WITH SPECIAL REFERENCE TO ACTIVATED SLUDGE—By Gilbert J. Fowler, D.Sc., F.I.C. Bangalore, India: Indian Institute of Science. Paper; 7 x 10 in.; pp. 32; illustrated.

A valuable study of nitrogen conservation, including the importance of the problem, various methods of nitrogen production, particularly activated-sludge possibilities. Mr. Fowler after seeing the early small-scale experiments of the Massachusetts State Board of Health at Lawrence, Mass., started the development of the activated-sludge process on a working scale in England where he was formerly connected with the Manchester sewage-works.

Fresh Treatment of An Old Subject

LANDSCAPE GARDENING—By O. C. Simonds. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 338; illustrated. $6.

Freshness of treatment, sanity, and relative brevity characterize this book. After outlining the aims of

landscape gardening and pleading for the conservation of natural features and resources, the author discusses land, planting materials and planting, water, home grounds, farms, and semi-arid regions, thoroughfares, railway properties, parks, golf and school grounds, arboretums and botanic gardens, cemeteries and city planning. An appendix contains two short papers on landscape work by the late Bryan Lathrop, of Chicago. Brief allusions are made to the part that the engineer may take in landscape planning.

PUBLICATIONS RECEIVED

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings of Annual Convention, 1920—Chicago, Ill.: C. A. Lichty, Secretary, C. & N. W. Ry. Cloth; 6 x 9 in.; pp. 220; illustrated. $1.

Bridge inspection forms, maintenance of timber docks, freight house floors, spray painting, the feeding of extra gangs and methods of filling bridges and trestles are the principal subjects included.

THE BUSINESS LIBRARY: What it is and What it Does—By Louise B. Krause, Librarian, H. M. Byllesby & Co., Chicago. Second Edition Revised. San Francisco, Cal.: Journal of Electricity. Cardboard; 5 x 7 in.; pp. 122; illustrated. $1.50

The first edition of this useful little book was noticed in these columns March 18, 1920, p. 581. The book now has a half dozen more pages than originally.

CANADIAN RECLAMATION SERVICE: Report, 1919-20—Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 80; illustrated.

Covers irrigation and drainage, with data on duty of water, evaporation, crops, and tables of city water consumption, classified by uses for provinces of Alberta and Saskatchewan.

CONSTRUCTION INDUSTRIES: Proceedings of the Philadelphia and National Conferences Under the Auspices of The Industrial Relations Committee of the Philadelphia Chamber of Commerce and The National Federation of Construction Industries, Philadelphia, Pa.: The National Federation of Construction Industries. Paper; 8 x 10 in.; pp. 254; illustrated.

DESCRIPTIVE GEOMETRY PROBLEMS—By F. G. Higbee, M.E., Professor and Head of the Department of Descriptive Geometry and Drawing, University of Iowa. New York: John Wiley & Son, Inc. London: Chapman & Hall, Ltd. Paper; 12 x 9 in.; pp. 218; illustrated. $1.50.

DETROIT AND WORLD-TRADE: A Survey of the City's Present and Potential Foreign Trade and Seaboard Traffic, and the Facilities Therefore, with Special Reference to the Proposed St. Lawrence Deep Waterway to the Sea—By Thomas Laurence Munger: Compilations by Frank Howard Evans, Statistician. Detroit, Mich.: Board of Commerce. Cloth; 6 x 9 in.; pp. 117; illustrated.

A DICTIONARY OF CHEMICAL TERMS—By James F. Couch, Chemist: Bureau of Animal Industry, U. S. Dept. of Agriculture, Washington, D. C., New York: D. Van Nostrand Co. Leatherette; 5 x 8 in.; pp. 204; illustrated. $2.50.

A handy chemical dictionary, "designed to lie somewhere between that of a standard English dictionary and that of an encyclopaedia; in most cases elementary terms have received more extended treatment than more advanced terms."

DOMINION WATER POWER BRANCH: Report Mar. 1918-19—Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 60; illustrated.

ENGINEERING CONSTRUCTION IN STEEL AND TIMBER: Part I—By William Henry Warren, LL.D., Whitworth Scholar; M. Am. Soc. C. E., Challis Professor of Engineering and Dean of the Faculty of Engineering, University of Sydney. Third Edition. New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 486; illustrated. $10.

The first edition was reviewed at length by Prof. Robert Fletcher in the Engineering Literature Supplement to *Engineering News*, June 16, 1910, p. 67. In the present edition "the text has been carefully revised, and additional Appendices have been provided on (a) Australian Timbers, and (b) recent Steel Column Experiments and Formula." The changes and new matter make a net increase of 14 pp. over the second edition. American authorities are cited. This edition is called Part I because it is to be followed by Part II., on Masonry and Concrete Structures.

EVILS OF OVERLOADING—By Robert O. Patten and F. C. Horner. New York: National Automobile Chamber of Commerce, Inc. Paper; 6 x 9 in.; pp. 8.

GYPSUM: Properties, Definitions and Uses—Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 21. 5c. from Superintendent of Documents.

HOW BUSINESS WITH FOREIGN COUNTRIES IS FINANCED, 1921—New York: Guaranty Trust Co. of N. Y. Paper; 6 x 9 in.; pp. 74; illustrated.

HYDROMETRIC SURVEY OF BRITISH COLUMBIA: Report 1918-19—By R. G. Swan, B. A. SC., District Engineer. Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 233; illustrated.

LATITUDE DEVELOPMENTS CONNECTED WITH GEODESY AND CARTOGRAPHY: With Tables Including a Table for Lambert Equal-Area Meridional Projection—By Oscar S. Adams, Geodetic Computer. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 5 x 8 in.; pp. 132. 20c. from Superintendent of Documents.

THE LOCATION, GRADING AND DRAINAGE OF HIGHWAYS: A Concise Discussion of General Principles Illustrated by Current and Recommended Practice—By Wilson G. Harger, C. E., Engineer N. Y. State Dept. of Highways; Former Senior Highway Engineer, U. S. Office of Roads. Author of "Highway Engineers' Handbook," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 294; illustrated. $3.50.

MAINE WATER POWER COMMISSION: Report, 1920. Augusta Me.: The Commission. Paper; 6 x 9 in.; pp. 271; illustrated.

THE MOTOR VEHICLE—COMPETITOR OR ALLY?—By George M. Graham, Vice-President Pierce-Arrow Motor Car Co. and Member of Motor Truck Committee, National Automobile Chamber of Commerce. New York: National Automobile Chamber of Commerce, Inc. Paper; 6 x 9 in.; pp. 22.

PAMPHLETS AND CLIPPINGS IN A BUSINESS LIBRARY—By Virginia Fairfax, Librarian, Carnation Milk Products Co., Chicago. San Francisco, Cal.: Journal of Electricity and Western Industry. 4 x 6 in.; pp. 62; illustrated. 75c.

Tells how to select, classify and file pamphlets and clippings for a business library.

PERSONNEL RELATIONS IN INDUSTRY—By A. M. Simons, Author of "Social Forces in American History." Formerly Lecturer on Personnel Relations in the Extension Department of the University of Wisconsin, and Manager Personnel Department, Leffingwell-Ream Co. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 341. $3.

PHYSICAL PROPERTIES OF MATERIALS: I. Strengths and Related Properties of Metals and Certain Other Engineering Materials. Edition No. 1, Preliminary and Subject to Criticism and Revision. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 52. 10c. from Superintendent of Documents.

Notes and tables published to elicit criticism.

PRODUCTION OF COAL AND COKE IN CANADA, 1919—John McLeish, B. A., Chief of the Division of Mineral Resources and Statistics. Ottawa, Can.: Dept. of Mines. Paper; 7 x 10 in.; pp. 39.

PUBLIC UTILITIES COMMISSION OF CONNECTICUT: Report, 1920, including the Financial Reports of all Public Service Companies (1919), with Statistical Tables Relating Thereto—Hartford, Conn.: The Commission. Cloth; 6 x 9 in.; pp. 784.

PYROMETRIC PRACTICE—By Paul D. Foote, Physicist, C. O. Fairchild, Physicist, T. R. Harrison, Associate Physicist, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 326; illustrated. 60c. from Superintendent of Documents.

RECONSTRUCTION AND PRODUCTION: Report of the Select Committee on Reconstruction and Production, U. S. Senate. Washington, D. C.: The Committee. Paper; 6 x 9 in.; pp. 61.

REDUCING THE TYPHOID TOLL: Five years of Sanitary Progress in West Virginia—Issued by E. S. Tisdale, Director Division of Sanitary Engineering, West Virginia State Department of Health. Charleston, W. Va.: The Dept. Paper; 6 x 9 in.; pp. 36; illustrated.

Reviews typhoid outbreaks in the State by groups of towns having water supplies of different degrees of safety; shows how chlorination and filtration, in conjunction with work of sanitary engineering division of State Department of Health, have reduced typhoid.

REINFORCED CONCRETE DESIGN: Vol. II. Practice—By Oscar Faber, O.B.E., D.Sc., A.M. Inst. C.E., A.C.G.I., etc., Consulting Engineer, Chief Engineer to Trollope and Colls, London, etc. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 246; illustrated. $6.50.

STATE ENGINEER OF COLORADO: Report, 1919-1920 to the Governor—Denver, Colo.: State Engineering Dept. Cloth; 6 x 9 in.; pp. 212.

Consists mainly of stream flow records and allied materials; contains some information on irrigation.

THE STATISTICAL STATUS OF THE SOUTHERN PINE INDUSTRY—By J. E. Rhodes, Secretary-Manager, Southern Pine Association. New Orleans, La.: The Association. Paper; 6 x 9 in.; pp. 16; illustrated.

A STUDY OF MAP PROJECTIONS IN GENERAL—By Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: The Survey. Paper; 5 x 8 in.; pp. 21, illustrated. 5c. from Superintendent of Documents.

THE TESTING OF THERMOMETERS AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—Ottawa, Can. Dept. of the Interior. Paper; 7 x 10 in.; pp. 15; illustrated.

THEORIE des TRAGERS auf ELASTISCHER UNTERLAGE: Und Ihre Anwendung auf den Tiefbau nebst einer Tafel der Kreis-und Hyperbelfunktionen—Von Dr.-Ing. Keiichi Hayashi, Professor an der Kaiserlichen Kyushu-Universität, Fukuoka-Hakosaki, Japan. Berlin: Verlage von Julius Springer. Paper; 7 x 10 in.; pp. 301; illustrated. Paper; 40 m.; bound, 50m.

TRIANGULATION IN RHODE ISLAND—By Earl Church, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: The Survey. Linen; 6 x 9 in.; pp. 97; illustrated. 30c. from Superintendent of Documents.

UNDERGROUND CONDITIONS IN OIL FIELDS—By A. W. Ambrose. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 238; illustrated. 65c. from Superintendent of Documents.

VENTILATION IN METAL MINES: Preliminary Report—By Daniel Harrington. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 44. 10c. from Superintendent of Documents.

WATER-GAS APPARATUS AND THE USE OF CENTRAL DISTRICT COAL AS GENERATOR FUEL—By William W. Odell. Illinois Coal Mining Investigations Co-operative Agreement. (This Paper was Prepared under a Co-operative Agreement with the Illinois State Geological Survey and the Engineering Experiment Station of the University of Illinois through its Department of Mining Engineering.) Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 28; illustrated. 5c from Superintendent of Documents.

WORKMEN'S COMPENSATION LEGISLATION OF THE UNITED STATES AND CANADA—Lindley D. Clark and Martin C. Frincke, Jr., Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 1211.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Practical Concrete Proportioning

Sir—In view of past discussions of the validity of the surface area and water-cement ratio theories of proportioning concrete the article in the March 17, 1921, issue of *Engineering News-Record* by Messrs. Young and McCarthy of the Hydro-Electric Power Commission of Ontario recalls several points which are worthy of further consideration.

These theories as originally proposed were stated to be of general application within the widest practical limits and in the attempt to adapt them to working conditions in the field it will be well to keep in mind the modifications and limitations which have been made and introduced. It should also be recognized that the production of a uniform quality of concrete with the same aggregate is not dependent upon any particular theory of proportioning, but mainly upon a system of field inspection which insures constant quantities of materials from batch to batch.

I previously pointed out, in the April 22, 1920, issue of *Engineering News-Record*, that the results obtained in Mr. Young's application of the two theories could not be considered as a verification of either owing to his elimination of their fundamental features and that his method differed little from what is now common practice.

Referring first to Mr. Young's article in *Engineering News-Record*, Jan. 1, 1920, in his Table III—the following values are found:

Class	Minimum Compound Stress Lb.	Cement Lb. per 100 Sq. Ft. Normal Consistency
A	2,500	3 18
B	2,000	2 58
C	1,500	2 08

Referring to Table IV in the same article, it will be seen that concretes which he lists to illustrate strengths actually obtained on the work contained a 1:2 ratio of fine aggregate to coarse aggregate. He also stated that "the most economical mixture is the one containing the lowest surface area per cubic foot of material which can be successfully handled and placed."

In my discussion of April 22, 1920, I pointed out, referring to his economical grading that "such a result is, of course, obtained by keeping the fine material in the sand or aggregate to a minimum. Therefore, to obtain low areas it is necessary that the grading of the sand, the material whose variation most greatly influences workability and segregation, be made as coarse as possible and still permit a workable mix." The same result, a low area combination, can also be obtained with a *fixed* sand grading by keeping the relative quantity of sand to gravel as low as possible. I included test results which showed that Potomac River sand might be regraded to furnish an aggregate having 100 per cent greater surface area and yet produce a concrete having the same cement content and flowability with no reduction in compressive strength with the added advantage of greatest practical importance to the field engineer, of no tendency to segregate in the wetter consistencies. In closing I also stated that a 2½:3½ or 2¼:4 sand-gravel ratio will have greater workability for the same flowability, higher strengths, and contain slightly less cement per cubic yard. In other words, concretes may be considerably "oversanded" as compared with the commonly specified 1:2 sand-gravel ratio and result in more economical concretes of equal or better quality. This, of course, absolutely contradicts the surface area theory, since such "oversanded" mixtures may have 50 per cent to 100 per cent more area for the same quantity of cement.

Now refer to the recent article by Messrs. Young and McCarthy in the March 17, 1921, issue. In Table I the following values are found:

Class	Minimum Compound Stress Lb.	Cement, Lb. per 100 Sq. Ft Normal Consistency
A	2,500	2 60
B	2,000	2 25
C	1,500	1 80

Comparing this Table I with the similar values shown in Table III shown previously, it is seen that for the same consistency he has considerably reduced his cement content per unit area and yet attains concrete of the same quality. The explanation of this is clearly seen in Table II of his latest article. Of the 54 concretes included, only 3 have a sand content which is less than 0.5 of the volume of the gravel or coarse aggregate. All of the remaining concretes, 51 out of 54, are "oversanded" and yet it appears that concretes of the same qualities are produced even though the quantity of cement per unit area has been reduced.

It appears that "oversanded" concretes are now being employed instead of the customary 1:2 sand-gravel relation and a 2,500-lb. concrete is now obtained with 2.6 lb. of cement per 100 sq.ft. of surface area, whereas previously with a 1:2 relation, 3.18 lb. were required. In a similar manner 2.25 lb. of cement now produce Class B concrete which formerly required a cement quantity of 2.58 lb. per 100 sq.ft. of area.

It should be understood, of course, that the difference between these corresponding figures *does not* represent cement *saved*. The cement contents per cubic yard of concrete are probably about the same, the difference in the preceding figures being due to the fact that the "oversanded" mixtures have a higher total surface area. Now, contrary to the surface area theory concretes of higher sand content are employed and the computed weight of cement per unit surface area of aggregate has been reduced without reduction in compressive strength, as should be expected. No doubt the greater degree of workability for the same flowability and greater freedom from segregation are also very marked although not commented upon in the article.

It is clear from a study of old Table III and new Table I, that "oversanded" concretes have proved their worth in actual practice, and in so doing have themselves offered the best possible proof that area may vary or increase within wide limits without requiring an increase in cement content, thereby contradicting the fundamental assumption of the surface area theory.

Without reproducing any of the test data, I must repeat that laboratory tests offer no evidence to justify any consideration being given to the surface-area theory. This also includes concretes and mortars made from similar aggregate gradings employed by the author of the surface-area theory in his original work on which the theory is said to be based. Repeated tests with Potomac River materials definitely emphasized this point and recent work with aggregates available in the vicinity of Saskatoon, Sask., offer even stronger evidence. Concretes in which the sand-gravel ratio varies from 0.5 to 3.0 have practically the same strength when of equal flowabilities and cement content. The quantity of cement per *unit area* is less than half in the latter than it is in the former.

The field experience of the engineers of the Hydro-Electric Power Commission appear to confirm this relation as indicated by their own test data and standards for proportioning. I have no doubt that the adoption of "oversanded" mixtures is "helping them to produce better and cheaper concretes."

Test data are quite consistent in emphasizing that it is unnecessary to vary cement content for ordinary variations in sand gradation for material from the same source. Practically it is an impossible task to attempt to change cement content for the variable gradations which are certain to result from batch to batch. Fortunately accurate test results, as well as the more variable field results, indicate that surface area is not a controlling factor in the production of concrete of predetermined or uniform quality, and may within wide limits be ignored. Attempt to follow such variation as is certain to occur on the job leads to a great amount of expensive and unnecessary work and causes the engineer to feel that uniformity in product is due to his careful attention to a feature which is actually unimportant and might well be disregarded within wide limits.

I have not discussed the water-cement ratio theory as applied in this work since it is quite apparent that with given materials and with batch quantities fixed, the actual quantity of water needed is entirely dependent upon the minimum workable flowability which can be employed on that particular portion of the work. With batch quantities fixed, the addition of more water will lower strength, which in turn necessitates the addition of more cement and *again* more water, to maintain the specified strength and flowability.

The production of concrete of known and uniform quality is neither so scientific nor so mathematical as might be assumed from a study of the many articles and discussions which have appeared during the past few years. To result in the efficient use in concrete of available aggregates I would briefly outline the following procedure, which has been worked out in detail for aggregates available in the vicinity of Saskatoon:

Step No. 1: To determine the "desirable" sand-gravel ratio.

Prepare concretes having the same cement content per cubic yard and the same flowability in which the sand-gravel ratio is varied from 1:2 to 2:1, comprising five or six combinations. Two different cement contents and two different flowabilities may be employed with each aggregate combination. Choice of the "desirable" combination should depend upon ease of working and freedom from segregation as well as compressive strength.

Step No. 2: For the "desirable" sand-coarse aggregate ratio determine the range in compressive strengths for different cement contents and the widest range of flowabilities which need be used in practice. A diagram is then prepared which will show at a glance the relation between compressive strength, flowability and cement content as well as volumes of aggregate required per bag of cement to result in a concrete of any specified strength.

Step No. 3: Involves the application of the method to work in the field and such modification of the curves of the diagram as would seem justified by the results of field tests of concrete taking into account the various factors which cannot be so accurately controlled and measured as in the laboratory. These factors are quality of cement, unavoidable variations in quantities from batch to batch of cement, aggregates and water, and curing conditions. It is presumed that an efficient method of field inspection will be employed. Such a diagram permits the specifying of any desired quality of concrete and indicates qualities of the particular materials which will result in this strength with any required flowability. The chief duty of the inspector is to insure proper measurement of cement and aggregate quantities and to restrict the flowability to the minimum usable for the portion of the structure being poured. Any necessary increase in flowability required should be immediately followed by a reduction in aggregate quantities as indicated by the strength-proportion-flowability diagram.

In conclusion, I do not wish to be understood as deprecating in any way the efficient and complete system of inspection which Messrs. Young and McCarthy have described. Concrete of definite and uniform quality can only be obtained by constant attention to the details of production, and supervision of all processes. Such organizations are the exception, rather than the rule as they should be, and the adoption of a systematic method of inspection on all concrete work of importance will do much to improve quality by bringing to the attention of those concerned the fact that specified qualities are rarely obtained without inspection, and that too often concretes as produced may not only be low in strength, but are extremely variable. I do feel, however, that the attention given to the natural variations in surface area of aggregates is not warranted either by carefully controlled laboratory tests or the results obtained in the field, and that the effort to attribute such uniform results to this factor and thereby verify one or more theories whose conditions are very incompletely complied with, is very misleading and unjustified.

G. M. WILLIAMS,
Professor of Civil Engineering,
Saskatoon, Sask., March 28. University of Saskatoon.

[The foregoing letter was referred to Mr. Young and he has replied as follows—EDITOR.]

Sir—The elaborate discussion presented by Prof. Williams is based on a misinterpretation of the data presented by Mr. McCarthy and myself. The facts are not as he has assumed. His arguments are based on false premises and consequently his deductions are at fault.

For one thing, we are not using oversanded mixtures. While the proportions stated in Table III are different from those given in my article of a year ago, the difference does not represent a change in the quantity of fine aggregate in the mixtures but is due to the different character of the aggregates used in the two cases. The proportions given in Table II are in terms of cement, pit-run sand and screen crushed rock, the former containing varying amounts of gravel and the latter varying amounts of fine material. The sand being fine, had a weight per cubic foot below the average and thus required the use of larger volumes to obtain given quantities of solid material. These facts, and not oversanding of mixtures, account for the differences in the proportions in the two cases.

We have had experience with oversanded mixtures and use them occasionally to meet certain conditions but for the usual run of work we are regularly using mixtures in which the ratio of sand to stone is closely 1: 2. On the same job from which the data of my previous article was obtained, 40,000 cu.yd. of concrete having this ratio have been placed in the last five months and the results obtained have been very satisfactory.

Prof. Williams further argues that this alleged oversanding has allowed us to reduce our cement content per unit area, as witness the difference in the table of cement requirements reported by us now and a year ago. It happens, however, that the tables in question refer to aggregates of different characteristics and to tests made with cement from different mills. The results consequently cannot properly be compared. It so happens that we are still using the former table on the work to which it originally applied.

Prof. Williams' method of determining proportions is cumbersome and expensive. He would require us to make at least 100 test cylinders and suggests more, while the methods we follow require but 30. A conservative estimate of the cost of a concrete test is $6 per cylinder, at which rate Prof. Williams would ask us to spend $600 to $1,000 when the necessary information could be had for less than $200. Unquestionably his method obtains more information than ours but all data essential for setting proportions for concretes of any desired strength and workability can be had from the cheaper tests.

We hold no brief for either the surface area or water-cement theories. There are data which cannot be explained by either and which are apparently in direct contradiction thereto but there are also data which support them and which cannot be ignored. We have never claimed them as general in their application, but used as we have used them they form valuable tools by which proportions can be more accurately set than by any scheme of equal simplicity yet developed. We fully expect them to be superseded at some future time when our knowledge of concrete has broadened but until such time arrives and a better tool is found they should not be utterly condemned.

Prof. Williams in this and other articles repeatedly refers to test data which "conclusively proves" his contentions. It seems a great pity that Prof. Williams has not seen fit to publish these data in detail for other investigators have done so and there is an apparent contradiction between their data and his.

There is an old French proverb which translated reads, "When good men disagree they may be both right." We have found it to be true so often that we suspect it applies in this case and that if all existing test information could be collected together and studied the apparent differences could be satisfactorily explained. After the confusion of the last two years, it would indeed be a step in advance if this could be accomplished. R. B. YOUNG.

Toronto, Ont., May 3.

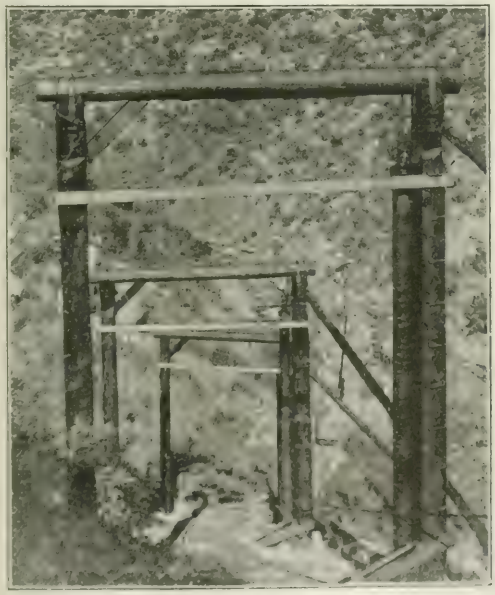
HINTS FOR THE CONTRACTOR

A Good Lagging Tool

A TOOL most useful to men working on repair of timber-lined tunnels has been developed on the Southern Pacific Railroad. It is made by reshaping the points of a well-worn pick into knife or chisel blades about 1½ in. wide which are made parallel to the pick handle. With this tool lagging can be split or chamfered; by reason of the length of the blade it can be used effectively on wood in places where an axe would be less serviceable, and it is particularly useful in shaping firm earth or soft rock for timber in cramped quarters.

Rollers Guide Cable on Steep Freight Incline

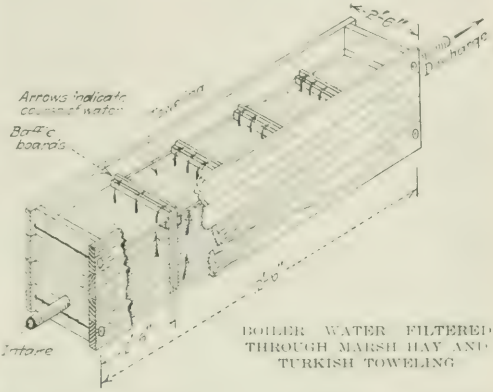
IN DELIVERING supplies and materials to the site of power house number two, built for the Southern California Edison Co., it was necessary to use sharp curves on an incline 7,000 ft. long with grades up to 75 per cent. To guide the cable around these curves a series of well-braced and guyed timber frames were built on the inner sides of the curves, and vertical idlers or rollers were set on each post as shown in the accompanying illustration. The rollers are heavy and at first their weight prevented them from turning readily, so that the loaded cable would often wear into the surface of a roller that did not turn. This was overcome by putting ball bearings on the upper end of the rollers. Small, slightly inclined rollers are used at the base of the vertical posts to serve as idlers to prevent the cable from cutting the timber braces when it rips at the foot of the vertical idlers. Twenty-ton loads are handled on this incline, using standard-gage cars.



FRAMES AND ROLLERS THAT GUIDE THE CABLE

Hay Filter for Feed Water

WATER, brown with unsettled mud, was made practically clear for feeding boilers on Miami River improvement at Dayton, Ohio, by means of the filter shown by the accompanying drawing. The construction is clearly indicated. Water entering one end near the bottom rises through a layer of marsh hay covered by turkish toweling, then drops down between the double baffle boards into the next compartment where it rises through a second hay and towel filter and so continues through five filters to the outlet. The toweling is tacked to frames which fit into the compartments and the hay is simply packed in evenly. Twice a week the towel screens are removed and new hay put in at intervals when the accumulated dirt clogs the filter. H. A Hanson, superintendent, and V. H. Tucker, fleet captain, of the river improvement operations, introduced the device on the Miami Conservancy District work from the New York Barge Canal operations of C. H. Locher where it had been previously used.



BOILER WATER FILTERED THROUGH MARSH HAY AND TURKISH TOWELING

Cleaning Arch Form with Air Hose Prevents Raveling Concrete

IN LINING railroad tunnels with concrete by the pneumatic method, filling of the side forms ordinarily causes the accidental deposit of more or less aggregate on the center of the arch form where there is little or no slope. This is material which has rebounded from the reinforcing rods or is otherwise separated from the concrete in transit, and for the most part has very little cement attached to it. Even where walls and arch are poured continuously this deposit does not seem to make an effective bond with the last concrete to be placed, and soon falls out after the forms are removed.

This raveling has been effectively prevented on the Southern Pacific R.R. by using a small air hose terminating in a short length of pipe, with which the bottom of the arch form is blown clean just before delivering concrete to the final section in the arch. In this way the deposit is imbedded in the concrete already in place where it can do no harm, and the fresh concrete gives a smooth, firm finish.

NEWS OF THE WEEK

New York, May 19, 1921

Discuss Hudson River Crossing Problem

Engineers Consider Bridge and Tunnel Projects at Am. Soc. C. E. Meeting

Questions involved in the crossing of the Hudson River at New York for better connection of New York City with the western portion of the metropolitan district were discussed from a number of points of view at a meeting of the New York section of the American Society of Civil Engineers on May 11. Prof. W. H. Burr opened the subject, analyzing in general terms the needs of the cross-Hudson traffic and concluding in favor of tunnel construction, in part because tunnels are adaptable to progressive construction as traffic needs and financial possibilities develop. He expressed the opinion that the cost of tunnels for eight railway tracks and fourteen lines of roadway traffic would be less than that of a bridge of the same capacity.

J. A. L. Waddell presented comparative cost curves for eight electric railway tunnels, eight main-line railway tunnels, and four two-line highway tunnels, as well as for bridges having equivalent capacities. The curves indicated that for either railway or rapid-transit service the bridge would be cheaper below a span length of about 2,600 ft., while in the case of highway tunnels the bridge held its advantage up to span lengths well in excess of 3,000 ft.

J. F. O'Rourke submitted a map of a river crossing and freight terminal project devised by himself involving a pair of tunnels across the river connecting the New Jersey Junction Ry. with a New York west side freight subway system to be built from 60th St. down to Murray St. For the tunnels he proposed tubes of 27 ft. internal and 31½ ft. external diameter, to be built preferably of concrete blocks.

Ralph Modjeski, pointing out the difficulties involved in taking care of the enormous vehicle traffic which a bridge as recently proposed would discharge into the congested district of Manhattan, suggested that a highway bridge connecting New York and New Jersey should be located in the Washington Heights district. James Forgie expressed the opinion that tunnels will be found cheaper than bridges if maintenance and real estate costs are considered.

Gustav Lindenthal spoke of the unsolved railway rate question, which will require a new method of New York terminal distribution of freight as soon as the terminal charge is allocated to the traffic. The Hudson River bridge which he has proposed as such a means can be so worked out as to take care of all traffic requirements and avoid difficulties with congestion. J. Vipond Davies, after stating that the topography of the Hudson River banks is such as to give preference to tunnels below 57th St., inquired whether at or north of this point a bridge is warranted. Upon analysis of the existing traffic and discussion of the bearing of progressive construction upon the problem, he declared that a bridge would be an economic fallacy. Clifford M. Holland reviewed the ventilation studies completed and in progress for the Hudson River vehicle tunnel, and outlined the tests now being carried on by the Bureau of Mines with a 200-ft. model of the tunnel equipped with all the essential elements of ventilation according to the design, in which ten automobiles are to be operated as a test of the working of the system.

The meeting was attended by the Italian Commission on American Railway and Industrial Electrification, whose chairman, Guido Semenza, made a brief address on differences between Italian and American engineering problems.

Col. Watson Declines New Jersey Tunnel Appointment

As announced in these columns last week the New Jersey Interstate Bridge and Tunnel Commission on May 10 appointed Colonel George L. Watson one of the three consulting engineers to advise the New Jersey commission on technical matters in connection with the building of the vehicular tunnel under the Hudson River. On May 12 Colonel Watson declined the appointment in the following terms:

"I am at present a member of the consulting board appointed by joint action of the two commissions, which position I could not, of course, consistently hold if I were to try and divide my allegiance between the two states concerned; and having heretofore devoted my entire energy to the project of building the tunnel I cannot see my way clear to becoming the advocate of any one state, believing further that the only position that an engineer can fill in a case of this kind is that his actions should be in the interest of the project as a whole and not divided in any way by state lines.

"While I therefore appreciate the honor of an appointment from the State of New Jersey, I am forced to respectfully decline the appointment tendered."

W. Va. License Bill Passed

The license bill introduced by the American Association of Engineers and the West Virginia Engineering Society at the recent session of the legislature has been passed by the Senate and House, and now awaits the signature of the Governor.

A. A. E. Rejects Plan for Salaried President

Buffalo Convention Revises Constitution—District Offices Discontinued as Economy Measure

Only by rescinding a vote of 7484 to 4591 immediately after it had been recorded was an upheaval in the administrative control of the American Association of Engineers averted on the closing day of that organization's annual convention held at Buffalo, N. Y., May 9-11. With 155 delegates present, representing about 200 chapters and clubs throughout the United States, the main issue of the controversy was the proposal to amend the constitution so as to provide for a paid president. Under the present organization a salaried secretary is the association's executive officer. If the move for a salaried president had suceeded, therefore, it is to be presumed that the executive control of A. A. E. would have passed into his hands, leaving the secretaryship an anomalous position.

It was through the medium of a plea by W. O. Witherspoon, of the Southwestern district, who called for reconsideration of the first vote on the ground that the proposal had not been fully understood and that political log-rolling had been largely instrumental in its passage, that the decision in favor of a paid president was reversed. H. O. Garman the newly elected president, stated that he had entered the campaign with no thought of remuneration other than the honor attaching to the office for which he was a candidate. At a meeting of the board of directors on the last day of the convention C. E. Drayer was continued as the association's secretary.

In its resolutions the association went on record against the passage of license laws which permit the practice of engineering by corporations and unrestricted partnerships. Favorable action was taken on a resolution for the continuance of federal aid in highway construction, but the resolution recommending the creation of a federal highway commission failed to receive the endorsement of the convention.

To a large extent the convention proceedings dealt with the association's internal mechanism, particularly organization, chapter activities and employment service, rather than with problems of broad engineering interest. With the exception of a report on professional practice and fees for consulting work the topics considered related principally to organization. A revision of the constitution consumed a large part of the time.

Approval was given to the plan of dividing the association into 12 districts for the purpose of electing directors; dues were maintained at $15, after a spirited discussion in which a $10 rate had considerable support; an apportionment of funds on the basis of 60 per cent to chapters and 40 per cent to national headquarters was ratified, representing a substantial increase over the previous chapter allotment; the control of collections of association money was given to national headquarters, with a proviso for collections by chapters in certain cases. Salt Lake City was chosen for the 1922 convention.

In a program of curtailing expenses the board of directors elimited the district offices at Washington and New York and suspended the activities of the director of field forces, Dr. F. H. Newell. Treasurer H. W. Clausen's report showed a total of $2,439 cash on hand April 30, 1921, as against $11,421 a year ago. Cash receipts going to national headquarters during the year amounted to $192,179, while disbursements totaled $201,161. The budget for 1921, as originally submitted, amounted to about $160,000 for national headquarters activities, equivalent, on an assumed basis of 21,000 members, to about $8 per member. This sum was reduced to $6 per member and alloted as follows: Business department $3.25; chapter activities $0.25; publishing *Professional Engineer*, $1.10; employment service department $0.40; federal department and field forces, $0.60; directors' expenses, $0.40.

L. K. Sherman, in his presidential address on the achievements of A. A. E. during the year cited the increase of 7,000 in membership in 12 months; the placing of more than 3,000 engineers in positions by the employment service; the activities in securing the passage of license laws by the states; the effort toward establishing minimum fees for consulting work through the medium of the committee on fees and services of practicing engineers; the development of the association's publication the *Professional Engineer;* and the installation of an improved office system at Chicago headquarters as the result of recommendations by a firm of experts in office management. The cost per member for national headquarters service in 1920 was $6.93 (19,000 members used as basis). Mr. Sherman recommended the following activities for the association during the year: Broadening the employment service; active participation in legislative work; educational activities by chapters; development of a national magazine; participtation in business activities of communities by chapters.

Secretary C. E. Drayer, in his address at the opening session, announced the membership as 24,480 on May 1, 1921. There are now 188 chapters and 75 clubs.

The subject of chapter activities was introduced by Dr. F. H. Newell, who outlined in detail a program for stimulating interest in local meetings and making their work effective.

In his report for the qualifications committee R. C. Kellogg advised a steady consistent canvass of new members rather than membership "drives." The time is at hand, he said, when the association must look more to the quality than to the quantity of its membership.

E. B. Miller, employment secretary, reported 20,000 applications for positions received, 7,663 positions vacant, 39,537 men referred to positions and about 3,500 men placed. About 65 per cent of the placements were made by the Chicago office and the remainder by the chapters. The average salary for the positions filled was $190 per month, the lowest $100 and the highest $1,250 monthly. The cost of the service was $6 per placement.

According to Robert Isham Randolph, speaking for the building committee, the time is not ripe for the association to attempt to own a building of its own.

For the committee on services and fees of practising engineers W. L. Benham announced the drafting of a minimum schedule and decried the following practices: Manufacturers furnishing engineering advice; engineers acting both as engineers and contractors at one time; professors or public officials doing consulting work at cut rates; bonding of consulting engineers; acceptance of work on a contingent fee basis; competitive bids for engineering services.

The report of the practice committee brought out a sentiment in favor of speedier action in disciplining a member guilty of unprofessional conduct.

Resolutions

The convention passed resolutions in favor of the following:

An engineer on the Interstate Commerce Commission; a national board for the classification of engineering schools; opposition to laws permitting the practice of engineering by corporations; taking a census of highway traffic; continuance of federal aid for highways; increasing allotment of federal-aid funds in public land states; advancing Government funds for reclamation work; sanitary engineers as public health officers; notice of at least two weeks in case of discharge; plan of financing A. A. E. employment service and consideration of payment for such service; increase of A. A. E. membership from all branches of the profession; fuller statement of the association's ideals and objects.

New Officers

The results of the election of officers was as follows: H. O. Garman, chief engineer, Indiana Public Utilities Commission, Indianapolis, president; A. N. Johnson, dean of engineering, Maryland State College, first vice-president; A. S. Morris, auditor, C. & N. W. R.R., second vice-president; E. F. Ayres, W. L. Benham, Garrison Babcock, Morris Bien, G. M. Butler and W. R. McKeen, directors. H. W. Clausen was reappointed treasurer.

The entertainment features of the convention, in charge of Charles W. Getman, of the Buffalo chapter, included a trip to Niagara Falls, a smoker, and the annual banquet at which Miss Frances Kellor, of the Inter-racial Council, spoke on "Americanization and Man Power Engineering."

Terminal Changes at Portland Are Under Negotiation

Plans to provide a new union passenger terminal at Portland, Ore., which will require radical revision of present freight and passenger terminal layouts and changes in city streets, have recently been under negotiation at Portland, Ore., between the city, the port administration and the railroads affected. Plans so far developed, however, do not contemplate a new union passenger station building since it is thought that a few additional tracks and umbrella sheds will render the present union station adequate. The agitation for this rearrangement began with the recent demand by the mayor that an adequate passenger depot be built for the use of all the roads entering the city. This was shortly after the railroads passed from government control, and the Spokane, Portland and Seattle Ry. and the Great Northern Ry. were preparing to resume use of the old passenger station at Tenth and Hoyt Sts.

Additional Street Traffic

A consequent change in freight terminal layout and operation and location of new freight stations would create additional street traffic on some streets, it is said. Additional width for Hoyt St. and 14th St. is asked by the city. A block in front of the Union Station and a small block west of the post office are asked for use as parks until they are needed by the railroads for terminal development. The city also asks for an additional approach to the Broadway bridge from the west.

The railroads are planning to build a freight yard and roundhouse on land owned in "Guild's Lake," about two miles northwest of the Union Station, by filling in the lake with sand dredged from the Williamette River. The cost of this development, including the fill, will be about $400,000. Until an agreement between the city and the railroads in the matter of vacating street ends is reached, it is said that an estimate of the cost of the whole development cannot be given.

The matter has been under negotiation for some time and more recently has rested in the hands of a subcommittee, consisting of the engineer of the port, the city engineer, and representatives of the Spokane, Portland & Seattle Ry., the Oregon-Washington R.R. & Navigation Co., the Southern Pacific Co., the Great Northern Ry. and the Northern Pacific Ry. It is thought that the city council may ask the people of Portland to vote upon the matter of vacating the streets at the special election, June 7.

Zoning Dominates City Plan Conference Topics

Attention Also Given to Major Street Planning, Population Distribution, Aerial Photography

Zoning dominated the thirteenth National Conference on City Planning, held May 9 to 11 at Pittsburgh. Some two hundred persons from outside places were registered. Meetings were held jointly with the Civic Club and the Real Estate Board of Pittsburgh.

How zoning affects living conditions was the subject of addresses by Robert H. Whitten, Cleveland, and Herbert S. Swan, New York City, in which the theory, practice and benefits of zoning were presented. The proposed zoning ordinance for Pittsburgh was outlined by U. N. Arthur, chief engineer, department of city planning, and J. M Clark, member city planning commission, Pittsburgh. There was a lively discussion of the methods and desirability of limiting special residence districts to single-family detached houses. On the advisability of limiting the number of persons per acre in the various zones there was a marked difference of opinion, but the consensus was against its wisdom.

James D. Hailman, secretary, citizens committee on city plan, Pittsburgh, described the recommendation of his committee for a major street plan which proposes eventually to widen 106 mi. of streets now existing and to add 20 mi. of new street. This compares with the Cleveland and St. Louis programs of widening 190 and 50 mi. respectively, and opening 23 and 17 mi. of new streets. The Pittsburgh proposal is based upon the studies of an active committee of representative citizens, covers 17 main metropolitan district traffic routes, and 64 internal major traffic streets, and the improvements for the relief of congestion in the downtown triangle, as well as the opening up of large suburban areas for residential development.

County Planning Advocated

Statistics of the street and highway situation in Allegheny County, outside of Pittsburgh, were presented by W. McC. Donley, consulting engineer, Allegheny County planning commission, who explained and emphasized the difficulties of proper design, construction, maintenance, and control where these functions are vested in the State, second and third class cities, boroughs, townships, and counties. He recommended that a county highway commission be appointed, consisting of five members, including at least one engineer, one real estate dealer, and one attorney, with authority to plan the county for one hundred years in advance, to be supported by a ¾-mill tax levy and supplied with adequate staff and consultants.

In speaking on "The Enforcement of a Street Plan," A. S. Tuttle, chief engineer, board of estimate and apportionment, New York City, urged the need of flexibility to provide for changes in basic conditions which affect the character of differnt portions of a community, and which may occur imperceptibly. Fixing the width of a street for a definite period of years is a method of much promise. The street should be located to avoid or minimize damages to buildings. The remaining area required for future traffic conditions can be designated as front court yards, and acquired as a right in fee by the city, but subject to the conditions that the areas not to be immediately occupied by the street may be retained by the present owners in their use. Mr. Tuttle concludes that for New York's conditions actual and prompt acquisition of street and courtyard areas is the only safe method of enforcing the plan and this procedure should be observed at the earliest possible date. The discussion on this subject brought out descriptions of methods possible in various states for securing street widening and the desirability of securing the co-operation of the interested property owners, and obtaining donations of land, and even of inducing them to assume portions of the cost of the improvement for which they are not liable under the existing state laws.

Distributing Population

J. R. Bibbins, manager of the transportation department, U. S. Chamber of Commerce, speaking on methods of distributing population, held that the decentralization of population imperatively requires the fullest use of all possible agencies of distribution, including railroads, subways, surface lines, buses, aëroplanes, etc. This local transportation is a natural monopoly and the attainment of the most effective results requires co-ordination of the above named facilities and rigid control of development, all based upon a wise planning for future growth and with the realization that political and geographical boundaries do not have as much influence as the length of ride, whose maximum Mr. Bibbins placed at 30 minutes. He has discovered a definite relation between the growth in population and valuation of property in the larger cities. The district assessment and road tax, and the use of bus lines for the early sparse development, are suggested as partial means of easing the financial burdens of transportation.

H. M. Brinckerhoff detailed some studies of the distribution of the homes of employees of the larger industries and gave the average distances traveled by vehicle and walking by these employees in going to and from work. Two papers on river transportation, dwelling particularly upon the question of terminal and river front improvement, were presented by Maj. J. Franklin Bell, U. S. District Engineer, and Kenneth C. Grant; these contrasted European practice on rivers similar to the Ohio with the local conditions.

John Ihlder, manager, civic development department, U. S. Chamber of Commerce, pointed out the importance of giving consideration to aërial transportation, and the necessity of disregarding political boundaries and of considering metropolitan areas and districts subject to regional planning.

Aerial Photography

A committee report on the use of aërial photography in city planning was presented by E. P. Goodrich, New York City, which pointed out some of the limitations of the process, when applied to city planning work, but concluded that it had great advantages for reconnoissance work. The discussion showed a very active interest in the subject, several novel uses being described.

The use of moving pictures in city planning was the subject of a committee report presented by Herbert S. Swan which described some of the experience of the Chicago Plan Commission and concluded that this device would be useful in showing progress on public improvement construction, congestion of traffic, and, by aeroplane pictures, the results of city planning in various cities.

The conference was closed by John Nolen, who gave as his opinion that among the wrong methods of getting results in city planning were promotion by only one class in a community, excessive promotion and inadequate promotion. He recommended an official planning commission with adequate powers and responsibilities; provision for sound legal advice; a broad but solid financial policy; constant education in schools and in public assemblies; appropriate and timely publicity; a persistent follow-up organization; a competent staff and consultant.

The conference elected Lawson Purdy, of New York, president, and George B. Ford, vice-president, and re-elected Flavel Shurtleff, Boston, secretary.

Conference of State Sanitary Engineers at Boston

Engineers engaged in state and federal health work will hold a conference at Boston, Mass., June 1 and 2. Besides an address on "State Sanitation," by G. C. Whipple, professor of sanitary engineering, Harvard University, there will be papers by R. B. Morse, chief engineer Maryland State Board of Health, W. H. Dittoe, chief engineer Ohio State Board of Health, and a number of other papers; also committee reports on stream pollution and sewage disposal, cross connections and by-passes on water supplies, mosquito control, and rat-proofing; and a discussion of "The Certification and Supervision of Water Supplies on Interstate Carriers," by engineers with the Public Health Service and state departments of health. I. W. Mendelsohn, assistant sanitary engineer U. S. Public Health Service, Washington, D. C., is corresponding secretary of the Conference of State Sanitary Engineers.

To Make "Business" Valuation of New York Transit Lines

A method of valuation based upon "estimated prospective earning capacity" has been included in the new rapid-transit law of the State of New York, following the special message from Governor Miller urging an amendment to provide a method of valuation embodying a standard "employed daily in the conduct of business affairs." The law states that the "value" found shall in no case exceed cost of reproduction less depreciation. It is said that the method prescribed means "value" will be fixed as the capitalized earning capacity that an individual company would previously have been expected to earn now under normal conditions at the original contract rates of fare. With new rates determined by such a valuation, each of the companies would earn the "estimated prospective" amount only provided that present traffic volumes would be the same as those that could reasonably have been expected previous to the war. The Governor's statement also indicates that it would be the intention to consider the future earning capacity of new lines now serving territory expected to develop. The law also provides for equalizing competitive rates between the same points, regardless of the valuation, by prescribing only the method for fixing maximum fares.

Utah Governor Appoints Water Storage Commission

In compliance with the law enacted by the Fourteenth Legislature, providing for a state water storage commission, Governor Charles R. Mabey has appointed the following as members of the commission: W. R. Wallace, E. M. Ashton, R. R. Lyman, W. L. Hansen, W. W. Armstrong, all of Salt Lake County; J. R. Murdock, of Wasatch County; W. V. Creer, of Utah County; A. F. Doremus, of Tooele County, and Sam G. Dye of Weber County. The state engineer is ex-officio a member of the association.

The law creating the commission provides that the body shall conduct investigations relative to water supply for irrigation purposes, and that any county, city or other agency may cooperate with the commission in obtaining data on water supply in that county or city, and that they may contribute to the cost of the work.

Full and proper development and utilization of the state's water supply is the object of the creation of the commission, and it will take over, to a certain extent, the work done during the last two years by the Utah Water Storage Association. An appropriation of $2,500 was made by the Legislature for the purpose of conducting investigations in relation to water supply. None of the appropriation is to be used in salaries, the members of the water storage commission serving without pay.

Hoover Selects Executive from McGraw-Hill Co. as Assistant

F. M. Feiker, vice-president and chairman of the editorial board of the McGraw-Hill Co., has been granted a leave of absence to accept appointment as assistant to the Secretary of Commerce. Mr. Hoover has divided the bureaus of the Department of Commerce into two parts. Assistant Secretary Huston will supervise the bureaus relating to navigation and fisheries while Mr. Hoover will give his personal attention to the bureaus of foreign and domestic commerce, standards and census. Mr. Feiker will directly assist Mr. Hoover in the expansion of these bureaus as aids to business.

The immediate problem is to find out

F. M. FEIKER

what kind of facts and figures industry needs from the government by means of a series of conferences with the representative men of industry. Having organized the department to function according to requirements, the next problem is to devise an adequate system of clearing the collected data back to business. Mr. Feiker's background of engineering training, viewpoint on the needs of industry and sense of publicity should be of unusual service in the furtherance of Mr. Hoover's plans.

Mr. Feiker was graduated in electrical engineering from Worcester (Mass.) Polytechnic Institute in 1904. Following graduation he assisted in special research work in high-tension transmission and generation at Worcester. From 1906 to 1907 he served the General Electric Co. at Schenectady, N. Y., as technical journalist, and in the latter year went with the magazine section at Chicago, shortly after developing the idea of *Factory*, of which he became managing editor. In 1912 he was appointed chairman of the editorial board of all the A. W. Shaw publications. He left Chicago in 1915 to join the McGraw Publishing Co. as editor of *Electrical World*. In the year following he established *Electrical Merchandising*, to supplement and extend the service of *Electrical World* to the industry. In 1919 he was made editorial director of the McGraw-Hill Co., and in January, 1920, was elected vice-president and chairman of the board of editors of its eleven publications.

Hearings on Townsend Bill Begin

Hearings on the Townsend highway bill began before the Senate committee on post offices and post roads May 13. George M. Graham of the highways committee, National Automobile Chamber of Commerce, urged the adoption of the Townsend bill principally on the ground that centralized supervision is essential to an efficient national highway system and because the greater number will benefit most by having primary interstate highways first. He declared that a federal commission, directly responsible to the President, is preferable to the bureau system for various reasons, among them being the fact that higher salaries can be paid under commissions. Since millions of dollars are to be expended on highways he argued that it would be the highest economy to pay higher salaries and secure as capable men as could be attracted to the work.

It is expected that the hearings will extend over a considerable period. One of the objects of these hearings is to build up a valuable record. Senator Townsend expects to exercise great care in developing all angles of the situation with the idea that the printed hearings will be an important contribution to the literature on highway development.

Stadium to Seat 85,000 Planned for Pasadena

Construction is to begin shortly on a stadium in the Arroyo Seco at Pasadena, Cal., about a mile above the Arroyo Seco concrete arch bridge and a short distance below Devil's Gate dam, which also crosses the arroyo. To make room for the stadium a new channel for the water course is to be provided along the east side of the arroyo and a dike will be thrown up to retain flood waters within the channel.

The stadium is to be built partly in excavation and partly on fill around an elliptical field with the south end left open. The diameters of the ellipse will be about 300 and 500 ft. Eighty tiers of seats are to be built along the sides and sixty tiers around the closed end. For the largest games temporary wooden seats are to be built across the open end, adding a seating capacity of about 15,000 and bringing the total seating capacity up to about 80,000.

The amount of material to be handled is estimated at 200,000 cu.yd. in the stadium and 125,000 cu.yd. in the dike. The cost of the structure complete is to be about $1,000,000 and the work is to be done in time for the big football game Jan. 1. Myron Hunt of Los Angeles is the architect.

Survey of Federal Departments Has Started

A thorough survey of the federal government's executive machinery has begun. The joint committee charged with the work met May 12 to organize and outline the work. President Harding was present.

Walter F. Brown of Toledo, Ohio, who is the executive representative of the committee, was elected chairman and Senator Smott, of Utah, vice-chairman. As soon as the survey of the departments has been completed public hearings will be held. The evidence gathered by the committee and that submitted by witnesses then will be studied and recommendations will be made which will cover, in addition to the subject of regrouping existing bureaus, the various proposals for new departments.

Extending Barge Canal Service

Operation of a number of deck-loading package freighters between Syracuse, Rochester, Buffalo and intermediate points along the New York State Barge Canal will be undertaken by the Merchants and Manufacturers' Transit Corporation of Rochester to provide a regular and frequent carload and less-than-carload merchandise service, according to announcement of Charles L. Cadle, superintendent of public works of New York State. The Syracuse-New York service will also be inaugurated, breaking bulk in Syracuse for local delivery and distribution to ports west of Syracuse. Eastbound shipments make bulk at Syracuse for delivery at New York. Alternate day sailings will be maintained to and from Buffalo and Syracuse and intermediate ports, except Rochester, where daily service will be provided. It is stated that the rates, including marine insurance, are 35 per cent less than rail rates. Through routes and joint rates will be maintained via canal and lake to Cleveland, Detroit, Chicago, Milwaukee, Duluth, St. Paul, and other Western ports. Agents will be stationed at canal terminal warehouses and freight will be accepted daily at all ports.

Commerce Dept. To Study Housing Problem

Secretary of Commerce Hoover has announced the appointment of seven engineers and architects on an advisory committee "to aid the department in solving the national housing problem." The men appointed are Ira H. Woolson, consulting engineer of the National Board of Fire Underwriters; Rudolph P. Miller, superintendent of buildings of Manhattan; J. R. Worcester, consulting engineer, Boston, Mass.; Prof. W. K. Hatt, of Purdue University; Ernest J. Russell, architect, St. Louis; Edwin H. Brown, architect, Minneapolis, Minn., and J. A. Newlin, of the Forest Products Laboratory, Madison, Wis. The committee will advise mainly on matters of building practice and not on the sociologic or city planning phases of housing.

In pursuance of the same idea a bill has been introduced in the Senate (S. 1152) authorizing the Secretary of Commerce to establish in the National Bureau of Standards a division to be known as the Division of Construction and Housing, the functions of which shall be to collect, classify, arrange and disseminate scientific, technical, practical and statistical information showing approved methods in building planning and construction and allied work.

Bill Creates Office of U. S. Civil Engineer

To improve the status of some of the assistant engineers in the United States Engineer Department who occupied responsible positions while officers in the Corps of Engineers were in war service, Senator Wolcott has introduced a bill (S. 1506) creating the office of United States civil engineer and providing for the pay and retirement of such officers. A part of the bill reads as follows:

"That all assistant engineers in the engineer department at large who at any time during the World War served as 'assistant engineers in charge' (district engineers) in engineer districts comprising river and harbor work, miscellaneous civil work, or fortification work, or as assistant engineer and secretary of the Board of Engineers for Rivers and Harbors, shall hereafter be designated as United States civil engineers; that their salaries shall be and the same are hereby fixed at not less than $5,000 per annum; and that they shall be retired in the same manner and under the same conditions as to disability, age, per centum of pay, and so forth, as are officers of the United States Army."

The bill also provides that these United States civil engineers are not to be liable to dismissal except for neglect of duty or malfeasance in office.

Kill Plan for Contract Cleaning of Philadelphia Streets

An attempt to amend the new charter of Philadelphia so as to make street cleaning in that city by contract again compulsory failed in the closing days of the recent session of the Philadelphia Legislature. Under the new Philadelphia charter, street cleaning, garbage collection and disposal, etc., must be done by the city itself unless the Mayor and Council decide in August of each year to have the work done by contract. A bill to amend the Philadelphia charter so as to change the word "may" in two sentences to the word "shall" made a rapid trip through the Senate, got entangled in the House in the course of a general factional political controversy, but finally was on its way toward passage when it was killed.

To Build Brooklyn-Staten Island Tunnel

By an act of the New York state legislature approved by Gov. Miller on May 12, the city of New York is directed to build a freight and passenger tunnel from Brooklyn to Staten Island. Construction must begin within two years, under the act. The work is to be done by the city's Board of Estimate and Apportionment. A tunnel route from the southerly end of the Brooklyn Fourth Avenue rapid-transit subway to Staten Island was laid out by the Public Service Commission a number of years ago but its construction has never been authorized. The present mandatory law takes the matter out of the hands of the Transit Commission.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-28.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Brooklyn (N. Y.) Engineers' Club, at its meeting May 26, will be addressed by one of its members on "Meters" from the standpoint of the city engineer, the legislator, the executive, the Lockwood Committee, the district attorney, and the public.

The Engineering Institute of Canada, Montreal Branch, at its annual meeting held May 5, elected J. H. Hunter chairman, and J. de Montrouge Duchastel, vice-chairman.

The Seattle (Wash.) Section, Am. Soc. C. E., held a dinner May 3 in honor of E. M. Chandler, former chief engineer, Washington State Reclamation Service, who has recently been appointed acting secretary of the American Society of Civil Engineers. There were addresses by E. B. Hussey, Joseph Jacobs and John L. Hall.

The International Association of Street Cleaning Officials will hold its annual conference at Chicago, Ill., August 10-12, at the Hotel La Salle.

Personal Notes

W. A. Duff, formerly assistant chief engineer, Moncton division, Canadian National Rys., has been appointed engineer of standards, with headquarters at Toronto.

Lang & Ross, surveyors and civil engineers, Sault Ste. Marie, Ont., have been appointed as engineers to the townships of MacDonald and Meredith, Algoma District, Ont.

B. G. Michel has resigned as city engineer of Kitchener, Ont., to enter business as a road contractor.

Frank N. Rutherford, of St. Catharines, Ont., engineer of Lincoln County, has been appointed road superintendent of Lincoln County Ont., succeeding Peter Robertson, resigned.

J. L. Weller, formerly chief engineer of the Welland Ship Canal and during the last two years of the war engaged in advisory work in connection with concrete shipbuilding in the United States, has entered private practice in Hamilton, Ont., specializing in canals, harbors, docks, dry-docks, dams, hydro-electric developments and foundations.

H. G. Bailey has been engaged as highway engineer of Henderson County, N. C.

John B. Fik has been appointed city engineer of Muskegon, Mich.

G. N. Houston, formerly acting commissioner of irrigation in the reclamation branch, Department of the Interior, Canada, has accepted a position as head of the provincial irrigation work with the Alberta government.

W. C. Jepson, recently in private engineering practice in the Niagara peninsula, has been appointed city engineer of Niagara Falls, Ont.

J. B. McKee has been appointed city engineer of Plattsmouth, Neb.

W. H. Houser has been appointed city engineer of Blue Springs, Neb.

B. A. Dockery has been appointed county engineer of Grundy County, Missouri, with headquarters at Trenton.

Clarence E. Shriver, formerly special engineer for the Tallassee Power Co., Badin, N. C., in connection with street layouts on sidewalk and drainage work, also water filtration, sewage disposal plants and systems, is now with the Kentucky State Highway Department.

Charles Schultz has been appointed city engineer of McKinney, Tex.

William J. Dwyer has been appointed county superintendent of highways of Cortland County, N. Y.

J. R. Sexton, regional engineer of the Erie R.R., with headquarters at Chicago, Ill., has been appointed division engineer, with headquarters at Huntington, Ind.

H. D. Herbert has been elected borough manager of Carlisle, Pa.

Walter A. Shaw, for oven seven years engineering member of the Public Utilities Commission of Illinois, has reentered private practice as a consulting engineer, with offices at Chicago, Ill. He will give attention to public utility rate cases, reports for banks and investors, public utility and industrial management, operation and construction, and all branches of municipal engineering and construction work, including designing and supervision.

D. B. Steinman, formerly special assistant to Gustav Lindenthal, consulting engineer, New York, and later professor in charge of civil and mechanical engineering at the College of the City of New York, has opened an office in New York City to make a specialty of service to engineers and architects in designs, estimates, structural problems, inspection, appraisals, research, reports, etc.

John M. Rice has established offices at Pittsburgh, Pa., to engage in private engineering practice. His experience covers the design, construction and operation of allotments and real estate developments, industrial housing developments, streets and highways, power plants, water distribution systems, sewage treatment and disposal works, etc., and the preparation of reports and expert testimony in these subjects.

H. Schantl, formerly engineer maintenance of way with the Mississippi River & Bonne Terre Ry., has been appointed chief engineer of the Missouri-Illinois with headquarters at Bonne Terre, Mo.

Guy C. Dunn, formerly engineer of construction Grand Trunk Pacific Ry., with headquarters at Winnipeg, Man., and since December, 1920, office engineer chief engineer's office, Eastern Lines, Canadian Northern Ry., has been appointed assistant to chief engineer Eastern Lines, Canadian National Rys., with headquarters at Toronto.

John Kaines has been appointed superintendent of highways of the Onondaga Indian Reservation by the New York State Highway Department.

Stanley Shupe of Ottawa, has been appointed city engineer of Kitchener, Ont.

George C. Wright, for eleven years connected with the Monroe County, N. Y., engineer's office and since 1914 deputy county superintendent of highways, has been appointed county superintendent of highways of Monroe County.

William T. Crowley, formerly construction superintendent with the Foundation Co., has been appointed city engineer of Lock Haven, Pa.

H. E. Anschutz, formerly with the Georgia Highway Department, has been appointed engineer of the city planning commission of Atlanta, Ga.

E. G. Hunt, civil engineer, has been appointed city engineer of Aberdeen, Wash.

Obituary

Eliot C. Clarke, civil engineer, died in Boston, Mass., May 4. He was born in Boston in 1845 and was graduated from Harvard University, 1867. In 1868 he was engaged as civil engineer on a bridge then building over the Mississippi River at Quincy, Ill. Among other works with which he was connected were the bridge over the Mississippi at Hannibal, Mo., the Detroit River tunnel, Chicago water-works tunnel and the Chicago sewerage system. In 1876 he was appointed engineer in charge of a survey for a main drainage system for Boston. In 1884 he became chief engineer of the Massachusetts Drainage Commission, created to design methods of preventing pollution of the Charles, Mystic and Blackstone river basins. In 1886 he was associated with James B. Francis and Clemens Herschel in a study of the floods of Stony Brook, Boston. The report of this commission is still considered of great significance in study of flood control problems. From 1886 to 1904 he managed mill properties at Lowell and in 1904 retired to manage his private affairs with an office in Boston, Mass. He was the author of "Astronomy from a Dipper," an account of the Main Drainage Works of the City of Boston, a Report of the Commission to Consider a General System of Drainage for the Valleys of Mystic, Blackstone and Charles Rivers, and contributions to engineering journals.

Major-General Francis V. Greene, police commissioner of New York under Mayor Low in 1903, and from 1904 to 1915 president of the Niagara, Lockport & Ontario Power Co., died May 15 in New York City. He was born in Providence, R. I., in 1850 and after graduation from the United States Military Academy at West Point in 1870 he entered the Corps of Engineeres, U. S. A. In 1876 he was assigned to special duty in the office of the Secretary of War in Washington, and in June, 1877, was sent abroad by the government to witness and report upon the military operations during the war between Russia and Turkey. In 1879 he was appointed assistant to the engineer commissioner at Washington, D. C., where he served six years. Shortly thereafter he resigned from the army. In 1901 he was elected president of the Barber Asphalt Paving Co. From 1903 to 1904 he was police commissioner of New York City and from 1904 to 1915 he was president of the Niagara, Lockport & Ontario Power Co., and vice-president of the Ontario Power Co. of Niagara Falls. He retired in 1915 on account of failing health and made his home in New York City.

Business Side of Construction

Facts and Events that Affect Cost and Volume

The Wage Situation in the Building Industry

Attempts have been made during the past few weeks in various cities suffering from building trade strikes to arbitrate wage disputes though little has has been acomplished in the way of arbitrating the difficulties so far. Another feature of the wage situation is the tendency of building contractors to turn to open-shop methods of operation as an answer to the flat denials from unions that they will not accept wage cuts.

Employers and employees in the building industry in Philadelphia are practically deadlocked, though there has been a considerable quickening of small alteration and repair jobs in the building trades. This condition is attributable, it is presumed, to the fact that many of the union carpenters and other mechanics out of employment are seeking so-called one-man development jobs to keep employed. During the past week the building department of the Philadelphia Department of Public Works issued the largest number of building permits for one day in the history of the department.

In Cleveland, attempts are being made to arbitrate the question of wages. Both employers and employees are standing firm in their respective views as to the justice and need of a wage decrease. Recently the Cleveland Builders' Exchange took out strike insurance to the extent of $1,000,000.

Arbitration proceedings are also reported in progress in Indianapolis, New Haven, Conn., and in Syracuse, N. Y., though success in adjusting the difficulties has not yet been attained. Along with the talk of arbitration proceedings in Kansas City, there is also some comment to the effect that a federal investigation is not impossible.

Practically all the building trades are out in Westchester County, New York, and all efforts to effect an agreement have so far failed. In Tulsa, Okla., wage reductions ranging from 10 to 20 per cent have been proposed by the employers association. In Toledo, Ohio, the builders are standing firm for a material decrease and in Minneapolis, where a 20 per cent decrease was proposed by the employers, certain trades are considering a smaller reduction, the bricklayers voting to accept a 10 per cent decrease, though strongly asserting that a 20 per cent decrease was too much.

The carpenters of Worcester, Mass., have voted to accept a 15 per cent decrease and it is thought that their action may have some effect upon other building trade mechanics who have been on strike for some time.

The 2,000 metal workers of New Orleans, employed in foundries, machine shops, and big repair plants, who have been on strike for sixty days, have resumed work. They accepted the wage cut of their employers, to 80 cents for mechanics and from 50 to 60 cents per hour for helpers.

Mason Building Material Dealers Fined a Total of $74,000

Though Special Deputy Attorney General William A. de Ford had recommended that heavy jail sentences be imposed on the members and corporations of the Association of Dealers in Mason Building Materials who pleaded guilty to conspiracy in restraint of trade following investigations made by the Lockwood joint legislative committee on housing, the nineteen individuals and fourteen corporations involved were fined May 16 by Justice Davis of the New York Supreme Court.

The individuals were fined $500 each, the fines of the corporations ranging from $2,000 to $7,500. The total penalty imposed on the individuals and corporations amounted to $74,000.

Freight Rates on Principal Building Materials

Comparison Given Between Shipping Cost and Cost to Contractor—Rates Irregular

Included in the accompanying table are the freight rates on the principal building materials and on coal from producing regions to centers of consumption. An analysis of these rates in connection with current quotations of the materials shows not only the lack of uniformity in per-mile charges for like materials shipped over different railroads, but also the presence of prohibitive charges in some localities. Evidently, in such instances, the rate operates in favor of other producing centers, or the transportation and handling difficulties are large. The table also shows that the freight rates of 1917 and 1920, expressed in per cent of materials prices, are not far apart.

It may be seen too, that, for instance, the rate on sand from Patapsco, Md., to Baltimore, and on sand and gravel from Peekskill to New York are in excess of the current market quotations for those materials, indicating that

COMPARISON OF PAST AND CURRENT FREIGHT RATES ON BUILDING MATERIALS AND COAL FROM PRODUCING TO CONSUMING CENTERS

Material	From	To	Miles	Rates in Effect: Jan. 1, 1917	Aug. 20, 1920	Jan. 1, 1921	Current Prices of Materials	Current Rates in Per Cent of Material Prices	Material Prices As of Jan. 26, 1917	Jan. 1, 1917, Rates in Per Cent of 1917 Material Prices
Cement, per bbl.	Ragland, Ala	Atlanta	119	$0 29	$0 37	$0 48	$2.75	17	....	..
	Union Bridge, Md.	Baltimore	108	17	29	.41	....	..	....	..
	Hudson, N. Y.	Boston	193		.48	.58	2 86	20	....	..
	Sandusky, O.	Chicago	281	29	41	56	2 17	23	$1.96[3]	15
	Hudson, N. Y.	N. Y. C.	113	20	32	.47	2.90	16	2.07[3]	10
Brick, per 1,000	Chattahooche, Ga.	Atlanta	8	45	1 65	1 65	12.00	14	...	.
	Waterloo, Va.	Baltimore	46	1 92	3.30	4.67	22.50	21	....	.
	E. Bridgewater, Mass.	Boston	25	1 92	3.30	4.67	21.75	22	....	
	Danville, Ill	Chicago	129	2 58	3.30	4 67	12.00	39	6.00	43
	West Haverstraw, N. J	New York	33	2 31	3.85	5.50	18.40	30	9.50	24
Gravel, per ton	Conky, Ga.	Atlanta	10	20	.50	.62	2.62	24	....	..
	Patapsco, Md	Baltimore	17	53	.80	1 10	1.40	78	....	..
	Canton, Mass.	Boston	14	35	.60	80	2.65	30	....	..
	Rupel Pit, Ind	Chicago	91	39	.55	77	1.83	42	.93	42
	Peekskill, N. Y	New York	40	1 26	1 80	2.50	1.67	150	.74	170
Lime, per ton	Calera, Ala.	Atlanta	175	1 20	1 50	1.87	15.00	12	....	..
	York, Pa.	Baltimore	65	95	1 40	1.96	17.50	11	....	..
	Pownal, Vt.	Boston	151	2 20	3 00	4.20	22.75	18	....	..
	Genoa, Ohio	Chicago	246	2 10	2 70	3 80	20.00[1]	19	....	..
	Ossining, N. Y.	New York	30	1 16	1 60	2 20	20 00	11	....	..
Sand, per ton	Dames Ferry, Ga.	Atlanta	72	30	50	.62	1 52	41	....	..
	Patapsco, Md	Baltimore	17	53	80	1 10	.70	157	....	..
	Sharon Heights, Mass.	Boston	18	30	90	1.30	2.00	65	....	
	Rupel Pit, Ind.	Chicago	91	39	55	77	2.04	38	.67	58
	Peekskill, N. Y	New York	40	1.26	1 80	2 50	.93	269	.33	380
Coal, per ton	Excelsior Colliery, Pa.	Atlanta	768	4 12	5 62	7.04	....	..	....	..
	Schuylkill Region	Baltimore	163	1 43	1 87	2.62	...	..	....	..
	Mayfield, Pa.	Boston	347	2 37	2 85	4 00	...	..	....	..
	Buffalo, N. Y.	Chicago	522	1 56	1 92	2.68	...	..	....	..
	Lehigh Region	New York	291	1 61	2.05	2 87	....	..	....	..
Lumber[2], per M ft b m	Tallapoosa, Ga.	Atlanta	63	1 44	1 80	2 25	27 50	8	....	.
	Waycross, Ga	Baltimore	771	8 40	10 50	14.00	60 00	23	....	..
	Allenhurst, Ga.	Boston	1,123	10 85	11 90	15.92	45 00	35	....	.
	Atlanta, Ga	Chicago	784	7 70	10 32	13 82	51 00	27	.27	38
	Savannah, Ga	New York	880	8 75	10 85	14 52	37 00	39	.29	30

[1]—Finished Lim in Chicago; [2]—All lumber white pine; [3]—Including bags, not delivered.

Patapsco supplies no sand to Baltimore and Peekskill neither sand nor gravel to New York. The rate therefore operates to prohibit the shipment of those materials to Baltimore and New York.

The information included in the accompanying table is taken from data collected by the U. S. Senate committee on reconstruction and production at hearings held throughout the country early in the year. The producing centers are those lying nearest points of consumption, giving the shortest rail haul. It is not, however, generally true, that the producing centers here given actually furnish the bulk of the materials indicated to the cities given, but merely show the trend of rates.

While the rates given in each case are for only one haul, it should be remembered that the proportion of transshipments for these materials, being in carload lots, is small. No account is taken in the table of less-than-carload lots, as such movement of building materials is small.

The current prices of materials are usually the prices delivered to the contractor. In the case of cement the quotations are prices per barrel in carload lots with the exception of Baltimore, where the price is that per barrel in drayload lots. The per barrel price in carload lots would be around $1 per barrel less. The quotations on sand and gravel are per ton in carload lots, the usual per-cubic-yard quotation in New York and Chicago being adjusted to a per-ton basis for the purposes of comparison. Quotations on lime are warehouse prices per ton for common lime, except in the case of Chicago as noted in the table. Brick is quoted per thousand, in carload or cargo lots delivered, except in Chicago and Atlanta, where the quotation is for brick not delivered. White pine is quoted in M. ft. b.m., on pieces 8 x 8 in., 20 ft. and under. The shipping rate on lumber was determined by referring to the weight per M. ft. b.m. on air-dried lumber as compiled by the U. S. Forest Service.

What Table Shows

As indicative of what the table shows the freight rate per barrel on cement now ranges from 41 cents for a 108-mile haul to 58 cents for a 193-mile haul, though a haul of an even greater distance—281 miles—is only 56 cents. Local shipping conditions might explain such a discrepancy. The rate on cement, expressed in a ratio to the current prices of cement in the various cities, ranges from 16 to 23 per cent.

Then, in comparing the ratios of freight rates for 1917 and 1921 with the costs of materials it is found that in 1917 freight represented 43 per cent of the cost of brick in Chicago, and 24 per cent in New York, whereas now these figures are 39 and 30 per cent, respectively. For lumber freight represented 28 per cent of the cost in 1917 in Chicago and 30 per cent in New York, and 27 per cent in Chicago now and 39 per cent in New York. Comparisons on cement between the two years cannot well be made, the 1917 quotation including bags and not delivered, the 1921 price being delivered and without bags.

As the table gives a fair idea of the rates on all materials it is left to the engineer and contractor to determine whether the rates on building materials are too high, as compared with the current costs of these materials.

Construction Articles in This Issue

Long Arch Bridge Built of Slag Concrete Page 840

Personnel Board Keeps Tab on Contractor's Field Forces Page 860

Felling Four Steel Chimneys Lined Outside with Concrete Page 855

Construction Industry Conference Proceedings Issued

The proceedings of the Philadelphia and the national conferences of the construction industry held Feb. 15-18 and March 2 and 3, respectively, has been issued. The Philadelphia conference was held under the auspices of the industrial relations committee of the Philadelphia Chamber of Commerce and the national conference was held in Chicago under the auspices of the National Federation of Construction Industries. Both of these meetings are reported in *Engineering News-Record*, the first in the issue of Feb. 24, p. 361, and the national conference in the issue of March 10, p. 447.

Production of Southern Pine

For the week ending May 6 the production of 132 mills reporting to the Southern Pine Association amounted to approximately 69,000,000 ft. b.m., or 77 per cent of the normal cut. The orders for the week were 75,000,000 ft. b.m. and shipment about 76,000,000 ft. b.m. This indicates that orders were 84 per cent of normal production and shipments 85 per cent.

Many Bank Buildings Being Erected

Hoggson Bros., the New York and Chicago builders who specialize in bank design and construction, report that during the period from Jan. 1 to April 1, they completed work on nine bank buildings, in New York City, Wyoming, Kansas, Pennsylvania, Illinois and Michigan. This is a three months' record for completed contracts. During the first three months of 1920 but one bank building was completed and for the first three months of 1919 only five. Five also was the average number of buildings built for any three months' period over the two years previous to Jan. 1, 1921.

Portland Public Utility Plans Extensions

The Portland (Ore.) Railway, Light & Power Co. is planning to spend approximately $2,000,000 in and near Portland in the near future, according to a statement recently made by the company. The money will be expended for the most part in the installation of a new steam turbine to cost $400,000; the rebuilding of a bridge, $150,000; overhead construction and extensions in the light and power department, $250,000; reconstruction of tracks and repaving, $260,000; bridges, buildings and maintenance wrok, $150,000, and maintenance-of-way work on Portland city lines, $350,000. The company recently sold $1,000,000 in gold notes to aid in this repair and extension work.

South African Railway Bids Will Be Received Until July 5

Bids for the electrification of the Cape Town-Simontown and the Durban-Maritzburg railway lines will be received up to July 5 by the office of the high commissioner for the Union of South Africa, London. Bids were asked on this electrification project previously, as noted in *Engineering News-Record*, May 5, advertising page 88, but an extension of time has been granted for the submission of bids.

Ogden to Build Outfall Sewer

Bids are soon to be advertised for the construction of a main outfall sewer for the city of Ogden, Utah. Plans and specifications for the work have been prepared and as the preliminary notice to contractors states (see this issue advertising page 62) the principal items of the work will include 10,500 lin.ft. of 42-in. sewer pipe, 2,900 lin.ft. 48-in. pipe and 16,000 lin.ft. of 60-in. pipe, in additon to excavation and back filling to the amount of 120,000 cu.yd.

Indiana State Building Close to $2,000,000

Summary of the building operations provided for by the Indiana legislature just ended and to be carried out by the McCray administration discloses nearly $2,000,000 of projects. The operations are to be spread over most of the four-year term of the administration. The proposed improvements include extensions to state insane asylum, the construction of a children's hospital, a state normal school branch, and a reformatory.

Sewage Disposal Project for Oklahoma City

Sewage works including settling tanks and sprinkling filters, as recommended for Oklahoma City, Okla., by Pearse, Greeley & Hansen, consulting engineers, Chicago, have been approved by the sewage board and the project is

now before the city commissioners. These works are necessary to comply with an order issued by the state board of health in November, 1920, requiring the discharge of sewage into the rivers to be stopped before the end of 1922. Two plants are recommended, both for domestic sewage only, the treatment of packing house sewage to be worked out later. The esimated cost is $185,000 for the former and $1,810,000 for the latter, or $2,560,000 for the latter with combined domestic and industrial sewage. For this purpose a bond issue of $2,000,000 is recommended.

Idaho Dam to Cost $1,200,000

Construction work will be started early this summer by the Emmett Irrigation District on the Black Canyon dam, 5 miles up the Payette River, from Emmett, Idaho, to be built at an estimated cost of $1,200,000. Power to lift water 30 ft. for the district will be generated in the dam. The water will be lifted by electrical power into the higher level canal of the Emmett Irrigation district, eliminating some 16 to 18 miles of side canal in the present system. Water will be supplied to the Black Canyon project through a lower level canal, involving the construction of 20 to 30 miles of canal. The dam will be of the gravity arch type.

Gold Imports and Exports for 1920 and 1921

According to a recent bulletin issued by the Department of Commerce the gold exports of the ten months ending in April amounted to $132,000,000, whereas the imports totaled $568,000,000. During the corresponding period of 1920 the exports were $454,000,000 and the imports $108,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4.00	$4.50	$3.23	$3.51	$4.65	$4.35	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	49%	50.65–5%	45%	58½%	51.9–5%	20%	49.80	45%	50%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.00	64.10	67.80	70.00	85.90	72.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80 (del.)	3.00	2.60	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	4.00	2.75	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	2.75	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	2.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	40.00	50.00	55.00	38.00	47.00	27.00	25.50@28.50	120.00
Lime, finished, hydrated, ton	21.00	22.50	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	3.00	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.50	16.00	12.00	18.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	12	.10	09	12½	.11	.19
Hollow partition tile 4x12x12, block	.....	15	.13	.096	.10	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	75	.66	.85	.82	.83	.90	.93	.79	.72
Common Labor:									
Common labor, union, hour	.75@.80	.35	.35@.45	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.35@.45	.40@.50	.50	.37½@.50	.50@.55	.40@.45	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Gravel, sand and brick are quoted delivered, crushed stone f.o.b. cars. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. **No organized** common labor in Montreal.

Changes Since Last Week

New York dealers have cut prices on cement until that material is hardly profitable to handle. On April 28 we announced the decrease from $3.10 to $2.90, and stated that the dealers were figuring a profit of only 4c. per bbl. The price has now been lowered to $2.80 without bags, delivered on the job. When it is considered that the manufacturers' price to dealers is $2.40 alongside and that unloading, cartage and handling in the yard cost 46c., it will be apparent that the dealer is on the wrong side of the ledger by 6c. per bbl. In fact his only chance of preventing a loss is to discount his bills. No cut has been announced by manufacturers.

Lumber is stronger in Atlanta, Dallas and Seattle, but down $3 per M. ft. b.m. in New York. Rivets are down 65c. in San Francisco, to $6.40 per 100 lb. Sand is off 15c. in San Francisco. Linseed oil is up 3c. per gal. in New York and 1c. in San Francisco.

As to labor—the latest report from Chicago is that the unions and the contractors' organization are to resume parleys with a view to settling the strike. Common labor demands a continuation of the $1 rate, but the contractors' offer is 65 to 75c. per hour. Non-union common labor is paid 40 to 50c. per hour.

Minneapolis unions and building crafts still refuse the 20 per cent cut that was announced by the contractors effective May 1. There will be a joint conference on the issue this week. Meanwhile, employers claim that sufficient labor is available at the new scale, while the union spokesmen maintain that in most cases where union men are being employed, the old scale is being paid.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

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Hudson Tunnel Engineers

OBJECTION has been made that the juxtaposition of a news article and an editorial note in *Engineering News-Record* for May 12 has cast reflection on three well-known New York engineers, George M. Wells, St. John Clarke, and Col. George L. Watson. The news note recorded the facts of the discharge by the New Jersey Interstate Bridge and Tunnel Commission of the board of consulting engineers employed jointly by it and by the corresponding New York commission, and the appointment by the New Jersey commission of the gentlemen above named as its consulting engineers. The editorial note gave emphatically this journal's views regarding the action of the commission. A reading of the editorial should in itself be convincing that the personality of the New Jersey commission's appointees was not even considered, but lest there be misunderstanding, *Engineering News-Record* desires to make it clear that its strictures applied to the action of the commission alone and was not meant to reflect on the engineers in question.

A Record County Road Program

MARICOPA County, Ariz., has leaped into fame among highway engineers because it let a contract for 141 miles of concrete road to a single contractor. No less notable is the entire plan, of which the first contract is only a part, involving 309 miles of paved roads in this garden country, not long ago given over to sand wastes, sage brush, and picturesque tall cactus. With an area of 8,891 sq.mi. it required the courage typical of our Far West to resolve to place every farm house in the valley within one mile of a paved highway. Eastern counties with their greater conservatism would have figured much longer and would undoubtedly have concluded to spread the work over a great many more years than called for in the Maricopa plan. The contractor's performance seems to keep pace with the boldness of the county's project, for an article in this issue tells about completing 3,000 ft. of highway per day, with five paving mixers in operation. It is true that a job of such size requires vigorous handling, but that fact does not detract from the credit that belongs to an organization which is putting the job through. Naturally in a project of this magnitude the general construction plan is of great interest. For that reason the article in this issue covers in a general way the plant and procedure adopted by the contractors. Later articles will give details that are of special interest.

Thickening Pavement Edges

EDGE BREAKAGE is being rather purposefully studied in recent designs for concrete roads. For the Maricopa County, Ariz., road system, the concrete slab, as shown on page 883, is thickened from a line 2 ft. back on each side, to the edges, the increase all being on the bottom of the slab. Recent pavements in Oakland, Cal., are built with inverted curbs, 6 x 12 in., reinforced at the bottom. In Illinois another design for the same purpose has been worked out as described in *Engineering News-Record* March 24, 1921, p. 504. Half a dozen localities report pavement failure due to the progressive breaking down of the edges of the slab by heavy trucks, and the opinion is expressed that something has to be done immediately to reinforce the strength of pavement edges or failures will be repeated. The change of thought is quite radical from a few years ago when engineers were speculating whether all purposes would not be as well served and concrete saved, by making the slab 3 or 4 in. thinner at the edges than at the center instead of 1 or 2 in. thinner as was the common practice.

Missing an Opportunity

AT ITS coming meeting in Chicago the American Society of Mechanical Engineers will have a session devoted to construction machinery. While, obviously, the design of such machinery might be considered within the scope of the mechanical engineer, its function is the business of the civil engineer and of his co-worker—the contractor. While no one can quarrel with the mechanical engineers in scheduling this subject for discussion, the incident serves to recall the sweeping neglect of construction by the American Society of Civil Engineers. In that field lies a large opportunity. What the engineer designs is of no value until it has been embodied in steel, in masonry, in wood, or in the other materials of engineering. The cost of putting these things together to produce the finished structure is largely determined by the type and efficiency of construction machinery. The design and development of such machinery, therefore, are nearly as vital to the civil engineer as are the methods and theories of design; all the more reason why the American Society of Civil Engineers should not neglect the subject. The opportunity is a great one and should have the consideration of the officers of the society in this day of revival of technical activity and interest.

Unified Terminal Operation

LAST WEEK these columns raised the question of effecting substantial economies in railroad operation through the application of exact, scientific methods to operating problems heretofore solved largely by rule of thumb. Emphasis was laid on the matter of freight-handling methods and terminal operation. The article in this issue, abstracting a recent paper of George H. Kimball on the terminal problem, points strikingly to possibilities of economy not only by better methods within single organizations but by cooperative methods between different companies and the elimination of wasteful competitive practices. Briefly, Mr. Kimball maintains that united operation of the terminal present

ties within a city is essential to economy. The directness of his argument suggests not only possibilities of consolidating railroad properties under the Transportation Act, but raises the broader question of how far the terminal business—between the outer classification yard and the shipper's door—should be separated from the line-haul business.

A Chance for the Critical

UNDER date of May 16 and with the postmark of one of our leading technical colleges a letter has reached this office. It contains the following reasonable request: "I understand that you have published an article on the design and construction of a concrete shipway. If you have such an article I would appreciate it very much if you would send me one as soon as possible. I have this subject for a graduating thesis in June, and as I have only a short time in which to work would appreciate a prompt reply." Aside from the fact that the allotted time seems distressingly short for the adequate preparation of a graduating thesis, there is little here that can be used to point a pedagogical moral. The critics of our educational system, though, are entitled to this one fact—the letter is not signed.

A Question of Communication

SO MANY problems meet in the Hudson River crossing question that a discussion such as was had before the New York section of the American Society of Civil Engineers last week inevitably brings forth a wide divergence of view. Technical details of the question, each constituting the immediate difficulty according to the individual standpoint, received main attention. It is true that all of these "details" are formidable engineering problems by themselves. Yet the isolation of New York island from the mainland, and therewith its physical separation from half its potential area of supply and influence, remains the major characteristic of the situation. That this stays in the background in a discussion of the kind referred to is the more easily understood when the effect of the intervening state-line on the relations between the two banks of the Hudson is taken into account. As time goes on, however, the political separation of the territory as well as the complication of the broad question by its difficult component problems are likely to prove less influential, and the essential demands of communication will receive more consideration. As has been urged time and again in these columns, adequate highway connection of New York with the rest of the country is vital to the efficiency of the nation's greatest commercial center, and hence also to the nation's own commercial efficiency.

Time Costs of Building Work

A NOTABLE contribution to the literature of cost data will be found on p. 888 of this issue. Frank E. Barnes, supervising building valuation engineer of the New York Central Lines, presents a great volume of experience regarding the time required for building construction operations. As indicated in the explanation in his article, the values have been determined with exceptional care. This is the important characteristic of these tables contrasted with similar schedules of time costs. They represent the consensus of opinion of many contractors, obtained during months of study of the subject in connection with the federal railroad valuation. The author was fortunately able to secure independent statements from reliable contractors regarding their cost experiences. Although developed primarily to determine the reproduction cost of existing buildings, the values given are equally useful for estimating the cost of new construction. The tables, therefore, serve not only the appraisal engineer, but building engineers and contractors as well. The values stated, like all other figures intended to define quantitatively the productiveness of labor, must be employed with good judgment. The author, an experienced contractor as well as an appraisal engineer, emphasizes this fact in his comment. In these days of uncertain efficiency of construction labor a reassertion of the warning is not out of place. Used wisely, the time cost schedules on p. 888 are of very great value.

Subgrades Under Suspicion

DECREASING confidence in subgrades has been a striking development of highway engineering thought during the past two years. Formerly, so long as the road was fairly well ditched and the pavement slab distributed the load fairly well, little fear of subgrade weakness was expressed. Disturbances due to freezing and heaving were always feared, but the supporting power, in general, of normally sound subgrade caused little concern. Now no detail of a paved road structure is more under suspicion. Indeed the capacity of subgrade for destruction has come to be spoken of almost tremulously. Two reasons appear. One is the report of paved roads breaking down under heavy truck traffic because of subgrade weakness. The second is laboratory evidence of moisture action on soil stability and the capacity of capillarity to develop a dangerous moisture content in soils. While enough facts of both sorts have been disclosed to warrant their careful appraisal and further investigation, the big fact remains that the mileage of pavement which has failed is a very small fraction of the total mileage and on the whole our paved roads have stood up well.

Department of Commerce Appropriations

ECONOMY in operating our federal government—and all governments for that matter—needs now to be preached in season and out. *Engineering News-Record* has consistently done so since the close of the war. It would seem to run counter to this policy to advocate additional appropriations. Yet the deficiency appropriations asked for by the Secretary of Commerce seem to promise such excellent returns to the industry of the country that we urge upon our readers their sympathetic consideration of these requests. If their views accord with ours, they should as citizens express their views to their representatives in both House and Senate. The House committee has already acted favorably upon the request, while in the Senate the bill is still in committee.

Briefly, Mr. Hoover has asked for deficiency appropriations totaling $618,000. This seems very modest, even when added to the $8,800,000 already appropriated, particularly when the amounts carried by the pending Army and Navy bills are considered. Of the additional appropriations asked for, $250,000 is for the promotion of foreign commerce, and an equal amount for broadening the work of the Bureau of Standards.

Of the need for intelligent promotion of our foreign trade there need be no demonstration to thinking Amer-

icans. Few subjects of national import have had so much attention since 1914. Mr. Hoover's plans for the use of this money contemplate an intensification of the present news gathering and distributing services pertinent to foreign commerce.

Of the requested appropriation for the Bureau of Standards, $50,000 is for additional work in the testing of structural materials; $100,000 for industrial research, looking to the elimination of waste in industry, and $100,000 for studies in standardization of equipment. The last-named studies have in view the establishment of manufacturing and commercial standards of machinery, equipment and devices, including such matters as the elimination of unnecessary forms, varieties and qualities. The structural materials studies would be directly largely toward securing information pertinent to the present housing shortage.

All of the objects so commend themselves to engineers and contractors that fuller discussion is unnecessary. Mere personal approval, though, is of no practical value. We must indicate to Congress that, even in these days of the need for urgent economy, we endorse these additional appropriations, confident that they will be a profitable investment and not an unproductive expense.

The A. A. E. Convention

THE present condition of the American Association of Engineers has been likened to that of a machine which has passed through the period of initial wear and is undergoing readjustment. This was apparent in the convention at Buffalo last week. With 7,000 names added to the organization's roster during the past year, bringing the total to about 25,000, it was to be expected that the mechanism for carrying on this year's activities would need attention, and the greater part of the time of the convention was devoted to a revision of the constitution and to a discussion of chapter activities.

Some of the older members of the conservative founder societies have thought of the American Association of Engineers principally in terms of an organized effort to secure increased salaries for its members. At the Buffalo convention this subject was decidedly in the background. It cropped out once or twice in connection with the report of the committee on standards of practice and fees for consulting engineers and in statements of what the railroad section had accomplished in securing increased compensation, but, by and large, compensation figured little in the discussions.

The meeting developed no matters relating to the constructive work of the association. The new administration will, in all probability, devote its principal effort to the strengthening of the local chapters, although no definite program was announced. The prediction is based upon the approval given to the increased allotment—60 per cent—of incoming funds to the chapters and the consequent curtailment of money available for headquarters, involving also the elimination of the district offices at New York and Washington and the suspension of the work of the director of field forces. Local autonomy also will be strengthened by the new scheme of districting and the election of directors by votes from the district they represent.

As far as the association's constructive work is concerned, therefore, the Buffalo convention made no contribution. Its sole accomplishment lay in the development of its internal mechanism.

An Important Experiment in Society Management

BRIEF comment was made in these columns last week upon the incorporation by the American Association of Engineers in its by-laws of the arrangement, already in partial effect through the directors' action, of allocating to the chapters 60 per cent of all initiation fees and dues. This allocation of more than half of the funds to the local bodies is the tangible expression of the theory of putting on the local chapters major responsibility for the service which the association is to render its members.

The thinking in engineering societies has been drifting in this direction for a long time. The American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been particularly active in trying to strengthen their local bodies. The same object was one of the cardinal doctrines of the progressive movement in the American Society of Civil Engineers. It should be noted, however, that none of these organizations has even dreamed of the degree of decentralization contemplated by the A.A.E. plans. This is indicated by the degree of financial assistance which they extend, or propose to extend. In the American Society of Mechanical Engineers, for example, the average contribution from national headquarters to the sections amounts to $1.25 per member, out of a full membership fee of $15, or 8½ per cent; the sections also receive 20 per cent of the initiation fees. The proposed constitution of the American Society of Civil Engineers, now going to letter ballot, provides that the contribution by national headquarters shall not exceed $3 per member, which is less than 15 per cent of the average dues. In other words, these national societies, while they propose to strengthen their local bodies, adhere to the principle that the main strength must lie in having a strong central organization. Their theory is one of centralization; that of the A.A.E., of decentralization.

Which of the two theories will prove to be the better remains to be seen. Tradition would lead us to be fearful of the results of the A.A.E. plan. Our older national engineering societies have, heretofore, functioned mainly as headquarters organizations. Even while the advocacy of the strengthening of the local bodies has been vigorous the proponents themselves have been fearful lest the granting of too much autonomy might detract from the soundness and prestige of the whole body. The advocacy of decentralization, therefore, loud as it may have been at times, has been decidedly conservative. Though the A.A.E. policy is not fully crystallized, the evident drift is toward giving the locals almost complete autonomy. In national questions, obviously, the chapters could not function except through national headquarters. On local matters it seems to have been concluded that the local bodies are the best judges of the desirable procedure.

Obviously, the success of the venture will depend upon the judgment displayed by the chapters. To be strong nationally the engineering profession should be strong locally, for the local problems coming before engineers are those that most directly interest and enlist the sympathy of the public. If A.A.E. chapters throughout the country grasp and handle these problems to the credit of the profession and at the same time continue loyal adherence to the national body the decentralized policy will be adjudged successful.

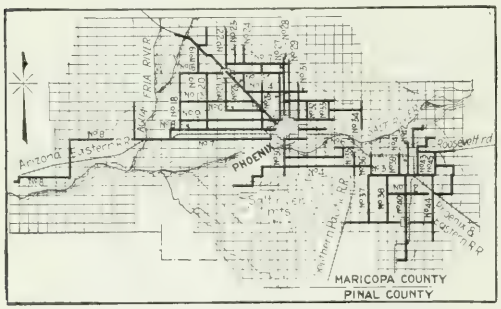
Arizona County Undertakes 309-Mile Paved Road System

Special Concrete Slab Section and Construction Methods Devised for Hot Dry Climate—System Brings Every Farm Within One Mile of a Concrete Road

By Ralph Rollins
Phoenix, Arizona

Maricopa County, Arizona, a comparatively small section of one of the least-populated states, is engaged in the most ambitious concentrated road program in the country. Not only is the mileage, and consequently the expenditure, per capita high, but the contract methods are unprecedented; one contractor is doing all the work under the first or $4,000,000 bond issue. In the following article the general outlines of the job are laid down, to be followed later with detail stories of how the roads are being built. Night work, for instance, is now being successfully prosecuted, and a description of that makes a story in itself.—Editor.

With 141 miles of concrete road under construction and 309 miles planned, Maricopa County, Arizona, leads all counties in mileage of paved road under contract and in volume of bond issues ($8,500,000) for highway improvement. The contract for the 141-mile section, undertaken by Twohy Bros. Co., is the largest single paved-road contract ever awarded. A slab section, thickened at the edges, unique in its employment for so great a mileage, is being constructed. The development of local aggregates for the whole mileage has been undertaken with large-capacity equipment. Machinery is employed in construction in every practicable manner, and with five paving mixers 3,000 ft. of road is being completed each day worked.



CONCRETE ROAD SYSTEM FOR MARICOPA COUNTY, ARIZ.

Location and Plan.—Maricopa County is the largest county in Arizona in point of population though not in assessed valuation. Its county seat, Phœnix, is the capital of the state and the metropolis of the Salt River valley, at one time a barren desert but now under intensive cultivation by virtue of a federal reclamation project under the Roosevelt dam. The highway program is being financed by two bond issues, one for $4,000,000 and the second for $4,500,000, the latter being voted before more than $1,000,000 of the original issue had been spent. The second issue, though voted, has not yet been sold. Actual construction started Nov. 12, 1920, and four months later, March 12, 1921, 32 miles of paving 18 ft. and 16 ft. in width and 6 in. and 5 in. in thickness had been laid. With five pavers in operation the contractors were then laying over 3,000 ft. per day.

As planned, the Maricopa County highway system is designed to place every farm house in the valley within one mile of a paved highway. The project comprises a series of main arteries of heavy construction to carry the heavy traffic, supplemented by parallel and cross roads of lighter construction, which will serve all sections of the irrigated district and also provide facilities for through traffic.

The selection of concrete as the material for these roads was made by the county highway commission after investigation of the adaptibility of all materials and methods to local soil and weather conditions. Between concrete and asphalt, the final choice was decided by price. It was found cheaper, all things considered, to build all-concrete roads than roads with concrete base and asphaltum surface, or with asphaltic-concrete base and asphaltic surfacing. Twohy Bros. secured the contract, let under competitive bidding, at the following figures: For 18-ft. 6-in. road, $31,400 per mile; for 16-ft. 6-in. road, $28,300 per mile, and for 16-ft. 5-in. road, $25,350 per mile. These figures are for complete road, including concrete culverts, bridges and all necessary drainage.

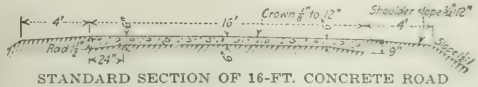
For the 18-ft. pavements, the subgrade has a 1-in. crown. Two feet from each edge it is beveled off to provide a thickness of 9 in. of concrete at the edge. The center of the pavement is 6 in. thick. One-inch crown is used in the paving, whether 16 ft. or 18 ft. wide or whether 5 in. or 6 in. thick. In the 5-in. paving, however, the thickness at the edge is reduced to 8 in. All of the 18-ft. paving thus far has been laid 6 in. thick and about one-half of the 16-ft. paving has also been laid 6 in. thick.

Plan of Construction.—In planning construction the system was divided into nine districts, in the center of each of which was to be set up a plant for the distribution of materials, each plant being accessible by rail. The aggregate is supplied from a central plant erected on the south bank of the Salt River at Tempe, and the materials are hauled from this plant by standard-gage equipment to the distributing plants. There is one exception to this general plan on a sub-contract for work south of Phœnix. Here an independent gravel plant has been erected which supplies materials which are transported by motor truck to the one paver on this unit.

The Tempe plant will furnish materials for the entire work, it being the intention to move the set-up from one district distributing point to another as the work in each district is completed. Each district plant is constructed of frames and walls made up in units and held together by bolts, in order that they may be quickly as-

sembled and knocked down. Two district plants have been built to date.

The construction is remarkable for the extent to which machinery and appliances have taken the place of labor. From the time the raw material is scooped from the river bed at Tempe to the time it is laid down on the sub-grade in the form of concrete, it is not touched by hand, nor, more important still, does it



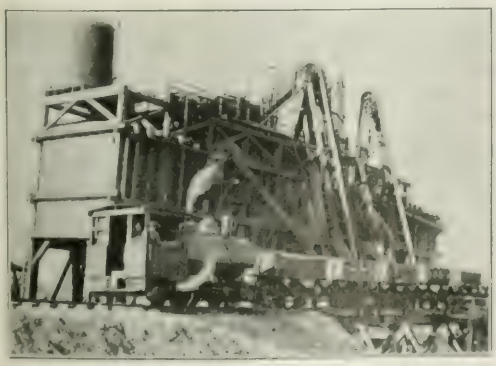
STANDARD SECTION OF 16-FT. CONCRETE ROAD

come in contact with the earth. The result is a clean, pure mix, free from dirt, twigs and other foreign matter.

Central Materials Plant.—At the point where the materials are excavated the bed of the stream is approximately half a mile wide, but the stream itself occupies only a fraction of this area except in rare times of flood. At present and for some time past, the stream has accommodatingly followed the north bank of the river, leaving an area of about 40 acres on the south side to be worked without interruption.

Approximately one mile of track is required to transport the raw material to the crushing plant. The material is excavated by a 70-ton steam shovel with a bucket capacity of 2½ cu.yd. Two shovelfuls constitute a load for one of the dump cars and six of these constitute a train operated by a dinky locomotive.

From the cars the material is dumped onto a grizzly designed to pass rock up to 2½ in. in diameter. The oversize stones fall onto a conveyor which carries them to a gyratory crusher. The crushed material, as well as that which has passed through the grizzly, is then elevated by means of a 60-ft. bucket elevator to the top of the washing tower. Here the material passes through a rotary washer, the oversizes being automatically returned to the crusher. All material under 2¾ in. in size is dropped through to the retaining bins for the rock. The fine materials are then passed through sluice boxes and washed to eliminate silt and débris, which are carried off with waste water through a flume. This leaves nothing but clean wet sand, which is carried by another flume to the sand pile. The sand is well graded from ½ in. down and averages about 1 per cent passing a 200-mesh screen. The vegetable



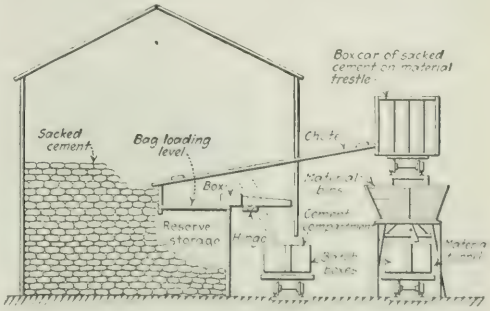
AGGREGATE WASHING AND SCREENING PLANT
1,500 TONS DAILY CAPACITY

content, as determined by colorimetric test, is practically negligible, the solution remaining perfectly clear.

All the equipment described is in duplicate, the material passing through the grizzly being conveyed to either one or both of the two crushers and from there elevated by either one or both of the two elevators, into their respective screens and washing plants. The daily capacity of the plant is 1,500 tons.

Distributing Plants.—From the central plant storage bins, the gravel is loaded by chutes into dump cars of 30-cu.yd. capacity; the sand is loaded by crane and 1½-cu.yd. clamshell. A special engine and crew are assigned to the sand and gravel trains. On an average, two trains of 16 cars each, are handled each day.

Each distributing plant consists of storage accommodations for sand, rock and cement, so arranged as to provide easy loading for the industrial railroad which conveys the material from the distributing plant to the points where the pavers are in operation. The standard-gage tracks are elevated sufficiently to allow

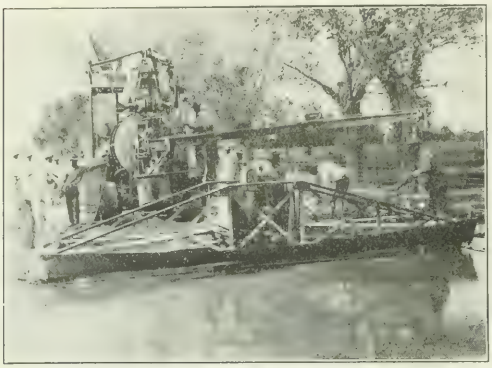


SKETCH SHOWING CEMENT HANDLING BY SACKS

the dumping of the sand and rock into the bunker, 300 ft. in length. This is built with inclined sides, averages 20 ft. in width and is 14 ft. deep. One-third of the bunker is for sand and two-thirds for rock. The practical storage capacity is 500 cu.yd. of sand and 1,000 cu.yd. of rock.

At the beginning of the job cement was shipped in bulk. The cement house is double-ceiled with building paper, is 25 x 80 ft. and has a storage capacity of 25 carloads. The cement was pumped from the cars by a vacuum pump, operated by a 62-hp. motor, either into the storage bin or onto a conveyor, 73 ft. long, which discharged into two double hoppers used for loading the industrial cars. It took approximately three hours to unload a car of bulk cement. There are also storage facilities for cement in sacks to provide for any interruption which may arise in the other method of handling. As a matter of fact the suction unloading method did not prove very satisfactory. The principal difficulty appeared to be the grinding out of the locks, due to the peculiar gritty quality of Western cement, which characteristic was apparently not taken into consideration by the manufacturers of the device.

[After Mr. Rollin's article was put into type a description of the cement-handling plant, as at present installed, was received. This plant is roughly sketched in the accompanying drawing. Cement is shipped in sacks, the cars being spotted on the material trestle so that gravity assists the movement of bags to cement



CONCRETE PAVING MIXER AND FINISHING MACHINE

sheds. The bag-loading level is above the reserve storage and of sufficient height so that a line of boxes, each holding four bags of cement and each having a chute, may be tipped by a man on the ground level and the cement discharged into the batch boxes on the cars. There are 48 of these boxes, sufficient to load two 12-car trains and so spaced that one spotting of the train allows for its entire loading. Reserve-cement storage is that which would be below the charging level, at which point a platform is built. Each box, holding 4 bags of cement, is so balanced that a man on the ground may reach up to the chute at the end of the box and tip it down, discharging the cement into the cement compartment in the batch box.—EDITOR.]

Industrial Railway Haulage.—In loading the industrial trains the cement is loaded first. Each truck carries two batch boxes, with compartments adjusted to provide one part of cement, two of sand and four of rock. The cars are spotted opposite the cement storage and loaded with four bags of cement or one barrel, and when filled the compartment is closed with a metal lid. After a train has been loaded with cement the cars are shunted into the loading tunnels formed by the rows of stanchions supporting the hopper. When properly spotted there is a chute above each car, each equipped with a lever and automatic cut-off.

Twelve cars, each with two batch boxes, and with each box containing 3,300 lb. of material, constitute a train, the total net load being nearly 40 tons. Each train is hauled by a 6-ton gasoline locomotive of the friction drive, four-cylinder type, and is operated by one man.

The entire industrial railroad for two distributing plants consists of 14 miles of track, 216 cars and 14 locomotives. The track is in 15-ft. sections with riveted pressed-steel ties. The shifting is done at night to prevent delay in paving. Seven and a half miles is the limit haul, this being the maximum distance from a distributing plant to the boundary line of that district. In each of the two districts now under construction, there are seven locomotives, each making from three to four trips a day, and from eight to ten trips to each of the pavers is made each day.

Concreting Procedure.—At the pavers, the batch boxes are lifted from the truck of the industrial train by the weight of the descending skip after it has unloaded the preceding batch into the retaining drum of the mixer. After 14 revolutions, or one minute lapsed time, the 18-cu.ft. batch of concrete is dumped into a skip on an 18-ft. boom and worked into place by four spreader men. Following the paver is a road finisher, equipped with a strike-board, tamper and a belt. A lute is sometimes used for the final finish.

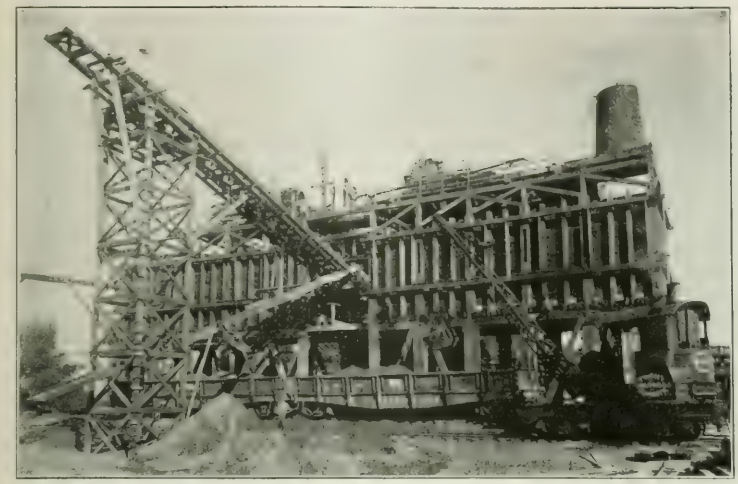
PONDING SYSTEM FOR CURING FINISHED PAVEMENT

As fast as the paving is finished it is covered with canvas, supported on frames made in 20-ft. units and carried on eight flanged wheels using the forms as a track. This covering which is about 150 ft. in length is used to prevent hair cracks and to aid in proper curing. Frost is practically unknown, but to offset this advantage there are a glaring sun, excessive dryness of the atmosphere and extremely high temperatures, all of which contribute to the formation of hair cracks, which are prevented only by taking the utmost precautions in the early stages of setting.

As the sunshade is pushed forward behind the fin-

isher, the surface is kept constantly moist by the spray from a hand nozzle. The next step is to cover the surface with 2 in. of soil and 2 in. of water is kept standing over the dirt for a period of sixteen days, following which the mud is allowed to dry, and is scraped off on the twenty-first day. A view of a ponded stretch is shown herewith.

To provide water for ponding and other operations, a 2-in. water main is laid along the road, sometimes for a distance of 2 miles or more. Sometimes irrigation ditch water is available and sometimes well water is used, but in either instance the water is first analyzed to determine the percentage of alkali, and if more than a trace is found another source has to be located and tested. Six portable gasoline pumps, each with a capacity of 60 gal. per min., furnish the water for the sub-grade, mixers and curing.



LOADING SAND FOR MARICOPA COUNTY ROADS AT CENTRAL PLANT AT TEMPE, ARIZ.

The slab is laid without expansion joints of any sort except those which are put in at the completion of each half-day shift.

Grading Procedure.—The valley is for the most part as flat as a marble slab. There are, therefore, no grades but to offset this the engineers have to plan culverts and bridges for the numerous waterways used for irrigation. As a rule the ditches are graded above the surrounding lands, so that every time one crosses the highway, the latter must be elevated. Otherwise the highway would have to be built on a uniform 4-ft. fill.

This plan was considered and abandoned, because of the additional expense, and because of the fear that the raised highways would act as dams to prevent the free escape of flood waters which occasionally visit certain sections. Except at ditch crossings, no grade is more than 1 per cent.

After the rough grade is established the forms are placed and a 10-ton roller is used to draw a sub-grader. The earth planed off by the blades of the sub-grader is left in two windrows. This material is first used to fill in low spots and the surplus is shoveled outside the forms to be used later to cover the pavement for curing and later to form the shoulders, 4 ft. wide on each side of the 16-ft. and 3 ft. wide on each of the 18-ft. pavements.

In the 32 miles of paving laid to March 12, not a single longitudinal crack has appeared; this is attributed to the heavy-edged cross-section, and to the care exercised in curing the slab and in preparing the subgrade. Excessive subgrade rolling is not permitted. Other factors in the success of the work are clean materials and a dry mix. Just enough water is used in mixing the concrete to form a plastic workable mixture.

Supervision.—Two men are employed to check operations at the central plant at Tempe, and there is also an inspector with each mixer. A resident engineer checks up the subgrade and the forms in each district. In addition to these, the engineering force consists of one chief engineer, one assistant engineer, one office engineer, three draftsmen, and one construction engineer in charge of the testing laboratory, which is completely equipped and where daily tests are made of sand, rock, cement and water as well as corrugated pipe, which in some instances is used in conveying irrigation water beneath the paving. The work is in charge of R. C. Perkins, chief engineer, Maricopa County Highway Commission, Phœnix, Ariz. Most of the equipment, notably that used for the handling of materials, together with the cars, track, batch boxes, pavers, finishers, sub-graders and pumps were furnished by the Lakewood Engineering Co., of Cleveland.

Advancing the Engineering Profession

Sixth, and finally, the ambitious engineer should remember that the individual cannot advance himself much beyond the attainments of his professional brethren. If many engineers are narrow in their views, lack initiative, are weak in executive ability, and poor in English, then the standing of the profession is low in the estimation of educated laymen and of other professional men; and any engineer who strives for a large professional success may be materially handicapped by the reputation of his professional brethren. Here, then, is the need of a real missionary. A missionary is one who conscientiously tries to help others to a higher, more useful, and more noble life. The graduate members of this fraternity should do all within their power to persuade all engineers that the highest success of the individual and the greatest advancement of the profession depends upon the technical knowledge of its members, but also depends to a large degree upon the breadth of view, the initiative, the executive ability, and the capacity of the individual to write and speak clearly and forcefully.—*Ira O. Baker, professor of civil engineering, University of Illinois, before 1921 convention of Triangle Fraternity of Engineers.*

Relation of Union Schedules to Building Operations

By William Joshua Barney
Barney-Ahlers Construction Corporation, New York City

The following discussion of so-called open-shop and union influences in the building industry was contained in a letter written recently by Mr. Barney to the head of a large industrial organization in Buffalo, N. Y.—Editor.

To one like myself who is giving considerable time personally to studying and considering this question of relation between building trades labor and employers, an inquiry like yours of April 13 is of very decided interest. The subject is a very large one to be covered by letter.

I note that you state the position, natural under present economic conditions, of the manufacturer towards organized labor. There is however, an essential difference in the relations between labor employed in the building trades and labor employed in the ordinary manufacturing process. You manufacturers have a decided advantage inasmuch as under normal conditions you are dealing with a more or less constant personnel, permitting direct relations between yourself and your employees on the theory that a decidedly large portion of those participating from the labor side will be in your employ for a number of years, and more or less steadily.

Many of your employees doubtless own homes in the neighborhood of your plant and, through local interest and pride in the company, can be directly appealed to and dealt with through employees' committees, through welfare work, through bonus systems, etc. and with whom in a strict business sense, wages can be talked over, as it were, between man and man. On the other hand, in the building trades a contractor employs mechanics only for the brief period of a building operation—and seldom the same group of mechanics. It is true that some of our largest construction companies, especially during the recent busy period of war and post-war construction, were able to keep a certain number of their carpenters, bricklayers and other mechanics steadily employed. The fact remains however, that the spirit of the relations between the contractor and his employees is not based on the theory of constant employment of the same personnel.

Value of Union Contracts

Consequently, in order to take care of this ever-shifting labor personnel, and to agree upon terms and conditions of employment as well as rates of wages, it is unquestionably a convenience and necessity to the building contractor to have labor organized into separate groups of its own and speaking through authoritative representatives with whom agreements covering a period of time can be made. Otherwise it would be practically impossible for any contractor to undertake a lump-sum piece of work extending over a long period of time.

Frankly, I believe that it would be impossible for any contractor to have even the appearance of working under "open shop" on any work of magnitude, except under peculiar local conditions such as theoretically are supposed to exist in Buffalo. For example, here in New York at present, work is scarce; and, undoubtedly, mechanics would be willing to work at rates of wages considerably lower than those now officially prevailing. On the other hand, as soon as the house-building season starts, as it will soon with low-priced houses, the mason and carpenter will be very extensively employed; and, under an open-shop arrangement, wages would immediately jump. *In 1919 in some cases on so-called independent or open-shop work, they rose to a rate of $15 and $20 per day.* How could an industrial or large-sized contractor exist under such conditions as that! Only on the undesirable "cost-plus-percentage" basis.

Dual Responsibility

I hold no brief for the unreasonable exaction of labor as to working conditions and wages; and, with other employers here in contracting, am doing my best to obtain correction of the many abuses that crept in during the unusual conditions of the war and post-war periods. Nor, on the other hand, have I great sympathy with the attitude of some employers who seem to think that "now that we have them in a corner, give them hell, boys." In other words, I think these undesirable extremes in the relations between employer and employee are apt to result from extreme economic conditions, and I believe that the firm business basis of a stabilized building industry can come only from an intermediate and consistent course of reasonable agreement between employers and employees, and I think the greater responsibility for moderation rests with employer, for obvious reasons.

We operated in Buffalo last year under the so-called open-shop conditions; but to all practical purposes, they might as well have been union conditions as exist in New York. Frankly, it would have been far more satisfactory both from the standpoint of estimating the cost of our work and of carrying it out, as we could draw from no personnel or long-established group of employees.

Now as to the wage rates themselves, in most cities agreements expire either on April 1 or May 1. Desiring to reduce the cost of building operations and to secure greater efficiency, many employers' associations, at the sacrifice of their business prospects this year, have entered into an attempt to compel labor to take a reduction in wages. Where these attempts are based upon moderation and with a reasonable relation to the reduction of the cost of living and changed conditions, they will undoubtedly be successful without much friction and will result in lower building costs without strikes and their consequent expenses. In some places however, employers have endeavored to obtain 25 or 30 per cent cuts, which, in my opinion, can only result in a long and costly trouble during this summer with the inevitable compromise at the end.

Labor Rates and Cost

In New York City the building trade agreements expire on Jan. 1, 1922. So there will be little, if any possibility of a change in the *rate* in the building trades locally, as the employers cannot afford to lose the moral advantage they have always had in the fact that they have never broken their agreement. As you can readily imagine, labor will hardly be coming forward voluntarily to suggest cuts even though for its ultimate benefit, through the consequent stimulation of building. I, as well as other large builders, recognize the necessity for reducing the cost of building as rapidly as

possible to stimulate building operations; but on the other hand, this cannot be done in a radical or "Bolshevik" manner without laying the foundation for much future trouble over a long period.

Now as to the *cost* of labor. There has been a very startling reduction in the cost of labor in building operations. Not only have the incompetent, unambitious and unskilled mechanics of the war period gradually disappeared through the keener competition for places, but the skilled mechanics now working are very anxious to keep their jobs and consequently are producing "a hundred cents on the dollar." Today, work can be organized along the lines of highest efficiency, planned with complete mechanical equipment, and with the knowledge that the labor organization, from the foreman down, will be working zealously, anxiously, and keenly for the interest of the contractor and the owner in order to reduce cost and time of building operation. There are very few of the trades, in this respect, that do not realize the war is over. Possibly in one or two of the minor building divisions where there still exists a scarcity of the particular skilled labor required, there remain traces of the post-war inefficiency; but they are so slight as hardly to affect the large reduction of costs in other directions.

Moreover, the enormous bonuses for over-time work, the excessive transportation costs in order to get your materials through on time, the absolute undependability in quality and workmanship of manufactured materials, have very largely, if not entirely, disappeared, at least in this section of the country.

Return Water Pumped 300 Feet To Serve Utah Irrigation Project

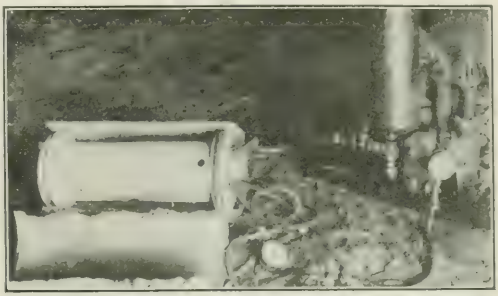
The Bonneville Irrigation District is now building works in Davis County, Utah, to supply water to 4,860 acres. The water is diverted from the Jordan River just north of Salt Lake City and consists of the return water from seepage and waste from lands higher up on the river which would otherwise flow unused into Great Salt Lake. A pumping plant is being installed to lift the water to two levels, 150 and 300 ft., respectively, above the source of supply. When another 5,000 acres are included in the district the development cost will be approximately $70 per acre, it is claimed, which is said to be much lower than that of gravity system in the vicinity. The development is to be finished about July 1, in time to deliver water for this season's crops.

The pumping station, located near a 44,000-volt transmission line, contains four pumping units, each direct connected to a 2,300-volt motor. The motors used on the 300-ft. head are rated at 1,200 hp. and 700 hp., respectively, while those on the 150-ft. head are 600 hp. and 350 hp., respectively. The pumps are all single-stage, double-suction centrifugals having 20-in. and 15-in. discharges delivering 25 and 15 sec-ft., respectively. The pumps on the 300-ft. lift are connected in series.

The operation, maintenance, depreciation and amortization charges for the first 20 years are estimated at about $10 per acre-foot of water required, or an average of $23 per acre of land now in the district. After this period the bonds issued for the construction of the pumping plant will have been retired and the charges are to be reduced to about half the initial rate.

Device for Testing Sections of Concrete Pipe

A DEVICE has been developed by the California Association of Cement Pipe Manufacturers with which hydrostatic tests can be made on single sections of concrete pipe without the use of false ends and tie-rods. After several modifications of the original, the form described in the following has been adopted as standard and the same design is used for various pipe diameters.



DEVICE FOR HYDROSTATIC TEST OF CONCRETE PIPE

The device consists chiefly of two aluminum clyinders, fitting one inside the other, and both of which have flanged ends. A tubular gasket made of rubber fits between the inner and outer flanges at each end of the cylinder. The outer flanges can be adjusted so as to fit tightly against the inside shell of the pipe, and after this has been done the rubber tubes are inflated with water pressure. The tubes are similar to inner tubes for automobile tires and are supplied by a separate hose from the pump. By forcing water into the tubes they are tightened against the concrete, and then water is admitted to the main pressure chamber, or space between the outer aluminum cylinder and the inner face of the concrete pipe. The pressure in the tubular gaskets and in the main pressure chamber can be supplied from the same source and increased at the same rate after they have separately been brought up to about 50 lb. Beyond this point the pressure in the main chamber is sufficient to hold the gaskets against the outer flanges.

Water pressure is ordinarily supplied by some form of hand pump, two gages are used, one to register the pressure of water in the rubber gasket, at the start of the test, and another on the supply line to the main pressure chamber. This main pressure gage is connected by rubber tubing to a small hole seen in the accompanying illustration to the left and below the opening which admits the water. This illustration shows a 10-in. testing device in a pipe section which has been broken by internal water pressure.

Pressures up to 260 lb. per square inch have been used with an 8-in. testing device of this design, although about 150 lb. per square inch is considered the safe limit for apparatus now in use. Improvements in the apparatus which are now under consideration are expected to raise the safe limit to a higher figure.

The foregoing was compiled from information supplied by F. W. Stanley, engineer for the California Associated Concrete Pipe Manufacturers.

Labor Hours Per Output Unit In Building Construction

Tables Showing Time Required To Accomplish a Unit of Carpenter Work, Masonry, Excavation, Painting, Plastering and Sheet Metal Work

By Frank E. Barnes
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It is a well-established fact that one of the greatest difficulties which building contractors have to face is to estimate with reasonable accuracy the amount of labor necessary to install various kinds of building material. Yet this knowledge is essential in order to figure correctly the cost of construction. There has been an increasing demand for reliable information of this nature. The accompanying tables are presented in the hope that they may be of assistance to estimators and others engaged in contracting. They are the result of painstaking research and the data from which they were derived were furnished by successful contractors of wide experience. No data were used that seemed in any way to include inconsistencies.

The information was required to establish unit prices as of 1914 for use in the valuation of some 30,000 buildings, constructed between 1880 and 1918, located throughout the northeastern part of the United States including such large cities as Boston, New York, Cleveland, Cincinnati, Chicago and St. Louis. In all of the unit prices required, the amount and cost of material and the cost of labor per hour could be established from existing records. There had to be determined, however, the number of labor hours. Therefore, a comprehensive questionnaire was prepared and sent to leading contractors throughout the section of the country where the buildings were located, asking for the amount of material that could be installed per day in each of the various classes of carpentry and masonry work entering into building construction. These returns were then tabulated and compared. Where any inconsistencies were found, they were returned to those who had furnished the information for review and revision. If apparent inconsistencies could not be entirely cleared up, the whole data would be rejected. After a very thorough and exhaustive study and comparison had been made and all errors eliminated, the average of the resulting figures was used in preparing the tables.

Some contractors, by thorough and careful supervision, get more work from a gang of men than do others. On rough work, such as heavy factory construction or large buildings, men can install more material per day than they can on private residences or small buildings. Differences such as these cannot be taken into consideration in tables of this kind. Unusual conditions should be taken care of by the estimator in preparing his unit prices.

It should also be stated that these tables were prepared for labor showing the efficiency that was common before the World War and on the assumption that proper supervision was exercised to secure the best results. They would not apply to the grade of labor that prevailed during 1919 and 1920, nor to the inferior labor that is sometimes secured in country districts and small towns.

Carpenter Work—The percentage of waste shown in Table I was figured on the assumption that ½ in. is used in the width of boards for squaring of edges and ⅛ in. for matching and that an additional 10 per cent of waste is required for cutting, sorting, etc. The tables can be used to figure the cost of the carpenter labor only, or the cost of the carpenter and common labor used in conjunction with the carpenter work. To illustrate: If twelve carpenters are used on a job with three common laborers, the carpenters receiving 75c. per hour and the common laborers 40c., the price of one carpenter should be added to one-fourth of the

TABLE I. CARPENTER WORK

Kind of Work	Per Cent of Waste	No. of Hours per M.B.F.	Cost at ....c. per Hour
Nov. drop sid. 5½ in. to W	25	17.6	....
Clapboards 4½ in. to W	46	17.8	....
Board and batten siding	10	17.3	....
6-in. wall sh. str. SIS2E	19	12.6	....
6-in. wall sh. diag. SIS2E	24	15.3	....
6-in. under fl. str. SIS2E	19	10.9	....
6-in. under fl. diag. SIS2E	24	12.9	....
Roof sh. str. 1x6 rough	10	12.7	....
Roof sh. str. 1x6 D. & M.	25	12.8	....
2-in. fl. plk. on joist, SIS2E	16	6.9	....
3-in. fl. plk. on joist, SIS2E	16	5.2	....
Fin. fl. on und. fl. 13/16x2¼	43	21.7	....
Fin. fl. on und. fl. 13/16x3¼	33	20.3	....
Fin. fl. on und. fl. 1 1/16x3¼	33	16.2	....
Fin. fl. on joist 13/16x2¼	43	22.4	....
Fin. fl. on joist 13/16x3¼	33	21.0	....
Fin. fl. on joist 1 1/16x3¼	33	17.5	....
Wall and ceil. sh. 1x3 D. & M.	43	21.7	....

TABLE II. CARPENTER WORK

Kind of Work	Unit of Work	No. of Hours	Cost at ....c. per Hour
Nov. drop sid. 5½ in. to W	100 S.F.	2.2	....
Clapboards 4½ in. to W	100 S.F.	2.6	....
Board and batten siding	100 S.F.	1.9	....
Wall sh. str. 1x6 in. SIS2E	100 S.F.	1.5	....
Wall Sh. diag. 1x6 in. SIS2E	100 S.F.	1.9	....
Under fl. str. 1x6 in. SIS2E	100 S.F.	1.3	....
Under fl. diag. 1x6 in. SIS2E	100 S.F.	1.6	....
Roof sh. str. 1x6 in. rough	100 S.F.	1.4	....
Roof sh. str. 1x6 in. D. & M.	100 S.F.	1.6	....
2-in. fl. plk. on joist, SIS2E	100 S.F.	1.6	....
3-in. fl. plk. joist, SIS2E	100 S.F.	1.8	....
Fin. fl. on und. fl. 13/16x2¼ in	100 S.F.	3.1	....
Fin. fl. on und. fl. 13/16x3¼ in	100 S.F.	2.7	....
Fin. fl. on und fl. 1 1/16x3¼	100 S.F.	2.7	....
Fin. fl. on jois 13/16x2¼	100 S.F.	3.2	....
Fin. fl. on joist 13/16x3¼	100 S.F.	2.8	....
Fin. fl. on joist 1 1/16x3¼ in	100 S.F.	2.9	....
1x3 in. side wall and ceil. sh.	100 S.F.	3.1	....
Wood shingles	100 S.F.	3.1	....
Asbestos shingles	100 S.F.	3.4	....
Slate roof	100 S.F.	2.9	....
Prepared roofing	100 S.F.	1.5	....

TABLE III. CARPENTER WORK

Kind of Work	Unit of Work	No. of Hours	Cost at ....c per Hour
Box fr. wind., incl. frame	Each	4.3	....
Pl. frame wind., incl. frame	Each	3.1	....
Hinged door, incl. frame	Each	5.0	....
Hinged door and trans., incl. frame	Each	6.1	....
Sliding door, incl. frame	Each	8.1	....
Sliding door and trans., incl. frame	Each	9.7	....
Grounds in frame building	100 L.F.	2.5	....
Grounds in masonry building	100 L.F.	3.6	....
One member base board	100 L.F.	4.5	....
Two member base board	100 L.F.	6.2	....
Chair rail	100 L.F.	4.1	....
Picture molding	100 L.F.	3.4	....
Mold. top of wainscot	100 L.F.	3.7	....
Mortised and tenoned framing	1,000 F.B.M.	21.4	....
Studding	1,000 F.B.M.	17.9	....
Floor and ceiling joists	1,000 F.B.M.	15.4	....
Rafters for gable roofs	1,000 F.B.M.	21.1	....
Rafters for hip and val. roofs	1,000 F.B.M.	26.5	
Floor sleepers in sand	1,000 F.B.M.	22.7	
Floor sleepers in conc.	1,000 F.B.M.	26.8	
Roof trusses 20 to 40 ft. sp.	1,000 F.B.M.	32.3	
Cornice ordinary plain	1,000 F.B.M.	37.9	
Wood lath	M	5.7	

rate of common labor or 10c., making a total of 85c. per hour. It is possible to include the carpenter foreman also if this seems desirable. For instance, if the foreman received $10 a day and the payroll of the carpenters and common laborers under him is $100 a day, then an additional 10 per cent should be added, 8½c., making 93½c. per hour as the entire cost of carpenter labor together with helpers and foreman, which, multiplied by the number of hours shown in the table, will give the cost of installing the various kinds of material specified.

Masonry Work—In figuring the masonry work the following general assumptions were made: That seven

TABLE IV. MASONRY WORK

Kind of Work	Unit of Work	No. of Hour	Cost at c per Hour
3-in. hol. tile part	100 S.F.	3.0	
4-in. hol. tile part	100 S.F.	3.1	
2-in. wall furring	100 S.F.	3.0	
24-in. brook tile	100 S.F.	2.6	
8-in. hol. tile in ext. walls	100 S.F.	4.4	
16-in. found. walls strk. jnts	1M brick	5.6	
16-in. factory walls, no pilas	1M brick	6.7	
16-in. wall, pilas, cornices, etc	1M brick	8.2	
12-in. factory walls, no pilas	1M brick	8.2	
8-in. factory walls, no pilas	1M brick	10.2	
12-in. wall, pilas, cornices, etc.	1M brick	9.3	
8-in. wall, pilas, cornices, etc	1M brick	12.0	
8 and 12-in. backing stone ashler	1M brick	7.6	
8 and 12-in. backing face brick	1M brick	7.8	
Face brick clipped bond	1M brick	17.5	
Face brick Flemish bond	1M brick	21.0	

brick should be figured for each superficial foot of wall 4 in. or one course thick; fourteen for two courses, twenty-one for three courses, etc., and that in figuring outs all openings should be figured full size, corners taken but once, and pilasters, corbles, etc., figured their exact size. In estimating wall and book tile, the net area should be figured. In case, however, of inches in the length or width of a wall, the next foot should be taken, and in estimating the area of openings, inches in dimensions of width or height should be omitted.

For filling in the cost column in Table IV, the rate per hour is intended to cover not only the cost of mason labor, but also that of hod carriers. When an equal number of each are used on a job, the rate per hour for masons should be added to the rate per hour for hod carriers and the combined figure used. If, however, more or fewer hod carriers are used than of masons, then a corresponding percentage should be added to or subtracted from the rate paid hod carriers before adding it to the mason's rate. For example, if masons are paid 80c. and hod carriers 40c. per hour and 10 per cent more hod carriers are used than masons, we would add 80c. to 40c. + 10 per cent of 40 or 44c., giving a total of $1.24 as the combined figure. In case it is desired to include the mason foreman, it can be done in the same manner as described for the carpenter foreman.

Excavation and Sheet Piling—The information for Table V was prepared by the same method and the same degree of carefulness exercised as in the tables for carpenter and mason work. It is for work done by the pick and shovel method only. The first column specifies briefly the kind of work, but any other excavation which is done by the pick and shovel method can be included by putting it under the heading most nearly fitting the conditions.

Each kind of work is figured for three kinds of soil: The first, "Light Loam or Sand," is intended to include any soil that can be shoveled with little or no picking. The second, "Heavy Loam or Medium Clay," includes soils that are easily loosened by pick and handled by shovels without much difficulty; while the third, "Hardpan or Cemented Gravel," includes those that are loosened by difficult picking or are of such a sticky nature that the shoveling is slow and expensive.

The work is again divided for conditions of soil, whether wet or dry. All soils are considered dry when it is not necessary to do considerable pumping and bailing, or to sheet pile, to keep out the water. The column "Team Haul" is intended to include a man and team. Where the haul is for distance greater than 500 ft., the cost can be figured on the assumption that a dump wagon holds 1½ cu.yd. and that a team will walk on an average of two miles per hour. Therefore, the time required to haul 1 cu.yd. one mile would be 0.67 hr., or for each additional 1,000 ft. haul, would be 0.125 hr.

The cost of sheet piling for cellars and trenches is for average work and the hours specified are for one carpenter, but on the assumption that two or more carpenters work together where more than one man is needed to do the work economically. The amount of lumber specified for sheet piling is on the assumption that 2-in. plank will be used and that 1 in. additional per square foot will be required for string pieces, bracing, etc. It is also assumed that the lumber is used twice. If, for any reason, it can be used only once, then the amount of lumber shown in the table should be doubled, and if used more than twice, a corresponding reduction can be made.

The cost of the work has not been carried out as the price of labor and material varies so much for different sections of the country.

TABLE V. EXCAVATION AND SHEET PILING
(Pick and Shovel Method)

Kind of Work	Kind of Soil (1) Dry (2) Wet		Hours per Cu.Yd. —Common Labor— Digging	Dumping	Total	Team Haul Under 500 Ft.
Cellars not over 8 ft. deep, loading to dump wagons	1	Light loam or sand	0.92		0.92	0.25
		Heavy lm. or med. clay	1.55		1.55	0.25
		Hardpan or cem. grav.	2.18		2.18	0.25
	2	Light loam or sand	1.50		1.50	0.25
		Heavy lm. or med. clay	2.40		2.40	0.25
		Hardpan or cem. grav.	3.43		3.43	0.25
Cellars not over 8 ft. deep, wheeling not over 100 ft.	1	Light loam or sand	1.60		1.60	
		Heavy lm. or med. clay	2.11		2.11	
		Hardpan or cem. grav.	2.96		2.96	
	2	Light loam or sand	2.11		2.11	
		Heavy lm. or med. clay	2.86		2.86	
		Hardpan or cem. grav.	4.21		4.21	
Trenches not over 6 ft. deep, throwing to one side	1	Light loam or sand	1.19	0.79	1.98	
		Heavy lm. or med. clay	1.63	0.83	2.46	
		Hardpan or cem. grav.	2.58	1.00	3.58	
	2	Light loam or sand	1.54	0.79	2.33	
		Heavy lm. or med. clay	2.16	0.83	2.99	
		Hardpan or cem. grav.	3.64	1.00	4.64	
Trenches not over 10 ft. deep, throwing to one side	1	Light loam or sand	1.40	0.79	2.19	
		Heavy lm. or med. clay	2.22	0.83	3.05	
		Hardpan or cem. grav.	3.64	1.00	4.64	
	2	Light loam or sand	2.38	0.79	3.17	
		Heavy lm. or med. clay	2.86	0.83	3.69	
		Hardpan or cem. grav.	5.00	1.00	6.00	
Trenches not over 14 ft. deep, throwing to one side	1	Light loam or sand	2.81	0.79	3.60	
		Heavy lm. or med. clay	3.53	0.83	4.36	
		Hardpan or cem. grav.	5.56	1.00	6.56	
	2	Light loam or sand	3.80	0.79	4.59	
		Heavy lm. or med. clay	4.44	0.83	5.27	
		Hardpan or cem. grav.	7.27	1.00	8.27	

SHEET PILING FOR CELLAR AND TRENCH EXCAVATION

Kind of Work	Lumber Work	Hours Carp.	Hours Help.
Cellars not over 8 ft. deep	100	4.00	
Trenches not over 6 ft. deep	100	3.00	3.00
Trenches not over 10 ft. deep	100	3.00	4.00

TABLE VI. PAINTING

Surface	Kind of Paint	Number of Coats	Material per Unit Work	Hours per Unit Work
Plastered walls and ceilings	Varnish size, gal.	1	0 17	0 45
Plastered walls and ceilings	Lead and oil, gal.	2	0 45	1 05
Plastered walls and ceilings	Glue size, lb.	1	0 17	0 25
Plastered walls and ceilings	Kalsomine, lb.	1	5 50	0 35
Plastered walls and ceilings	White-wash, lb.	2	4 00	0 67
Brick walls	White-wash, lb	2	6 00	0 67
Brick walls	Cold water paint, lb.	2	10 00	0 57
Brick walls	Lead and oil, gal.	2	1 45	1 13
Floors, wood	Linseed oil, gal.	2	0 37	0 83
Floors, wood	Filler, lb.	1	2 00	0 67
Floors, wood	Varnish, gal.	2	0 47	1.17
Interior woodwork	Filler, lb.	1	2 00	1 25
Interior woodwork	Shellac and putty, gal.	1	0 35	0 85
Interior woodwork	Varnish, gal	2	0 45	1.90
Interior woodwork	Rub and finish, gal.	1	0 10	1 17
Interior woodwork	Lead and oil, gal.	3	0.70	2.37
Exterior woodwork	Shellac and putty, gal.	1	0 35	0 85
Exterior woodwork	Varnish, gal	2	0 42	1.83
Exterior woodwork	Lead and oil, gal.	3	0.72	2.77
Single door with transom	Filler, lb.	1	1 50	1 45
Single door with transom	Shellac and putty, gal.	1	0 20	1 00
Single door with transom	Sandpaper and varnish, gal.	2	0 50	2 25
Single door with transom	Rub and finish, gal.	1	0 10	1.25
Single door without transom	Filler, lb.	1	1.25	1 20
Single door without transom	Shellac and putty, gal.	1	0 13	0 85
Single door without transom	Sandpaper and varnish, gal.	2	0 40	1 60
Single door without transom	Rub and finish, gal.	1	0 08	0.85
Single window	Filler, lb.	1	0 50	0 45
Single window	Shellac and putty, gal.	1	0 09	0.20
Single window	Sandpaper and varnish, gal	2	0 20	0 70
Single window	Rub and finish, gal.	1	0 05	0 33
Single window	Lead and oil, gal.	3	0.26	1 08
Shingles	Stain, gal	1	3 00	0 50
Picture mould or chair rail	Filler, lb.	1	1 00	0.30
Picture mould or chair rail	Varnish, gal.	2	0 25	0 82
Base board	Filler, lb.	1	2 00	0.75
Base board	Varnish, gal.	2	0.75	2 25
Base board	Lead and oil, gal.	3	0.70	3 00
Picture mould or chair rail	Lead and oil, gal.	3	0 23	1 00
Iron stairs and railing	Lead and oil, gal.	3		13 50
Gutters and leaders	Lead and oil, gal.	3		5 00
Sheet metal roof	Lead and oil, gal.	3		0 62

NOTE.—Unit of work: 1 to 19,100 sq ft ; 20 to 32 each, 34 to 39, 100 lin ft ; stairs per flight, shingles per M.; roof per 100 sq.ft.; gutters per 100 lin.ft.

Painting—Table VI is compiled from information furnished by a number of painting contractors who are thoroughly competent and have for many years been doing painting work in connection with all grades of building construction. No attempt has been made to carry out actual costs for labor and material as the prices that would fit conditions today might be worthless in the course of a few months. In regard to overhead and profit, if this work is to be done by a subcontractor, there should be added at least 25 per cent to the cost of labor and material to cover his overhead and profit.

Sheet Metal Work—Table VII was prepared in the same manner as Table VI. Ten per cent has been added to material for waste in standing seam work, and five per cent for flat work for both side sheathing and roofs. Seventeen and one-half per cent has been added for corrugated iron and steel to take care of laps, cutting waste, etc. The table shows the amount of material and the number of hours required both for shop and field labor. Prices of material and labor will vary according to local conditions. At least thirty per cent should be added to the cost of labor and material to take care of overhead and profit for the sub-contractor, and in some cases it is claimed by sheet-metal workers that their overhead is fully thirty per cent and that ten per cent more should be added for profit.

Furring and Lathing—Table VIII, in the column "Spacing of Supports," for the first eleven lines, shows the spacing of furring, while lines 12 to 21 inclusive, show the spacing of wood studs or joists. The column for furring cost, in the first eleven lines, gives the weight of furring material, including the necessary

TABLE VII. SHEET METAL WORK

Kind of Material and Gage	Wood or Steel	Wt. Lb. per Sq.Ft.	Wt. 100 S.F. Fin. Work, Lb.	Hours to Lay One Sq. with Man and Helper
Plain steel No. 28		0 638	67 0	3 2
Black iron No. 28		0 625	65 6	3.2
Plain: Galv. steel No. 28	Wood	0 798	83 8	3.2
Galv. steel No. 26	Wood	0 925	97 1	3 2
Galv. steel No. 24	Wood	1 180	123 9	3 2
Galv. steel No. 20	Wood	1 690	177 4	4 0
Plain: Galv. iron No. 28	Wood	0.785	82 4	3 2
Galv. iron No. 26	Wood	0 910	95 6	3 2
Galv. iron No. 24	Wood	1 160	121.8	3 2
Galv. iron No. 22	Wood	1 410	148 0	3 5
Galv. iron No. 20	Wood	1 660	174 3	4 0
2½ in. Corr.: Galv. steel No. 28	Wood	0.870	102.2	3 2
Galv. steel No. 26	Wood	1 009	118.6	3 2
Galv. steel No. 24	Wood	1 287	151 2	3 2
Galv. steel No. 20	Wood	1 843	216.6	4 0
2½ in. Corr.: Galv. steel No. 28	Steel	0 870	102 2	4 0
Galv. steel No. 26	Steel	1 009	118 6	4 0
Galv. steel No. 24	Steel	1 287	151 2	4 0
Galv. steel No. 20	Steel	1 843	216 6	4.5
1¼ in. Corr.: Galv. steel No. 28	Wood	0 895	105 2	3 2
Galv. steel No. 26	Wood	1 037	121 8	3 2
Galv. steel No. 24	Wood	1 323	155 5	3.2
1¼ in. Corr.: Galv. steel No. 28	Steel	0 895	105 2	4 0
Galv. steel No. 26	Steel	1 037	121 8	4 0
Galv. steel No. 24	Steel	1 323	155 5	4.0
2½ in. Corr.: Galv. iron No. 26	Wood	0 992	116 6	3 2
Galv. iron No. 24	Wood	1 265	148 6	3 2
Galv. iron No. 22	Wood	1 538	180 7	4 0
Galv. iron No. 20	Wood	1 810	212 7	4 0
2½ in. Corr.: Galv. iron No. 26	Steel	0 992	116 6	4 0
Galv. iron No. 24	Steel	1 265	148 6	4 0
Galv. iron No. 22	Steel	1.538	180 7	4 5
Galv. iron No. 20	Steel	1 810	212 7	4 5
1¼ in. Corr.: Galv. iron No. 28	Wood	0 880	103 4	3 2
Galv. iron No. 26	Wood	1 020	119 8	3 2
Galv. iron No. 24	Wood	1 300	152 8	3 2
1¼ in. Corr.: Galv. iron No. 28	Steel	0 880	103 4	4 0
Galv. iron No. 26	Steel	1 020	119 8	4 0
Galv. iron No. 24	Steel	1 300	152 8	4 0

Kind of Material	Unit	Wt. Lb. per Unit of Fin. Work	With Man and Helper Hours Req. One Unit of Shop Labor	Hours Req. One Unit of Field Labor
16-Oz. Copper				
Batten seam roof	100 S.F.	110	1 7	3.2
Standing seam roof	100 S.F.	110	1 7	2 5
Flat steam roof	100 S.F.	105	2 3	3.6
Wall covering	100 S.F.	105	1 1	4 0
Plain casings	100 S.F.	105	1.1	5.3
20-in. flashings	100 Lin. Ft	175	0 6	4 0
36-in. box gutter linings	100 Lin. Ft	315	6 9	24 0
Mouldings 24-in. girt	100 Lin. Ft	210	6 9	8 0
Mouldings 30-in. girt	100 Lin. Ft	262	8 6	10 7
Mouldings 36-in. girt	100 Lin. Ft	315	10 3	10 7
Mouldings 42-in. girt	100 Lin. Ft	368	12.0	16.0
Mouldings 48-in. girt	100 Lin. Ft	420	13 7	16 0
Leaders 4x5 in.	100 Lin. Ft	166	5.7	8 0
Leaders 4x4 in.	100 Lin. Ft	150	5 7	8 0
Leaders 3x4 in.	100 Lin. Ft	125	5 7	8 0
Leaders 2½x3 in.	100 Lin. Ft	100	5 7	8.0
Leader heads	1	5	2 3	1 6
IC 40-Lb. Tin				
Batten seam roof	100 S.F.	70	1 7	3 2
Standing seam roof	100 S.F.	70	1 7	2 5
Flat seam roof	100 S.F.	68	2.3	3 6
36-in. box gutter linings	100 Lin. Ft	204	6 9	24 0
20-in. flashings	100 Lin. Ft	113	0.6	4 0
No. 22 Galvanized Iron				
Mouldings 24-in. girt	100 Lin. Ft	296	6 9	8 0
Mouldings 30-in. girt	100 Lin. Ft	370	8 6	10 7
Mouldings 36-in. girt	100 Lin. Ft	444	10 3	10 7
Mouldings 42-in. girt	100 Lin. Ft	518	12 0	16 0
Mouldings 48-in. girt	100 Lin. Ft	592	13 7	16 0
Plain casings	Sq	148	1 1	5 3
Leader heads	1	5	2 3	1 6
No. 26 Galvanized Iron				
Leaders 4x5 in. or 6-in. diameter	100 L.F.	152	5.7	8 0
Leaders 4x4 in. or 5-in. diameter	100 L.F.	137	5 7	8 0
Leaders 3x4 in. or 4-in. diameter	100 L.F.	114	5.7	8.0
Leaders 2½x3 in. or 3-in. diameter	100 L.F.	91	5.7	8 0

TABLE VIII. FURRING AND LATHING

Item No.	Class of Work Furring and Lathing	Kind of Material	Spacing of Supports, In.	Time Required to Install One Sq Yd Hrs.	Furring Material In Lb. per Sq Yd	Lath, Sq.Yd
1	Beams and girders	1x3/16 in. bar iron and metal lath	12	0 80	7 1	1.05
2	Beams and girders	1x3/16-in bar iron and metal lath	16	0 66	5.7	1.05
3	Metal partitions	1x1x1/4-in angles and metal lath	12	0 42	8 5	1.05
4	Metal partitions	1x1x1/4 in angles and metal lath	16	0 32	6 8	1.05
5	Heavy cornice and false beam	1x3/16-in bar iron and metal lath	12	1 00	7 1	1.05
6	Semicircular or segmental ceilings	1x3/16-in. bar iron and metal lath	12	1 00	7 1	1.05
7	Groined arches, domes, etc	1x3/16-in. bar iron and metal lath	12	1 78	11 7	1.25
8	Ceilings, furring clipped to beams	1-in. channels and metal lath	12	0 25	9 4	1.05
9	Ceilings, furring clipped to beams	1-in. channels and metal lath	16	0 20	7 2	1.05
10	Hung ceilings, including purlins, clips, etc	1-in. channels and metal lath	12	0 33	12 8	1 05
11	Hung ceilings, including purlins, clips, etc	1-in. channels and metal lath	16	0 26	10 2	1.05
	Metal Lath					
12	Ceilings and partitions stapled on wood	Metal lath and staples	12	0 12	0 05	1.05
13	Ceilings and partitions stapled on wood	Metal lath and staples	16	0 09	0 05	1 05
14	Coves and cornices stapled on wood	Metal lath and staples	12	0 22	0 05	1.05
15	Coves and cornices stapled on wood	Metal lath and staples	16	0 18	0 05	1 05
16	Beams and girders stapled on wood	Metal lath and staples	12	0 22	0 05	1.05
17	Beams and girders stapled on wood	Metal lath and staples	16	0 18	0 05	1 05
	Wood Lath				Nails	No
18	Partitions and ceilings	Wood lath and nails	12	0 11	0 10	14 5
19	Partitions and ceilings	Wood lath and nails	16	0 08	0 10	14 5
20	Coves and cornices	Wood lath and nails	12	0 22	0 14	14 5
21	Coves and cornices	Wood lath and nails	16	0 17	0 11	14 5

tieing wire and for lines 12 to 21, the weight of staples or nails per yard of lath. Five per cent has been added to metal lath to take are of cutting waste, etc. If the work is done by a sub-contractor, from twenty to twenty-five per cent should be added for overhead and profit.

Plastering—Table IX shows the amount of material and labor for one coat of various kinds of plaster work as specified in column 2. The assumed thickness is given in column 3. This thickness, of course, will vary due to the kind of metal lath, spacing of wood lath, the irregularity of the wall, etc. The amount of material as given in column 5, except for the finished coats, will vary somewhat where a different thickness is used than that specified. The same applies to the labor. In case of very irregular walls, open lath, etc., the time shown would be somewhat increased. The table, however, is intended to take care of average work. If the work is done by a sub-contractor, at least twenty per cent to the cost of labor and material should be added for overhead and profit. No blanks have been provided for carrying out the cost of labor and material, as it is thought that anyone using this table would probably draw it off on other paper. In which case, they could easily arrange for the necessary blank spaces. It will also be necessary to combine the scratch coat, brown coat and finish when plastering on lath, and brown coat and finish when plastering on masonry, in order to make a complete cost of plastering.

TABLE IX. PLASTERING

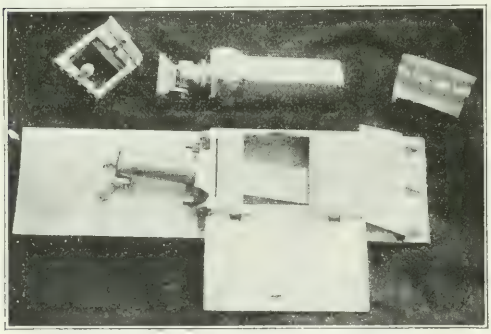
Kind of Coat	Thickness	Kind of Material	Material, per Sq.Yd.	Labor per Sq.Yd.
Scratch (1-2) on wood lath	3/4	Lump lime and hair, bbl.	0.0204	.....
		Sand, cu yd	0 0108	0.0519
Scratch (1-2) on wood lath	3/4	Neat plaster, ton	0 0068	.....
		Sand, cu yd	0 0108	0 0519
Scratch (1-2) on metal lath	3/4	Lump lime and hair, bbl.	0 0323	.....
		Sand, cu yd	0 0143	0.0571
Scratch (1-2) on metal lath	3/4	Neat plaster, ton	0 0091	.....
		Sand, cu yd	0 0143	0.0571
Brown (1-3)	3/4	Lump lime and hair, bbl	0.0278	.....
		Sand, cu yd	0 0111	0 1231
Brown (1-3)	3/4	Neat plaster ton	0 0050	.....
		Sand, cu yd	0 0111	0.1231
Finish—smooth—sand		Lump lime, bbl	0 0086	.....
		Plaster Paris, ton	0 0012	0.1067
		White sand, cu.yd	0 0003	.....
Finish—smooth—sand		Hydrated lime, ton.	0 0016	.....
		Plaster Paris, ton	0 0012	0.1067
		White sand, cu.yd	0 0003	.....
Finish—smooth		Lump lime, bbl	0 0083	.....
		Plaster Paris, ton	0 0017	0 1000
Finish—smooth		Finishing lime, ton	0 0016	.....
		Plaster Paris, ton	0 0017	0 1000
Finish (1-3) sanded		Lump lime, bbl	0 0066	.....
		White sand, cu yd	0 0091	0.1333
Finish (1-3) sanded		Hydrated lime, ton	0 0012	.....
		White sand, cu.yd	0 0091	0 1333
Scratch (1-1-5) Keene cement on metal lath	3/4	Keene cement, ton	0 0062	.....
		Hydrated lime, ton.	0 0062	0.0615
		Sand, cu yd	0 0154	.....
Brown (1-1-7) Keene cement		Hair, ton	0 0100	.....
		Keene cement, ton	0 0032	.....
		Hydrated lime, ton	0 0032	0.1333
		Sand, cu yd	0 0149	.....
Finish—Keene cement (300 lb. K. C. 100 lb lime)		Keene cement, ton	0 0043	.....
		Finishing lime, ton	0 0009	0.1455
Brown—P. C. (1-4-20% lime) on brick	3/4	Portland cement, bbl	0 0222	.....
		Sand, cu yd	0 0118	0 1600
		Hydrated lime, ton	0 0025	
Brown—P. C. (1-3-10% lime) on terra cotta	3/4	Portland cement, bbl	0 0455	
		Sand, cu yd	0 0182	0 1600
Brown—P. C. (1-4-20% lime) on terra cotta	3/4	Hydrated lime, ton	0 0021	.....
		Portland cement, bbl	0 0333	.....
		Sand, cu yd	0 0177	0 1600
		Hydrated lime, ton	0 0018	
Finish—P. C. (1-3-10% lime)	1/4	Portland cement, bbl	0 0156	
		Sand, cu yd	0 0061	0 1333
		Finishing lime, ton	0 0007	.....
Stucco (1-1-2) pebble-dash		White P. C. bbl	0 0500	.....
		White sand, cu yd	0 0667	0 3200
		Gravel, cu yd	0.0143	.....

Authorize Higher Working Stresses in Steel Framework of New Buffalo Hotel

By vote of the city commission of Buffalo the use of working stresses of 18,000 lb. per square inch has been authorized for the steel framework of the new Statler Hotel in that city. As the structure was originally designed by George B. Post & Son of New York City, architects for the owner, the Buffalo building code was followed literally, the beams being designed for an extreme fiber stress of 16,000 lb. per square inch and the columns for a flat unit stress of 12,000 lb. per square inch, as allowed by the code for columns shorter than 90 radii. The steel frames so designed involved about 8,000 tons of steel. E. M. Statler, the owner, thereupon made application to the city commission that the code be suspended for this particular building and working stresses one-eighth higher be sanctioned for the design. The request was made with the approval of W. J. Thomas, structural engineer to the architect, and was endorsed by the building code revision committee of Buffalo. This committee's recommendation was subsequently adopted by the city commission. The steel framework has therefore been redesigned for beam stresses of 18,000 lb. per square inch and a column loading of 13,500 lb. per square inch, instead of 1,600 lb. and 12,000 lb.

Pivoted Jacks to Prevent Rotation of Tunnel Shields

TO ELIMINATE difficulties in shield tunneling from rotating of the shield a new jack arrangement has been developed by W. B. Updegraff, of the Watson-Stillman Co., New York and patented. It is now ready for practical application in that company's shield-jack equipments. Hitherto no satisfactory means have been available to the engineer engaged in driving a tunnel through soft ground by the shield method for dealing with the tendency manifested by many shields to rotate around the longitudinal axis as the tunnel is driven ahead. Since working platforms, doors and other internal structures of the shield are thrown out of level by the rotation, the tunneling operations are made noticeably more difficult, expensive and dangerous. With an elliptical section of tunnel, rotation would, of course, be wholly unpermissible, and the chance that it might occur has been urged as an effective reason against the adoption of such a section when proposed as a means of improving the clearance or strength conditions of tunnels. The new arrangement is exceedingly simple, consisting of nothing more than mounting the jacks in such a way that they can be adjusted in a tangential plane through 10 or 15 deg. either side of the front-to-back erection. When a jack is thus "angled," it will



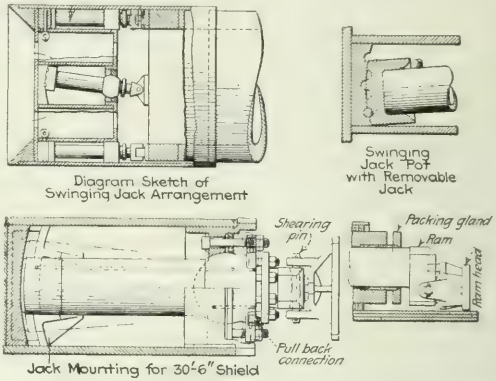
MODEL OF PIVOTED JACK, ASSEMBLED AND UNASSEMBLED

obviously exert a rotative moment on the shield as it is operated to force the shield ahead.

One or all the jacks of a shield so equipped may be angled, in different amounts, and the rotative forces thus adjusted to suit the requirements of the moment. By proper manipulation, moreover, it is possible to use the jacks to exert a vertical force (lifting or depressing) on the nose of the shield; or a lateral force to right or left, to help in guiding the shield. However, the primary function of the pivoted-jack is to deal with rotation.

A diagram sketch of the pivoted-jack arrangement is shown in the upper part of the drawing, which represents a sectional plan view of a shield with the lower jack set at an angle. There is a pivotal mounting at the rear end of the jack, and a circular-arc block bearing at the front, with provision by registering notches and a locking pin for setting the jack at various angles along the arc. The detail sketch at the right shows a separate jack pot which constitutes the shoe of the swinging part, the jack being set into the pot as a separate member, for removal, repair, or replacement.

Adaptation of the design to a working scale is shown in the lower part of the drawing, taken from a working drawing of the jack mounting for a shield of 30 ft. 6 in. diameter. This shield is to be equipped with 31 jacks, each of 36-in. stroke and 216 tons capacity. In this design the arc block is detailed with



PIVOTED JACK MOUNTING AS DESIGNED FOR 30-FT. SHIELD

lateral wings to form the jack pot, and the jack merely butts against the cylindrical face of this block, without locking arrangement. Two bolts, which hold the head of the jack in its spherical socket, control its angular setting and hold it in position. By removing these two bolts the jack may be pulled out for inspection or repair. Felt packing between the main socket plate and its cover plate prevents the entrance of dirt or grout into the jack compartment, and the head of the jack with its bolts, etc., may be protected by clay mudding.

An important element of the design is the selfadjusting bearing shoe at the outer end of the ram. The shoe swings on the ball end of the ram, and is held by a pin whose seating hole in the jack head is slotted to taper form to permit the head to swing in a plane tangential to the tunnel while yet resisting the twist that would develop as a result of the offset between the shoe and the ram center, when the jack is operated at an angle.

Work Begun on Calcutta Dock

Work has begun on the King George's dock in Calcutta, India, according to recent issue of *Commerce Reports*. Owing to the nature of the soil, it is proposed to construct both entrances and the dock itself by sinking wells or monoliths. The first section of the work will consist of the entrance lock and dry docks and the northern portion, comprising altogether 11 berths, arrangement being made to use the first 5 of these as soon as they are ready, probably by 1927. It is estimated that each year's work will involve the utilization of large quantities of brick, lime, cement, steel, and stone, and that 13,250,000 cu.ft. of excavating will be done, employing some 10,000 laborers. The dock system will consist of a basin and two long arms, each about 4,500 ft. long by 650 ft. wide. When complete the water area of the dock will be about 190 acres, the length of the quay wall about 25,000 ft., and the number of berths 35. The two dry docks will measure in all 1,190 x 80 ft. Thirty-three of the berths will be equipped as import or export berths.

Unified Terminal Operation Held Essential to Economy

Abstract of paper by George H. Kimball, consulting engineer, Pontiac, Mich., read before Buffalo Section, Am. Soc. C. E. April 5, 1921.

UNIFIED operation of all terminal facilities, a general classification and clearing yard, exterior connecting lines for diverting through freight movements, and local yards, for holding city and industrial freight ready for delivery, must finally control the terminal situation in any great city if industrial growth is to go on unchecked and service be performed with economy and dispatch. Any discussion of the subject must be largely general since its ramifications reach out into details varying with circumstances. Present conditions are a discredit to all concerned, but the railroad service holds the engineering and operating ability to work the necessary transformation. We have come to a time of forced readjustment in railroad affairs, when to stand still is impossible, even though our future course is far from clear, but the great need today is for an increase of capacity together with more prompt movement and greater economy.

Line Movement Slowed Down

The terminal problem has emerged following the growth in tonnage density which has doubled about every ten years. Under these conditions, the *line movement* slowed down in spite of the rapid increase in the capacities of cars and locomotives and the reconstruction of tracks and structures, so that the proportionate capacity from increased facilities was not fully realized. Since the steam locomotive, speaking broadly, has reached its limits of economy and efficiency and imposes limitations on the whole operating system, electrification may be considered the only ultimate solution of present railroad difficulties. Electrification of terminals will naturally come last, but the requisites of economical terminal operation apply either with steam or electricity. If we propose to pour at least twice the present volume of tonnage through these terminal "bottle necks," the whole operating system, at least so far as train movements and things related thereto are concerned, must be modified to secure the full benefits of possible economies. There is no doubt at this time that these possibilities are very great. I feel sure that this problem will have to be met before we can fully prepare for it.

As a result of a year's investigation of the Buffalo freight terminal situation in 1904, four things were found to be necessary as prime factors to make possible the solution of the problem or any other similar terminal problem: Unification of all terminals and terminal facilities as to operation, but not necessarily as to ownership; provision for a general classification and clearing yard of proper location and conformation; connecting exterior lines for the purpose of diverting all through freight movements around the congested areas, and local outer yards for city and for industrial freight. Within the Buffalo terminal area lie a crowded network of main lines and freight yards, with frequent crossings at grade, forming a congested area wherein economy or efficiency under present methods and conditions is impossible. The facilities of each corporate ownership are operated as a unit in spite of their interrelation under heavy volume of interchange business. Independent switching involves both duplication of facilities in track, equipment and service, with overlapping and delay at many critical points.

The principle of unification was held to include, in addition to the plan of unified operation under one management, freedom of access to all terminal territory, thus placing all railroads and all shippers on an equal footing so far as charges for the same or similar service were concerned. The intent being that shippers located on the rails of any one railroad should be free to receive and forward freight via any railroad route they might choose. So far as possible to determine, these principles were then formulated for the first time.

The Cost of Wasteful Competition

The chief difficulty in the way of a better order of things is in the unwillingness of the railroad corporations to co-operate for the common good by making unification possible. Past practices of refusing through rates and through bills, etc., have been stopped generally through legislation. So will unification in the operation of terminals come about. Unified terminal operation was put in practice during the period of Federal control, and in spite of the handicap at that time, noticeable results were produced. Since the return to private operation, however, terminal methods have sagged back to the old order of things. Still the problem presses everywhere, and is a sink-hole of expense, limiting business and industry in every city and port of the country.

Unified operation permits close co-ordination of facilities and service, and the use of the best possible methods. It prevents overlapping and interference in switching movements, and also reverse and duplicate movements. The general clearing yard must be so located that practically all of the freight traffic to be handled can pass through it, combining receiving, classification and forwarding facilities with large capacity for gravity switching, and for engine and car repairs. The situation will be further helped by the complete classification of traffic as to *trains*, as well as a more complete classification of the trains themselves.

In Extent Terminal Is Adequate

With the co-ordination of these facilities must come modification and re-arrangement of all other details and methods. Present track facilities within the congested limit of the city of Buffalo are doubtless more than sufficient in their *extent* for present and future needs, but they must be rearranged and modified as to use. It may be anticipated that extensive terminal trackage and large areas of valuable property now in use in railroad service will be released for other purposes or will be held for future expansion. Freight stations can be brought up to date by building double-deck freight houses, by the use of electric trucks with trailers, and the further use of appliances for mechanical handling which have proven their value but lack general application.

The question of store-door delivery of city freight is now under consideration by the railroad executives, with prospect of its adoption. There is no good reason why city house-freight arriving during the night and early morning should not be off the floor and in the hands of consignees at an early morning hour, or be sent to storage on consignees' account. The growing use of containers is also a valuable factor.

Notes on English Bituminous Road Practice

Slag Preferred for Tar Macadam—One-Coat and Three-Coat Systems Employed—Asphaltic Macadam Surface Increasing in Favor

By A. Dryland
County Engineer of Middlesex, England

THE most approved form of tar-macadam construction used in England today is undoubtedly that in which blast-furnace iron slag is used as an aggregate. For some years a controversy was carried on as to the relative virtues of granite and slab for the purpose, but there would be few found today who would deny the superiority of slag both in wearing and waterproofing capacity.

Among granites most success was attained with those generally deemed of a second- or third-rate character as road metals. The reason is probably to be found in the fact that the harder and denser the stone, the less the porosity. The difficulty chiefly found with granite was to combine sufficient matrix to produce a waterproof coating without making it so susceptible to summer heat as to allow of movement in the material.

Blast-furnace slag, however, contains a large number of small pin-holes and slight honeycomb indentations which in practice seem to give it just that porosity necessary to retain tar in the ideal quantity. The individual pieces of aggregate often vary in density and hardness, and a considerable amount of crushing takes place, resulting in the coating forming a dense cake. With granite aggregates, on the other hand, the individual stones do not crush and bind together in the same way, but tend to move and rub off the tar coating.

Slag Tar-Macadam

Slag tar-macadam is made by admixture with refined tar when the material is quite dry. Various makers have their own particular grades of tar, but the author has found refined tar meeting the requirements of English Road Board specification No. 1 quite satisfactory. The quantity of matrix varies from about 9 gal. per ton of aggregate of the coarsest grades to 11-12 gal. for the fine material used for topping.

There are two methods of laying mainly used in this country: The first—more particularly used to produce coats not more than 3 in. in consolidated thickness—is by laying a mixed gage material running from 2¼ in. down to ⅜ in. gage, of which about 60 per cent is 2¼ in. This is laid in one coat with, perhaps, the addition of a light sweeping of ⅜-in. tarred material to fill interstices before completing rolling.

The three-coat system is usually adopted for 4-in. consolidated coatings on heavy traffic roads. A base coat of 2¼-in. gage is laid to a consolidated thickness of 2½ in.; upon this is spread a layer of 1½- to ½-in. graded material rolled down to about 1¼ in., and thereupon, before consolidation is perfect, is laid a thin layer of ⅜- or ½-in. material.

Coatings so constructed have had to date a life of 9½ years with trifling repairs, except an annual summer dressing of tar and chippings on important arteries, such as the Brighton and Portsmouth roads adjoining the London boundaries.

In the secondary streets of the metropolis and, indeed, on some of those of the first class, and on many important town streets and heavily trafficked arterial routes, the bituminous or asphalt macadam form of road surface is finding increasing favor. The usual practice is to lay a base coat of tar-macadam or asphalt-macadam, varying from 2¼ to 3 in. when consolidated according to the nature of the highway, and imposing thereon 1¼ or 1½ in. of asphalt.

The base coat is generally made of either granite or limestone, 1½ down to ⅜ in. gage, but in many cases the old waterbound macadam surface is taken off the road to a depth of about 3 in., and the material is passed through a drier combined with a fan to extract the very fine dust. Apart from this dust the whole of the material is retained for use and, as the author can testify, produces a very satisfactory base coat when heated and mixed with a pitch matrix composed of about 82 per cent Road Board specification soft pitch and 18 per cent heavy tar oils.

With clean granite or limestone aggregates refined tar is sometimes used as a matrix, but this involves delay in executing work, as the tar-macadam requires 7 to 10 days to get thoroughly hard. This method is only pursued where speedy opening to traffic is not a necessity.

For the heaviest class of work about 6 per cent asphalt-cement binder is used and has the advantage, which is also attained by the pitch matrix before referred to, of allowing the immediate superimposition of an asphalt coating.

The English practice which has the greater vogue for surface coating is composed of Trinidad bitumen and graded sands laid to a consolidated thickness of 1¼ or 1½ in. to the following specification:

Trinidad bitumen epuré, 75 per cent; heavy petroleum residuum oil, 25 per cent; penetration at 77 deg. F., 55 to 65, according to location and extent of traffic.

Soluble bitumen content, 67 per cent; mineral matter, 28 per cent; specific gravity, 1.27.

Sand aggregate, free from clayey matter and giving about 20 per cent passing 80 and 100 meshes combined, and not more than 10 per cent passing meshes below 40. Intermediate meshes are not considered very important.

Filler, 15 per cent of portland cement or other equally fine inert material.

Proportion, 7.3 cu.ft. graded sand; 120 lb. portland cement; 150 lb. asphalt cement, penetration say 60 at 77 deg. F.

TYPICAL ANALYSIS

	Per Cent
Bitumen soluble in CS 2	12
Aggregate passing 200 mesh	16
Aggregate passing 100 mesh	12
Aggregate passing 80 mesh	10
Aggregate passing 50 mesh	40
Aggregate passing 40 mesh	4
Aggregate passing 30 mesh	3
Aggregate passing 20 mesh	2
Aggregate passing 10 mesh	1
	100

The surfaces produced by the foregoing methods are very durable in this variable climate and the maintenance for the first 10 years is very small. The only objectionable feature is a tendency to "rippling" or small corrugations which the author believes to be

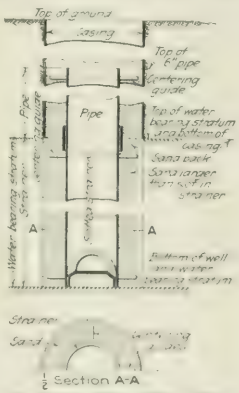
largely due to the plasticity of the material in its early life and to temperature changes. This corrugation does not appear to increase materially with age or to cause undue wear or deterioration, but it is, nevertheless, an annoying feature to the experienced observer and is, in some cases, sufficiently marked to be apparent to a traveler in a small or light car. If our American friends can tell us how to exorcise this "ghost" they will earn our lasting gratitude.

Deep Wells with Packed Strainers to Exclude Sand

By F. D. Yeaton
Assistant Engineer, Chicago, Milwaukee & St. Paul Ry., Chicago, Ill.

DRILLED wells so constructed that they will not become partly filled with sand have been used with success by the Chicago, Milwaukee & St. Paul Ry., and are of importance for the reason that railroads and municipalities experience considerable trouble each year with bored or drilled wells partially filling with fine sand. The flow into the well is diminished, and if the sand is very fine it is drawn up by the pumping machinery, damaging the working barrel, causing wear of the pump leathers and reducing the efficiency of the pump.

It is common practice to clean out sand filled wells periodically, but to do this the pumping machinery must be removed. If the well is shallow the sand can sometimes be blown out with compressed air. For deeper wells it is necessary to use a sand bucket or other means for bailing out the sand, which is a slow and expensive process and may cause damage if there is a brass strainer or screen in the well.



PACKED STRAINER FOR DEEP WELL

For sand-proof construction, the well is drilled and cased to the bottom of the water-bearing stratum. A strainer with closed bottom, the diameter of which is about half that of the casing and the length of which is equal to the depth of the water-bearing stratum, is then lowered by means of a line of pipe which may be of the same diameter as the strainer, or smaller. The strainer is held in place by centering guides and a coupling at the top enables the pipe to be detached after the strainer is set.

The space between the strainer and casing is then packed with sand of larger size than the slots or openings in the strainer, after which the casing is pulled back to the top of the water-bearing stratum. Sometimes it is advisable to leave a short length of pipe attached to the top of the strainer, as shown in the drawing, and the drop pipe of the pump can be inserted into this pipe to advantage. Trouble in raising the casing of a well more than 200 or 300 ft. deep may be avoided by the use of a temporary inside casing which is removed after the strainer and packing have been placed.

When the work is finished the well is developed by pumping at different rates, slowly at first. This accelerated pull or draft will remove any fine sand that might have lodged near the strainer and will bring the stratum around the well to a stable condition, offering free passage to the water. Theoretically each grain of fine sand removed from the water-bearing stratum has been replaced with a grain of sand larger than the slots in the strainer. This coarse wall or filter holds back the fine sand, preventing the breaking down of the water-bearing stratum and the possible failure of the well. A large diameter is advisable, but a 12-in. well with 6-in. strainer will give good results.

In one case a 265-ft. 12-in. well provided with a 6-in. sand-packed strainer 20 ft. high, with No. 14 screen, yields 250 gal. per minute, although several earlier wells without sand-packed strainers furnished only 75 gal. when drilled and later became filled with sand so that their capacity was reduced to about 40 gal. per minute.

This method of placing a sand or gravel filter around a strainer is not new and is mentioned in Flinn, Weston & Bogart's *"Waterworks Handbook."* (p. 239). More care in the finishing of the well in the water-bearing stratum would save the expense of cleaning out sand, replacing damaged strainers and maintaining worn pumping machinery.

Broad Powers for Sacramento City Engineer

Under the new commission-manager city charter for Sacramento, Cal., that will go into effect on July 1, the city engineer has broader powers, or at least powers much more specifically defined than is usually the case. Before citing these it may be mentioned that the charter provides that the city engineer "shall be a civil engineer of not less than five years' practical experience as such." His powers and duties are thus defined.

Sec. 61. The city engineer shall be ex officio superintendent of streets. He shall have charge of the planning, opening, construction, paving, maintenance and repair of streets, boulevards, alleys and public ways. He shall have supervision over the sewers and sewage system, the crematory, the corporation yard, the cleaning and sprinkling of streets and the levees of the city. He shall have charge of the city water-works and mains and of any filtration plant operated by the city. He shall have charge of the construction, maintenance, repair and operation of all public buildings belonging to or used by the city, all wharves, docks, chutes, ships, quays and waterfront property, of the construction and maintenance of fire and police alarm systems, of all buildings and automobile mechanics and machinists in the employ of the city and the enforcement of all rules and regulations pertaining thereto, of the inspection of all electric wires for furnishing heat, light or power, and of the wiring of all buildings hereafter erected in the city and of the inspection of buildings and the issuing of permits for building operation in accordance with the rules and regulations which may be prescribed by ordinance. He shall also perform such other duties relating to his department as may be required of him by the city manager.

In addition to the foregoing powers and duties of the city engineer, the Sacramento charter specifically provides that he "shall cause to be made a full and complete set of water system records consisting of maps, plats, notes, and other records of the city water pipe system," specifying further details as to what the records shall include. Further duties of the city engineer, subject to the approval of the city manager, will be "to furnish to any department of the city such service, labor and materials as may be requisitioned by the head of such department."

Concrete Sea Wall Poured in Block Sections by Tremie

Position of Suction Pipes for United Electric Plant on East River Makes Special Formwork Necessary All Concreting Plant on Traveler

IN BUILDING the new steam power plant of the United Electric Light & Power Co., on the East River at 138th St., New York City, a departure from the usual design is found in the use of individual suction pipes for each generating unit, instead of a single suction tunnel. The position of these suction pipes—the ends of which extend well into the water at low tide—in the discharge tunnel bulkhead, extending as they do through the bulkhead at an approximate angle of 49 deg. from the horizontal, lead the contractors, the P. J. Carlin Construction Co., to devise a system of pouring the bulkhead, or sea wall, in sections, three distinct operations being necessary to complete it. The position of the discharge pipes in the inside wall of the tunnel also made special formwork necessary, though

FIG. 1. LOWERING OF BLOCK FORMS—ONE BLOCK IN PLACE

the spectacular work was done in concreting the sea wall. On the sea wall the method followed comprised the pouring of block sections between suction pipes first, then pouring closure sections to the full wall height leaving only space enough for setting the pipes, and concreting by hand around and above the pipes.

The new plant is to have an ultimate capacity of 280,000 kw., though the initial installation is to be half this. It comprises a turbine room that runs parallel to the river front an approximate distance of 370 ft., its line of columns on the front face resting on the sea wall. Behind the turbine room is a boiler house of the same length, these two buildings, built practically as a unit, having a width of 320 ft., and a height of 120 ft. The initial installation of generating equipment will consist of two 35,000-kw., 25-cycle, three-phase, 11,400-volt turbo-generators, and two 35,000-kw., 60-cycle, three-phase, 13,200-volt turbo-generators. The steam end of the 25-cycle units will be of single-cylinder type, while the 60-cycle units will have tandem compound reaction turbines. Separated from the boiler house by a narrow passageway are being constructed the electrical galleries—a reinforced-concrete building of seven stories with outside dimensions of 105 ft. and 112 ft. A wharf in front of the sea wall, and coal and ash

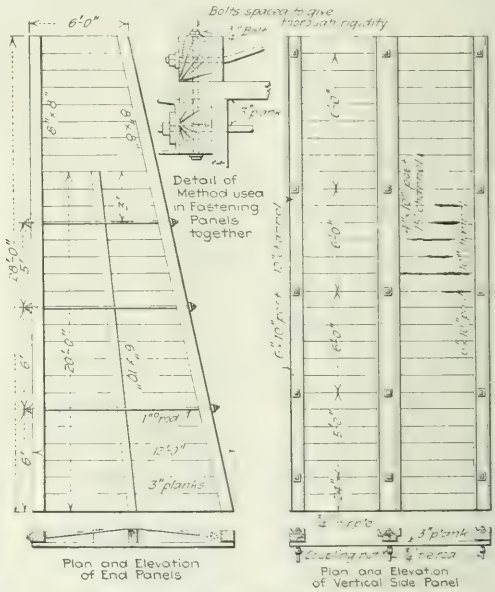


FIG. 2. DETAILS OF SPECIAL FORM CONSTRUCTION

handling and other mechanical equipment will complete the installation.

The site of the entire turbine room was practically all under water and to obtain the most economical results the work was designed in such a manner as to minimize the amount of concrete to be poured under water. The plan consisted in building a sea wall along the easterly building line of the turbine room parallel to the river, and return walls on the north and south building lines, extending inshore where the high water line reached solid rock bottom. All these walls were parts of the completed structure. On account of the openings in the discharge tunnel these walls could not be made continuous, and where the breaks occurred construction gates made of timber had to be inserted in slots left to receive them.

The sea wall, as is indicated in Fig. 5, forms part of the outside wall of the discharge tunnel. It has a top width of 6 ft. and a bottom width of 12 ft. From its outside face to the tunnel center line is 21 ft. 9 in.—the tunnel having a width of 11 ft. 6 in.—and to the center line of the discharge pipes 32 ft. 3 in. The tunnel is constructed with each end open to the river.

At the site of the sea wall before dredging, there was an average depth of 10 ft. of water at low tide. In

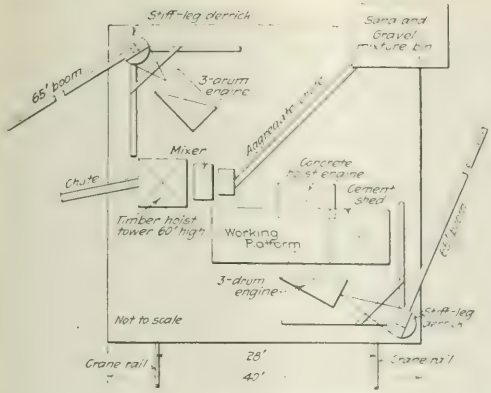


FIG. 3. PLAN OF TRAVELER

order to secure a solid rock foundation for the wall, it was necessary to dredge a depth of from 12½ ft. to 17½ ft. The character of the material dredged was Manhattan schist. Considerable drilling and blasting was also necessary, being done from a drill boat, holes being charged from the drill boat through a casing. The cleaning of the bottom was done from a scow equipped with an 8-in. suction pump and a 3-in. jet pump. The material pump was handled by a derrick directed by a diver who also operated the jet pump, moving the fine material toward the suction, and loosening the material generally. Boulders and other material too heavy for the suction, were raised in buckets.

After the dredging had been done, the block forms, which had been constructed simultaneously with the preparation of the foundation, were lowered into place. The block forms, as shown in Fig. 2, were built essentially as follows: The end panels, 6 ft. wide at the top and 12 ft. wide at the bottom, were built first. They were made of 3-in. planks, with an 8 x 8-in. post extending at either side of the panel the full wall height—28 ft. Midway between the side posts was placed a 6 x 10-in. timber extending from the bottom of the panel upward 20 ft. This timber was fastened with its 6-in. face against the planking, and over it and through the side posts were run three ¾-in. iron rods, trussing the panel to give it adequate stiffness. The rods were spaced 6 ft. apart, the first being 6 ft. from the bottom of the panel, The side panels were also built of 3-in. planks, 6 x 10-in. timbers being placed flat at the sides with a 4 x 10-in. timber at the center. Ten-inch channels were secured to the side timbers and a 15-in. channel to the center timber to give additional stiffness and to add weight to the form so that it would sink easily. End and side panels were bolted together through the side timbers of the respective panels.

In order to make the entire form rigid, ¾-in. nipples were passed through the channels and threaded into coupling nuts on the inside of the form. To these coupling nuts were threaded ¾-in. tie rods set into the forms 5 ft., 6 ft., 6 ft., and 8 ft. apart, respectively, beginning at the bottom of the form, the first rods being 2 ft. from the bottom. In stripping the forms the tie rods with the coupling nuts necessarily remained in the wall. The block sections were set on 42-ft. centers for almost the entire length of the wall—400 ft. The intake pipes were sixteen in number set in pairs on 13-ft. centers, giving a distance of 42 ft. between the centers of each two pair of pipes.

After the dredging and some cleaning had been done, the block forms were lowered into place and braced to the traveler trestle. As the river bed was not level, the forms were trued up after lowering and continuous 2-in. planks were nailed to the bottom of the form on the inside so that the ends of the planks followed the contour of the river bed. With the form thus sealed bags of a sand and gravel mixture were lowered to divers who placed them on the outside of the forms to seal the bottom and secure the planking which patched the bottom of the form. Bags were generally placed well above what patching work was necessary.

FIG. 4. SETTING THE CLOSURE FORMS

The block forms were then filled with concrete with a tremie.

In order that concreting might be done on any section of the wall as desired, the entire concreting plant was set on a traveler operating over a 28-ft. gage track which was sustained by a 12-in. timber trestle with bents on 12-ft. centers. This traveler, as shown in Fig. 3 was 40 ft. square. On opposite corners were placed stiff-leg derricks, each with a 65-ft. boom and each operated by a three-drum engine. On the front of the traveler was placed the concrete hoist tower, guyed to the traveler, and 60 ft. in height. The mixer was directly behind the hoist tower and aggregate was chuted to the mixer from an overhung material bin on one of the rear corners of the traveler. Over one of the derrick engines was built a platform that supported a cement shed. Behind the mixer was the hoist engine.

The tremie was supported from the end of the front derrick booms by heavy cables. The traveler was placed so that the distance from the derrick to the outer face of the sea wall was about 45 ft. Cables from another boom supported the two 30-ft. sections of chuting extending from the hoist-tower toward the tremie. The chuting was in two 30-ft. and one 10-ft. length, the

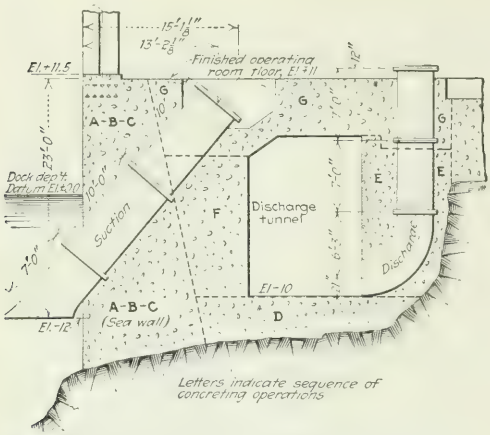


FIG. 5. CROSS-SECTION OF TUNNEL AND SEA WALL SHOWING SEQUENCE OF CONCRETING OPERATIONS

10-ft. length resting with its outer end on the tremie hopper platform. The other derrick was used for the transference of materials from stock piles to the traveler.

The tremie pipe was spiral riveted with a ½-in. plate 12 in. high riveted to the end to give it sufficient stiffness. It was 12-in., inside diameter, and was secured at its top by a cast-iron flange to a hopper made of No. 8-gage sheet iron. The hopper flared from this flange on a 45-deg. angle to a 4-ft. square 3 ft. high. Around the mouth of this hopper was built a wooden platform with a hand rail for the use of workmen. The platform was fastened to the tremie with 3½ x 3½-in. angles. The capacity of this hopper was approximately 2 cu.yd. above the tremie pipe.

In concreting, the work was started with the bottom of the tremie resting on rock. Concrete was then chuted from the tower down the tremie until the hopper contained about 1½ cu.yd. of material. The tremie was then raised slightly, the signal to raise and lower being given by a system of red and blue lights showing in the derrick engine room and running to a double knife switch on the hopper platform. Successful concreting required that concrete always be kept in the tremie hopper. Concrete used was of a 1:2:4 mix, the aggregate being dredged gravel—screened, proportioned, and mixed before being barged to the site. After all the block sections had been poured the forms were stripped permitting the closure sections to be put in while the blocks were installed farther along the wall. There were 30,000 cu.yd. of concrete in the wall and tunnel, and 25,000 cu.yd. of rock were taken from the site.

As there was a clear span of 29 ft. 3 in. between blocks, the forms for the closure sections were built in two 16-ft. sections, the overlap serving as a guide in fitting the closure forms over the blocks already poured. These forms were built up in much the same manner as were the block forms, 6 x 10-in. timbers being used at either side of the panels, with 4 x 10-in. timbers and 15-in. channels in the center of the panels. The same system of tying the panels together was employed as in the construction of the block forms. The two 16-ft. sections were bolted together in place by divers. Inasmuch as the closure sections were particularly heavy, they were generally built up on stringers extending from the shore to the block sections. The derrick had then only to tip them into place.

The cast-iron intake pipes were set in the wall at an approximate angle of 49 deg. from the horizontal. They are in three sections, of 7, 10 and 10 ft. respectively, of an inside diameter of 54 in. and a thickness of 1½ in. The position of the flanges made concreting additionally difficult.

After the pipes were set in the wall and braced, the spaces between the pipes and the concrete were filled by divers in the following manner. Braces were set vertically to hold 1-in. sheathing cut to fit around the pipes and cover the opening. After the boards had been placed

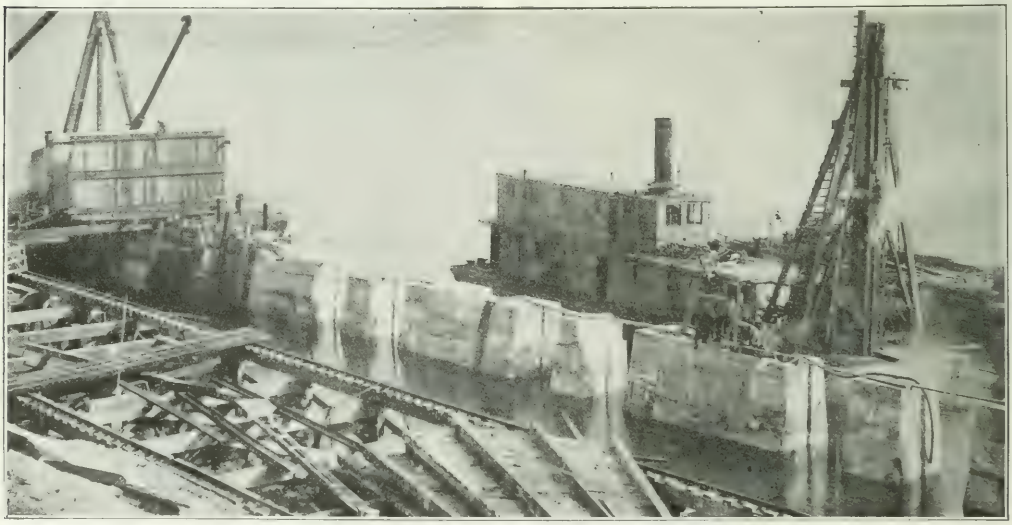


FIG. 6. CLOSURE SECTIONS OF CONCRETE SEA WALL IN PLACE

FIG. 7. WALL AND TUNNEL FLOOR COMPLETE

and wedged securely, the diver emptied into the space bags of concrete of a stiff mix. This hand method of pouring was carried on until the concrete was above the water line. As the bottom of the intake pipes was about 12 ft. below mean low water (—12), and the range of tide is about 7 ft. at the site, most of the concreting that formed the third operation to complete the wall was done by the hand method. The finished elevation of the wall was generally +11, variation being made where column grillages for the superstructure were to be placed.

After the sea wall had been poured entirely, the bulkhead gates at either end were inserted. These gates were built of heavy timbers strengthened by posts and channels, and were set as snugly as possible into the channel guides in the sea wall and the retaining walls on shore. The joints between the bulkhead gates and channel guides were then caulked. With a 10-in. electric pump the water was pumped from behind the sea wall, no leaks whatever being found in the wall.

After the area behind the sea wall had been excavated to solid rock, a slab of concrete was put in to an elevation of —10, forming the floor of the discharge tunnel and the foundation of the outside tunnel wall. The next concreting operation was on the shore wall of the tunnel through which the discharge pipes ran. One discharge pipe was placed at either end of the tunnel wall, seven pairs being set between the end pipes, a clear span of 26 ft. being the distance between each two pairs of pipes. The concreting work on the shore wall of the discharge tunnel was done much in the same manner as that on the sea wall. Sections between each two pairs of discharge pipes were poured first. The two lower sections of the discharge pipes were then set in place, and the third, or top, section of the discharge pipe, was bolted on to the pipe which was already in place.

The third concreting operation on the discharge tunnel itself was carrying the sea wall side of the tunnel wall up the full height of the tunnel. The concrete slab over the tunnel and both walls was then poured to its full thickness and width. The sequence of operations in pouring is shown in Fig. 6, which also furnishes a typical cross-section of the completed tunnel. The position of the intake pipe made it necessary to bevel the discharge tunnel roof. The wall was started Nov. 1, 1920, and finished Jan. 1, 1921.

The P. J. Carlin Construction Company has the contract for the construction of the sea wall and discharge tunnel. Post & McCord are the contractors for the structural steel and the U. S. Structural Company for the superstructure. Thomas E. Murray, Inc., are the engineers for the design and construction of the entire plant. E. A. Herrick is the general superintendent for the contractor and S. Kent is the contractor's engineer on the job.

How To Use Crayons for Tinting Charts and Diagrams

COLORED crayons can be used by draftsmen to tint charts and diagrams with greater ease and with nearly as good effect as water colors will produce. Julian Hinds, engineer, U. S. Reclamation Service, tells how to secure the best effect in the February *Reclamation Record* (Washington, D. C.) as follows:

The crayon should be applied lightly to the paper and spread with gasoline applied with strips cut from an ordinary blotter or with a fairly stiff color brush. The blotting paper may be rolled or folded to give greater stiffness. Absorbent cotton twisted around a sharpened stick also makes an excellent spreader. For small or narrow areas a soft splinter, or a match stick, sharpened to a blunt point may be used. For large areas an artist's stub will be found convenient. Some men prefer to flow the gasoline on rather freely, rubbing the color very lightly; others prefer to use only enough gasoline to moisten the spreader.

Crayon colors have a distinct advantage in that they can be applied to tracing cloth. For this purpose, a blotting paper or cotton spreader should be used with a minimum amount of gasoline. If the gasoline is flowed on too freely the color may be entirely removed.

In applying the color to the paper, it is important that the crayon be rubbed in lightly. If pressure is used, the pigments are rubbed into the paper and will not spread readily. Deep tones should be obtained by continued light rubbing. The colors are much stronger after spreading and care should be used not to apply too much pigment.

After the application of the gasoline, the color should be dead flat, uniform and perfectly transparent. Color applied in this way does not readily rub off, but unless the paper is very porous may be removed with a soft rubber eraser.

An inexperienced man will get much more artistic results with gasoline and crayon than with water color, and an experienced man will get good results with a much smaller expenditure of time and patience. For small intermittent jobs, crayons possess the advantage of being always ready and requiring no paraphernalia. Also, shades applied at different times are easily matched. Wax crayons probably give best results.

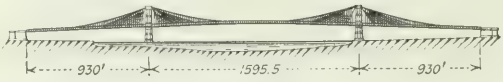
Planning for Hudson River Bridge at New York City

WITHIN the last six months active work has been resumed on the old project for bridging the Hudson River at New York City. Increasing pressure of traffic demands, both railway and highway, has resulted in steady growth of the demand for a river crossing of large traffic capacity, which led last November to the formation of a committee comprising members of a number of strong financial groups, for carrying out a careful study of the project. Plans for a railroad bridge in the neighborhood of 23d St. had been worked out about twenty-five years ago, but the change of conditions since then was believed to call for a restudy of the entire project, including both traffic and structural phases. The committee has since been succeeded by the Hudson River Bridge Corporation, incorporated in February, with George A. Post as president, Thomas H. Simpson and George F. D. Trask as vice-presidents, and Fulton McMahon as secretary. A large engineering organization has been built up, which is at work under the direction of Gustav Lindenthal, chief engineer, making structural and traffic connection studies and developing plans. Co-operation of all the railroads entering New York has been secured in the effort to adapt the project as efficiently as possible to the New York terminal traffic requirements.

While a War Department permit for a bridge over the Hudson at 23d St. has been issued, a site considerably more northerly has been in view for the last dozen years or more, in recognition of the rapid northward shift of business activities in the Borough of Manhattan. The present project, so far as developed until now, contemplates a site in the vicinity of 57th to 59th Sts. Structurally, it involves a suspension bridge with a main span of 3,240 ft. and side spans of 1,710 ft., making the total length between faces of anchorages 6,660 ft.; the clearance height at midspan is 155 ft. and that at the towers about 140 ft. above mean high water. Braced suspension members forming inverted arches 160 ft. apart carry a double-deck roadway, the upper for highway traffic and the lower for railway traffic, both carried by a single plate girder floor-beam construction. Each suspension arch consists of two eyebar chords in the same vertical plane, braced together by a light web system. In so large a structure protection of the material from corrosion is held to be a primary essential in order to assure permanence; on this account the towers, built of steel, are intended to be incased in a protective masonry shell and the cable chains are provided with continuous sheet copper inclosures. For the same reason the steelwork of the suspended double-deck platform will be protected against the weather by the solid buckle-plate floor carrying the roadway. The only steelwork exposed to the weather will be the bracing between the chords, and the suspenders from chords to deck.

The total width of structure contemplated is 220 ft., as the floor beams cantilever 30 ft. beyond the suspension members. Fascia trusses 32 ft. deep on either side furnish partial stiffening, though the main stiffening is to reside in the bracing members between the superimposed suspension chains. It is also planned to reduce the deflections of the suspension system by supporting the side spans at their midpoints by an anchor column, for the reason that topographical conditions require these spans to be of greater length than the best design of the structure itself would dictate.

Detail designs are being developed on the basis of the above indicated general dimensions and proportions, although these themselves are considered to be subject to modification.



Brooklyn Bridge

ELEVATION OF PROPOSED HUDSON RIVER SUSPENSION BRIDGE COMPARED WITH THAT OF BROOKLYN BRIDGE

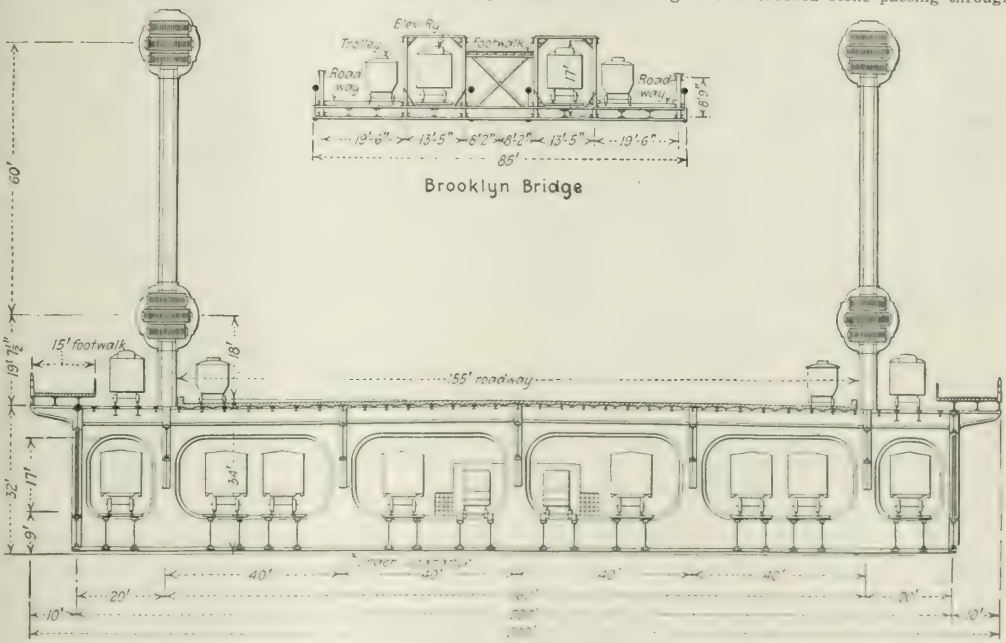
Application of this bridge to the traffic needs to the New York-New Jersey connection will probably use the following general scheme: Highway traffic, to which the entire width of the upper deck of the bridge, with a capacity of 16 lines of vehicles, two wide promenades and two surface-car tracks, is given over, will be led directly eastward in Manhattan to connection with a sufficient number of east and west streets, and north and south avenues to permit effective distribution of the maximum traffic. On the New Jersey side, where Bergen Hill will be cut through by the bridge approach either in tunnel or in open cut, additional roads connecting with the state road system may be required, as the existing streets and roads are inadequate for the increased service. Connections with the low ground east of the hill, with the hill top, and with the meadows level to the west are possibilities.

Railroad connections, for which 10 tracks are provided on the bridge, involve three elements, requiring separate treatment: through traffic, commuting passenger traffic, and freight traffic, the last of which is by far the largest in volume and in difficulty of treatment. On the New Jersey side freight classification and supply necessarily involves a classification yard on the meadows west of Bergen Hill and adequate trackage connecting it to the several railroads, as well as running tracks from the railroad main lines direct to the bridge tracks for through traffic. On the New York side the project comprises a union passenger station, a double freight trackage and warehouse system extending down the west side of the island to the lower limits of the commercial district, and provisions for commutation passenger service either integrated with one of these

two elements or separately making connection with the city transit lines.

Descending from the bridge level on grades of 2½ per cent or less, the railroad tracks (on the lower deck) would swing southward by way of a line west of Ninth Ave. to a large passenger station of through arrangement not far from 42d St. The tracks passing out of this station to the south would again turn westerly and loop back northward to the bridge. Other tracks would pass south and west from the bridge, leading into a freight-track stem located between 10th Ave. and West St. and continuing southward to the collecting, distributing, and warehouse system already mentioned, which would extend from Little West 12th St. to the vicinity of Liberty St. Between the bridge and Little West 12th St. the track system (including the passenger terminal) is adaptable to either elevated or subsurface construction. In the terminal and warehousing section of the line, however, the tracks will be elevated, leaving the street level free for access of trucks to freight elevators.

The full development of this part of the system will most likely be carried out in co-operation with the newly appointed interstate port authority. Its characteristic feature is the provision of distributed team and warehouse terminal facilities along the entire length of the line, as well as direct connection by either rail or truck to the shipping piers along West St., and at the same time to leave existing street facilities substantially undisturbed. The practicability of operating this system as a railroad will be assured by one-way or loop operation. A capacity of 10,000 cars per day can be reached, and the system will have standing room for a sufficient number of cars and motor trucks to allow of developing this capacity.



CROSS-SECTION OF ROADWAY OF PROPOSED BRIDGE ACROSS HUDSON RIVER AT NEW YORK

British Tests on Concrete for Ships

EXPERIMENTS on concrete to be used in ship construction paralleling those carried out by the U. S. Emergency Fleet Corporation were made during the war by the British Admiralty, and later by the Controller General of Merchant Shipping. A paper giving some of the results was read by T. B. Abell before the Institution of Civil Engineers. It may be abstracted as follows:

Compression tests show a wide variation. The concrete was of a rich mixture varying from one part of cement with 2.67 parts of mixed aggregate to one part of cement with 3.66 parts of mixed aggregate. The aggregate consisted of natural gravel or crushed stone passing through ⅜-in. square or ½-in. round holes. There was no disadvantage in using a well-rounded smooth beach gravel as aggregate. Better results were obtained with such an aggregate than with an angular aggregate. Good grading of the aggregate, together with extra fine grinding of the cement, were always found advantageous.

Density of concrete is important for ship construction, since the weight of the ship without cargo is an important factor in determining the dimensions of the ship. The extreme variation in weight per cubic foot amounted to 10 lb., involving nearly 7 per cent variation in the weight of the hull structure.

Bending tests were conducted on reinforced concrete beams to determine (1) The value of concrete under tension; (2) The comparative value of round bars and different types of wire rope for reinforcement; (3) The behavior of concrete under alternating stress: (a) At a stress less than that corresponding to rupture under tension; (b) At a stress greater than that corresponding to rupture under tension.

The beams for the alternating tests consisted of hollow cantilevers of rectangular cross-section erected vertically. Their lower ends were fixed in the ground, and the upper ends were subjected to an alternating force having a frequency of

4 to 7 (complete reversals) per minute. The calculated stresses in the concrete during the experiments were 180 lb. and 360 lb. per square inch. The cantilevers were filled with water so that evidence would be forthcoming directly the concrete on the tension side was completely fractured. Cracks were produced after a time with the tensile stress as low as 180 lb. per square inch. The noteworthy feature about the tests was the eventual sealing of cracks through which water had been percolating. Whether the sealing was due to further hydration of the cement after grinding under the alternate opening and closing of the crack was not determined, but the cracks remained tight and were only reopened on increasing the load. The total number of reversals was 200,000 on one beam and 100,000 on a second. Further tests were made to determine whether concrete could be placed on a practical scale in thin slabs so as to act as a container for heavy oil fuel of high flash point, and also for gasoline. There was no difficulty in regard to the heavy oil, and though with extreme care concrete containers might have been made to retain gasoline it was decided that the risk would be far too great to enable gasoline to be carried in bulk in a ship.

The remaining tests relate to experiments carried out to determine the permeability of concrete, the means of protecting reinforced concrete from the corrosive action of salt water and from the disintegrating effect of vegetable lubricating oils on the interiors of the self-propelled vessels. It was found that without any surface treatment 2-in. slabs of concrete, east with their faces vertical, would frequently resist water pressure of 200 lb. per square inch. It was concluded that it was unnecessary to use any waterproofing compound, and that the richness of the concrete together with the grading of the aggregate were sufficient to guarantee watertightness.

Flow of Water in Tile Drains

A NEW formula for computing the flow in tile drains was presented at the annual meeting of the Iowa Engineering Society by D. L. Yarnell, senior drainage engineer of the U. S. Department of Agriculture. He pointed out that in tile drainage work an important problem is the determination of the proper size of tile to be used, but that many of the formulas in general use were devised when tiles were small as compared with the 12- to 48-in. sizes now used. Continuing, Mr. Yarnell said, in part:

Results of experiments on iron, steel, concrete and wood-stave pipes are not directly applicable to tile drains, as the tiles are usually less regular in size and shape, this condition being noticeable where two tiles are butted together. This unevenness at joints multiplied by the great number of joints, with tiles only 1 to 3 ft. long, disturbs the flow of water to such an extent as to render of doubtful value the formulas for other kinds of pipe. In the new formula, given below, V is the mean velocity in feet per second, R is the mean hydraulic radius and S is the hydraulic gradient,

$$V = 138\ R^{\frac{2}{3}}\ S^{\frac{1}{2}}.$$

This formula is based on a series of experiments made at Arlington, Va., on 4- to 12-in. clay and concrete pipe. The method of its derivation has been given in Bulletin 854 of the U. S. Department of Agriculture. In all these experiments the Kutter coefficient of toughness n and the Chezy coefficient C have been determined. The value of n for tile flowing full but not under pressure lies between 0.011 and 0.012. It was concluded that the value obtained for a pipe with any depth of water less than full does not necessarily apply when the pipe is flowing full. The exponent of the slope, S, was found to be practically 0.5, the loss of head being in proportion to the 2.0 power of the velocity and not the 1.8 power given by many authorities. The exponent of the mean hydraulic radius, R, is $\frac{2}{3}$. Although the Chezy formula gives the same velocity in a pipe flowing full or half full, with the grade constant, "the experimental data seem to disprove this commonly-accepted theory."

Of 75 drainage engineers who replied to a questionnaire of the American Society of Agricultural Engineers, 50 used the Chezy-Kutter formula (with values of n ranging from 0.013 to 0.017), 12 used the Poncelet formula, 13 used Elliott's modification of the Poncelet, and 8 used miscellaneous formulas. The Chezy-Kutter formula was not intended originally for application to flow in pipes.

Experiments on a 30-in. concrete tile drain in Minnesota were made in 1920 by C. E. Ramser, senior drainage engineer, U. S. Bureau of Public Roads, with results as given in the accompanying table. The drain was on a grade of 0.1 per cent and in the first four tests it was under pressure at the upper surface inlet. It will be noted that the value of n for the tile with pressure ranged from 0.0122 to 0.0133, but was 0.1185 for the tile nearly full. The coefficient of roughness increased with the decrease in depth of flow.

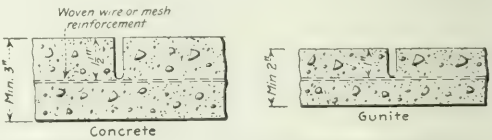
EXPERIMENTS ON FLOW IN 30-IN. CONCRETE DRAIN TILE

Depth of Flow	$\frac{d}{D}$	Area of Flow	$\frac{a}{A}$	Hydraulic Radius	Discharge	Velocity	Slope	Kutter Coefficient	Chezy Coefficient
(d) Ft.		(a) Sq.Ft.		(R) Ft.	(Q) Cu.Ft. per sec.	(V) Ft. per Sec.	(s)	(n)	(C)
50	1 00	4 91	1 00	0.625	29 96	6 10	0 00551	0 0133	103 9
48	0 99	4 90	0.99	0.638	23 00	4 69	0 00257	0.0122	115.8
48	0 99	4 90	0 99	0 638	21 21	4 33	0 00239	0.0126	110.9
.45	0 98	4 87	0 99	0 666	20 16	4 14	0 00210	0 0126	110 7
.26	0 90	4 58	0 93	0 702	17 11	3 73	0 001345	0 01185	121.3
.92	0 77	4 03	0 82	0 753	13 44	3 33	0 001126	0 0126	115.0
.59	0 64	3 28	0.67	0 713	9 74	2 97	0 001017	0 0127	110 3
.31	0 52	2 60	0.53	0 640	6.56	2 52	0 000966	0.0135	101.3
.21	0 48	2.35	0 48	0 610	4.95	2 11	0 000966	0.0154	86.9
.74	0.29	1 22	0 25	0 420	1.63	1.34	0 000976	0.0178	66 1
.67	0.27	1 06	0.22	0 388	1 31	1.24	0.000966	0.0186	60.1

During the past year Mr. Yarnell interviewed a number of drainage engineers in Minnesota and found that they used almost exclusively the Chezy-Kutter formula with a coefficient of roughness of 0.013 or 0.015, but the Arlington tests indicate a value of 0.011 to 0.012. Mr. Ramser's experiments on large sizes of tile show a value of 0.012 for tile flowing full and Mr. Yarnell suggested the desirability of further experiments on large sized tile in order to determine the coefficient of roughness and also to check the accuracy of the new formula.

Special Joints for Concrete Canal Lining

In the U. S. Reclamation Service Flathead project in Montana the new design for concrete lining of the canal calls for alternate bids for reinforced concrete 3 in. thick and for gunite 2 in. thick, each carrying a woven wire or mesh reinforcement at its middle line. Contraction, or expansion, joints are placed every 10 ft. as shown in the accompanying cut, extending from the



CONCRETE LINING JOINT EXTENDS ONLY TO STEEL

base of the lining to the steel only. In explaining the detail J. L. Savage, designing engineer, says: "The joint is intended to locate the contraction cracks by weakening the section of concrete at 10-ft. intervals. Attention is called to the fact that the lining is reinforced very lightly and no attempt has been made to reinforce against temperature stresses. For this reason the lining without joints would crack at frequent intervals with irregular cracks. It has been found that the cracks can be controlled by grooving the green concrete as shown on the drawings, and a very much better appearance results in the finished work."

Quantity, Surveys and Estimate Payments in Construction

Recommendations of Incompleted Joint Report—Reduction in Estimating Overhead to Be Test of Survey's Usefulness

A JOINT committee of representatives of the American Institute of Architects, Engineering Council, and the Associated General Contractors of America has been studying the subject of quantity surveys and payments for estimating since the fall of 1919. Though the report is not yet complete the committee on methods of the Associated General Contractors submitted, at the recent New Orleans convention of the association, certain extracts from the latest draft of the joint report. This draft has not been approved by the committee or any of the associations represented on the committee and is not final.

That accurate predetermined quantities insure economy both to the owner and to the contractor; that known requirements promote healthy competition; and that competition should be substituted for speculation are the fundamentals underlying the committee's recommendation that "architects, engineers and contractors should jointly use their efforts to have established facilities for making quantity surveys in their respective communities."

Survey's Advantages

The partial report of the committee points out that the advantage of a quantity survey to the prospective owner is a saving in the overhead charge which he must pay to the contractor, by reason of the contractor's including in his successful bid the overhead charge for estimating upon bids in which he was unsuccessful. By the quantity survey, then, the owner pays only for the cost of estimating the particular project in which he is interested.

The advantage to the contractor is that all contractors are placed upon the same basis with some means provided whereby the work as proposed will not be left to individual interpretation of the plans and specifications. It also allows the contractor to submit a lower bid.

The committee recommends to architects and engineers that unless elininated for some particular reason all plans and specifications submitted to contractors for proposals should be accompanied by a quantity survey and the net result should be a reduction in the contractor's proposal. It also recommends that quantity surveys for purely building purposes should be insisted upon, providing the net result will be to reduce the prices on any specific project. From one-fourth of one per cent to one per cent of the cost of commercial or public works building and not more than twice that for residential construction is the recommended fee.

The committee believes that the owner should pay for having an itemized list of all quantities entering into the proposed work made, whether he proceeds with the building or not. It is obvious that such payments would be much less than the owner would otherwise pay, as each bidder is furnished with this list of quantities, and thereby released from the work entailed in taking off the quantities from the drawings and specifications.

With these foregoing conclusions as a basis, the committee makes the following recommendations:

1. *Quantity Surveying*—Architects, engineers and contractors should jointly use their efforts to have established facilities for making quantity surveys in their communities.

2. *Cost of Survey*—From one-fourth of one per cent to one per cent of the cost of the project for commercial and public work and not more than twice as much for residence work, should be the cost of the survey.

3. *Basis of Contracts*—Owners have the option of: (a) Making the quantity survey a part of the contracts; (b) giving the successful bidder, at his own expense, an opportunity to verify the accuracy and completeness of the quantity survey before the contract is signed. If he proves an error to exist in the survey the bidder shall be permitted to adjust his bid accordingly.

4. *Unit Quantities and Standards*—The schedule of unit quantities should conform to local customs or methods of measurement and should be so stated on the survey. The eventual adoption of national standards is recommended.

5. *Guarantee*—The guarantee of quantities by the quantity surveyor is not recommended for it might influence the surveyor to protect himself by increasing the quantities. The extra cost of the guarantee would not be warranted.

6. *The Cost of Preparing Survey*—The cost of preparing the quantity survey should be borne by the owner, whether the project is constructed or not.

7. *Existing Systems*—Existing systems which do not eliminate duplication of estimating effort or which do not produce the most economic results to the owner are not endorsed, but it is realized that existing systems will continue in operation until quantity survey bureaus are established so as to be available in each community.

8. *Payments*—Payments should be made by the owner to each bidding contractor based on an individual certificate issued by the architect or engineer. The amount of the payment should be:

(a) Where a quantity survey is furnished: no payment.

(b) Where a quantity survey is not furnished.

Under the system of duplication of the determination of quantities now in vogue each contractor is put to large expense for such estimating of quantities. Therefore, where plans and specifications are not accompanied by a quantity survey furnished by the owner, the owner should agree to pay to each contractor submitting a bid on his project, for the preparation of an estimate or survey of quantities one-half of one per cent of the cost of the project on all commercial or public work and one per cent on all residence work regardless of whether the contract is let or not.

9. *Cost of Project*—The cost of the project is defined as the accepted bid or, in cases where no bid is accepted, the bid of the lowest responsible bidder as determined by the architect or engineer.

10. *Alternate Bids*—Alternate bids when requested by the designer should be paid for by taking the sum of the cost of one bid plus the cost of such alternate bids involving refiguring of quantities.

11. *Altered Plans*—Altered plans which involve a change in quantities justify an addition to the original payment for estimating on the same basis as the first estimating fee.

12. *Sub-contracts*—Sub-contracts where the quantity survey does not cover the sub-contractor's work general contractors should

(a) provide such quantity survey or

(b) arrange for payment for estimating to sub-contractors, making due allowance for the contingency that the same sub-bid may be submitted to several general contractors.

World Production of Coal in 1920

According to a recent bulletin issued by the United States Geological Survey, the world production of coal during 1920 was 97 per cent of that produced in 1913. Total coal produced during 1920 was about 1,300,000,000 metric tons, of which the United States produced approximately 45 per cent. Although this represented a large increase over 1919, it was still 42,000,000 tons short of the output in 1913.

Eight-Story Steel-Frame Building Moved on Rollers

Pittsburgh Building in Way of Street Widening Moved Forty Feet — Load Carried on Temporary Column Brackets

By E. Dauenhauer
Chief Engineer, John Eichleay, Jr., Co., Pittsburgh

THE widening of Second Ave. by the city of Pittsburgh made it necessary to move the eight-story Woodwell Building from its location on the corner of Second Ave. and Wood St. to a new site 40 ft. back from Second Ave. The structure is a narrow steel-frame building, 20 x 80 ft., with brick walls and fireproof floor construction; its total weight is about 5,000 tons, which is carried by twelve steel columns, six on either side. The John Eichleay, Jr., Co. undertook to move the building and to keep it in service during the entire operation. This undertaking was successfully carried out, the building being not only moved to its new location, as shown in Fig. 1, but elevator, telephone, heating, lighting and sanitary service being maintained while the structure was in motion.

The columns on the south or Second Ave. side of the building had their footings at basement floor elevation,

FIG. 1. BUILDING MOVED FROM CORNER (LEFT) TO ITS NEW POSITION

but those on the north side extended 15 ft. lower, and were proportioned for a future twenty-story building, being party-wall columns. These party-wall columns were burned off at the basement floor line when the column load had been transferred to the rolling blocking by attached brackets preliminary to moving.

New concrete column piers to receive the building were prepared at the new site. A grillage on which to raise and move the building was prepared of 3-in. plank laid close over the whole site, flush with the pier tops, after the soil had been leveled and tamped; on this were laid transverse 12 x 12 timbers 18 in. on centers, and longitudinal 12 x 12 timbers to receive 24 rows of 20-ton jacks, 1 ft. on centers. The jacks (Fig. 2) carried a layer of 6 x 8 blocks supporting a rolling track of 85-lb. rails. Three-inch rollers traveled on these rails. The load was brought on the rollers by ½-in. steel roller plates, a 3-in. wooden cushion, another ½-in. plate, and lines of three 24-in. 100-lb. steel I-beams, one

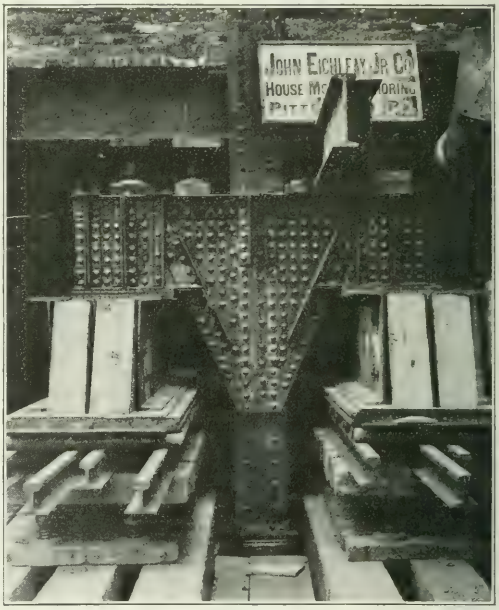


FIG. 2. ROLLING TRACK AND BRACKET SUPPORT

line along either side of each column to be moved. Specially constructed steel brackets were riveted to the columns for transferring this load to the I-beams.

There were two lines of jacks either side of each column. For raising, one man was assigned to about 20 jacks, and at a signal each man gave a quarter turn to his set of jacks, passing down the line, and a second quarter turn on the return, then waiting for the next signal. By this procedure the building was raised evenly. A total raise of 12 in. was required to suit the new site, in addition to the raise necessary for transferring the load.

Moving the building was accomplished by placing twelve drums with jacks against the building, and went on at the rate of 3 ft. per hour. As part of the movement was over a sand and gravel bed, careful levels were taken while the structure was being moved, but no settlement took place at any point. The concrete sidewalks on the Wood St. and Second Ave. sides were carried with the building. After the new location was reached, the old cast-iron bases on the south side were replaced under the columns, while on the north side, where the columns had been burned off, new bases were spliced on and set.

The work required over 100,000 ft. of timbers and lumber, 300 tons of steel rails and I-beams, 1,000 jacks, and 900 steel rollers.

The Activated-Sludge Process of Sewage Disposal

Abstract of paper by George G. Nasmith, Toronto, before the Engineering Institute of Canada, Feb. 3, and of discussion on the paper.

THERE are now three methods of sewage treatment that are capable when carefully operated, of yielding a clear, stable effluent and a nonputrescible sludge: (1) Sedimentation tanks, sludge digestion and sprinkling filters; (2) Imhoff or Travis tanks and trickling filters; (3) activated-sludge digestion (or drying the activated sldge). The first two combinations are well known and, though the inoffensive digestion of sludge in separate single-chambered tanks presents some difficulties, it can be, and is being done on a very large scale, as at Birmingham and Baltimore.

The activated-sludge process will, when the simple but essential conditions of operation are carefully observed, yield a clear, sanitary, non-putrescible effluent. The excess of activated sludge produced is, however, still putrescible, can at present not be cheaply or easily dewatered, and is difficult to dispose of. Should the dewatering problem be economically solved the activated sludge process of sewage disposal would immediately become more desirable and feasible than it is at present, chiefly for the reason that activated sludge has a high fertilizing value and is, therefore, valuable from the standpoint of conservation. The activated-sludge process, as carried out at present, though embodying many good features, has some undesirable ones, and is by no means the last word in sewage disposal.

Advantages and Disadvantages of the Process

The advantages of the activated sludge process of sewage disposal are: (1) The plant is comparatively simple in construction, consisting, as it does, of a series of tanks and means for injecting finely divided air at the bottom of the same. (2) It will produce in the one operation an effluent that can be obtained in other systems, only by a combination of operations. (3) It is, during operation, quite inoffensive. (4) It can be carried on with the minimum amount of pumping.

The inherent disadvantages of the activated-sludge process over other combinations are not negligible. Where improperly operated, the effluent is neither stable nor sanitary. Disinfectants and certain trade wastes are liable to destroy the activated sludge; under these circumstances it will take weeks to build up again the necessary volume of activated sludge. The filtros plates used for finely dividing the injected air are subject to plugging with smoke and dust, in which case the areas of sludge not agitated are apt to undergo anaerobic decomposition, while there are inherent difficulties with air blowers and other mechanical features of the aeration system. Though attempts have been made to derive an income from the dried activated sludge as a fertilizer, the hopes entertained have not as yet been realized in practice and it is doubtful if the day has yet arrived when the chemist or sanitary engineer is honestly justified in advising that an activated-sludge system be constructed with the guarantee that the increased cost of the plant or the high cost of operation will be compensated for by the sale of sludge or other material derived from the process.

On the other hand, some cheap method of satisfactorily dewatering the sludge may entirely change our viewpoint in regard to this matter. The activated-sludge system is unsuitable for small communities or large institutions where an automatic system is highly desirable.

The dewatering of sludge can only be brought about in two ways, viz.: the expression of the bulk of the water present by pressure methods such as the sludge press—a very cumbersome and objectionable process—or through the more recent method of centrifugal action. Both of these methods will produce a sludge cake containing from 75 per cent to 80 per cent moisture from which the remaining moisture must be removed by heat.

A centrifuge of the Baseo Ter Meer type has been experimented with for a month at Milwaukee and promises to be more suitable for dewatering Milwaukee activated sludge than sludge presses. The machine is almost automatic in operation, occupies 15 minutes for each cycle, and will centrifuge from 2,000 to 4,000 U. S. gallons of sludge per hour. It takes a sludge containing 98½ per cent moisture and reduces the moisture to from 79 per cent to 85 per cent. About 20 per cent of the solids of the sludge pass over the filtrate and it is expected that, with experience and improvements, it will prove more efficient and satisfactory than any type of sludge press hitherto tried out.

F. A. Dallyn, Sanitary Engineer, Ontario Provincial Board of Health—Dr. Nasmith said that he did not think the activated-sludge process applicable to smaller plants. We have found it most excellent for institutional plants in Ontario. At one of these we find that we can put the air compressor in a boiler room or in one of the machinery buildings and treat the sewage of the institution practically without supervision. An activated-sludge plant in use at the Guelph Agricultural College since 1917 has given uniformly good results. It has been neglected occasionally, but it has been easy to rectify any trouble caused by neglect so that within a day or two the plant could be in good working condition.

We have recently built two other plants: one at an institution at Orillia and another at the prison farm at Burwash. They are both giving excellent satisfaction.

In the last two years I have strongly advocated the adoption of the activated-sludge process in remodeling some of the sewage disposal plants in the province. The cost of this remodeling has been a minor matter as compared with the cost of introducing some of the older methods, and the results we expect to obtain are much more satisfactory than under the operating conditions we have had before.

The city of Kitchener [formerly Berlin] when activated-sludge was in its infancy did not feel like experimenting with the activated-sludge process. It put in a plant of another type with a capacity of 800,000 Imp. gal. a day that cost roundly $60,000. Recently Woodstock built an activated-sludge plant with a present capacity of 2,500,000 Imp. gal., with provision for enlargement to 4,000,000 gal., and the construction price was only $55,000 under existing high cost. Such saving in interest charges alone warrants, to my mind, a municipality in making such an experiment because I think our knowledge of sewage disposal is advancing so rapidly that expenditures for the older systems are not warranted because they would probably be scrapped inside of fifteen years.

The Ontario Provincial Board of Health has been experimenting with the activated-sludge process for some years. I was sent to England to see everything that was to be seen there in 1916 and again in 1917 and still again in 1918.

Air Fed from One Side of Tank

In our experiments, instead of using the saw-tooth bottom, like that at Milwaukee, the air is fed from one side of a long tank at a probable increase of 25 per cent in efficiency. This arrangement is particularly advantageous in connection with the remodeling of old septic tanks, of which there are many in this province. In such remodeling a row of porous plates can be put at one side and the old tanks divided by partitions into widths of 6 to 9 feet.

I am confident that the operation of the activated-sludge process can be made largely automatic and if this can be done then with the decreasing cost of hydro-electric power in Ontario, which may be expected in the next ten years, the activated-sludge process will be brought quite within the realm of municipal economy.

As to dewatering the sludge, our experiments have shown that by putting the sludge in a separate tank, activating it, and changing the water three times we can reduce its moisture content to about 65 per cent. In so doing, however, we lose about half the nitrous contents of the sludge, producing about 2½ p.p.m. of nitrogen instead of 4½. That is a considerable loss and the question is whether by further studies we can maintain more of the nitrogen content.

There does not seem to be any question but what the sludge from the activated process will have a fertilizing value with an increasing market. The abattoirs are very

largely withdrawing from the fertilizer market because they are finding other uses for their products. They can convert many of their former waste products to stock foods.

Mr. Redfern — Plans for an activated-sludge plant with a capacity of 200,000 Imp. gal. per day, with a 6-hr. period of aeration, and a maximum capacity of 500,000 Imp. gal. per day, have been submitted by the town of Newmarket to the Provincial Board of Health and have been approved by the board. The lowest bid for the construction of the plant, complete, was $31,000. I think this price was lower than could have been obtained for any other type of plant even with the high cost of materials and labor that existed at the time, but the building of the plant was put over for a year or two. I have no doubt but that it will be built soon.

William Gore, Consulting Engineer, Toronto — Experiments with the activated-sludge process have been carried out by Dr. Nasmith and myself. The raw sewage is first mixed with well digested sludge and then passed to an ordinary activated-sludge tank. The sludge formed in the activated-sludge tank is returned to a digesting tank. The effluent has a slight straw color. We have run for some periods with as low as ⅞ cu.ft. of air per gallon based on a 10-ft. depth of tank, our tank being only 7½ ft. deep.

Inclined Wall Braced by Struts to Hold Sliding Loess

Slides Threatening Illinois Hospital to Be Checked by Reinforced-Concrete Retaining Wall of Unusual Type

A RETAINING WALL decidedly different from standard walls is under construction at Menard, Ill., to arrest slides and slumps which in the past have occurred on the north and northwest side of the State Hospital for Criminal Insane. The general topography of the site is shown in Fig. 1. The slides, indicated on the map by wavy lines, have been of frequent occurrence during the last few years and it was feared that they might endanger the safety of the building. In the lower part of the drawing, a cross-section looking northeasterly, the various underlying strata are shown. The thickness of these strata, as well as their slope, varies considerably, but the section illustrated may be considered as fairly representative and has been made the basis for the design of the wall.

The loess, which is the surface material, is a brown soil composed of a very fine wind-blown silt containing sufficient clayey material to bind it together so that it often stands with a vertical face. As it is exceedingly porous, water passes through it readily. If the base of the deposit becomes saturated it loses its "body" and unless confined has a tendency to run under the weight of the overlying loess. The slumps or slides mentioned are therefore most likely to occur after a heavy rainfall, the main cause being the saturation of the base of the loess, and a contributing cause the slipperiness of the supporting impervious shale when wet.

The shale varies greatly in character, the poorest kind being little more than compacted mud, becoming soft as clay when wet. Other deposits are very calcareous and there are even certain lenses of limestone. Such shale

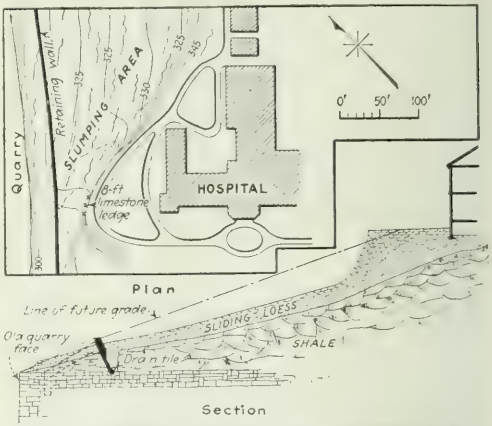


FIG. 1. SLIDING LOESS AND WALL TO STOP IT AT ILLINOIS HOSPITAL

is but very little affected by water. In general the shale is hard and firm and affords an excellent foundation for the building, except when long exposed to the weather or poorly drained.

The limestone occurs in strata several feet thick and makes a perfect foundation for the wall. It is well exposed at the quarry ledge and on the lower slope of the bluff.

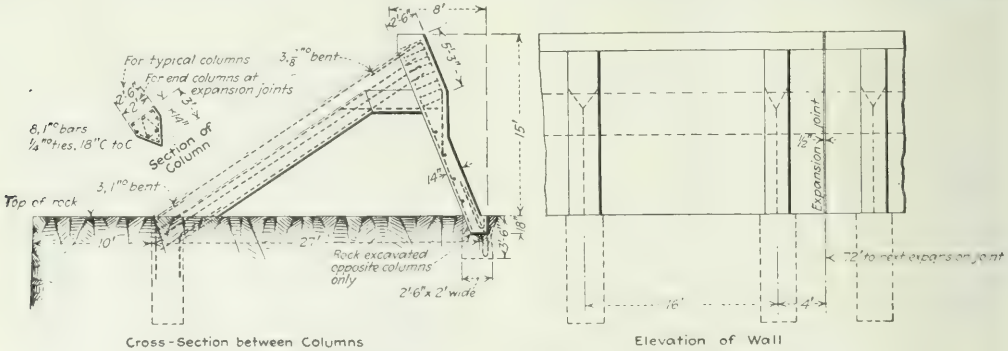


FIG. 2. RETAINING WALL AT ILLINOIS STATE HOSPITAL

On account of the unusual conditions, the amount of the lateral pressure against the wall is even more uncertain than in the case of ordinary retaining walls supporting earth pressure. A limiting value of the thrust could evidently be obtained by considering the loess as a fluid of weight 100 lb. per cu.ft., acting on the total vertical height of the slope. However, as it is evident that such a pressure cannot exist, due to the inability

of the overlying material at the lower end of the slope to resist any great amount of upward pressure, this principle of pressure calculation was not used. Nor was it thought necessary to consider any dynamic force against the wall due to the motion of the loess; for the displacement of this material after a slide was found to be a few inches only and its velocity very small.

It was finally decided to consider as actual lateral pressure the component of the total weight of the material above the shale parallel to its under side, reduced by the frictional resistance of the loess against the shale. The coefficient of friction was taken as 0.15. Considering the section shown in Fig. 1 as representative for the entire length of the wall, there is obtained the total normal pressure for one typical 16-ft. bay as follows:

The total amount of loess supported is 32,000 cu.ft., which at 100 lb. per cu.ft. weighs 3,200,000 lb. The component of this force parallel to the top of the shale is 800,000 lb. which reduced by a frictional resistance of 3,100,000 x 0.15 = 465,000 lb. gives a total normal thrust of 335,000 lb.

The upper part of the wall has been designed as a beam of 13½-ft. clear span to resist this pressure, and the inclined columns have been designed for approximately the same load. The amount of steel, 10 sq.in., in the center of the beam span is slightly in excess of that at the column supports due to the T-action of the lower part of the wall. Prison labor being available both for crushing stone and for general concrete work, the cost of the concrete is exceptionally low, and therefore the percentage of steel has been kept somewhat lower than is common in ordinary practice.

The wall was designed and the work is being executed under the direction of the Department of Public Works and Buildings of Illinois, for which Col. C. R. Miller is director, Edgar Martin supervising architect and A. S. Ritterwold engineer in charge.

British Road Classification Completed

The classification of roads in Great Britain is now complete, the percentages of first and second-class roads being as follows:

	Per Cent
England and Wales, first class roads	11.6
England and Wales, second class roads	[illegible]
Scotland, first class roads	17.0
Scotland, second class roads	13.1

The money derived from the tax on all mechanically propelled vehicles will be paid into a central fund. Fifty per cent of the cost of maintenance of the first-class roads and 25 per cent in the case of second-class roads will be contributed from this fund, the remainder to be found by the local authorities.

The Ministry of Transport has issued a return of the amounts collected by local authorities in road taxes from Jan. 1 to March 7; this totals £7,092,422. The following is the approximate analysis of the sources of this total:

Class	[illegible]	[illegible]
Cars taxed on hp.	[illegible]	[illegible]
Motor cycles	[illegible]	[illegible]
Bath chairs, etc.	[illegible]	[illegible]
Commercial motors	[illegible]	2,[illegible]
Road locomotives, etc.	[illegible]	[illegible]
Motor ploughs, etc.	[illegible]	[illegible]
Motor tractors, etc.	[illegible]	[illegible]
Taxicabs, etc.	[illegible]	1,1[illegible]
Trailers	[illegible]	[illegible]
General Identification marks	[illegible]	[illegible]
Horse-drawn (private and hackney)	[illegible]	[illegible]
Miscellaneous receipts		[illegible]
	[illegible]	7,09[illegible],400

Notes From Foreign Fields

ENGINEERING IN VENEZUELA AND COLOMBIA

By Jacob L. Crane
Formerly of Gannett, Seelye & Fleming, Harrisburg, Pa.

THE great mineral and agricultural resources of Venezuela and Colombia present the incentive for, and their climatic and physical characteristics from the intensely hot sea-coast area to the cold mountain ranges of the Andes constitute the obstacles to, extremely interesting engineering achievement. Unusual difficulties have to be overcome, such as instability of governments, total lack of co-operation between adjoining countries, difficulties of climate such as disease for agents and workmen, and physical handicaps equaling those in some of the famous projects of this country.

Roads.—The original roads of these countries were first foot paths and then mule trails following the streams and meandering through jungles and over the mountains. Now, however, the highway building era is well under way and such roads as that from LaGuayra to Caracas, or from Estacion Tachira to Cucuta are good example of the progress being made. In the cities the old pavements are of cobble, while the newer ones are of macadam or in some instances ashphalt. The country roads of the better type are built of Telford macadam and seem to be well made. Of course labor is cheap (40 to 80 cents per day) and plentiful, and in the writer's opinion fully as intelligent for this work as American labor.

On the mountain roads the curves are more frequent and sharper than one ordinarily finds in this country, but the grades are low and uniform. The maintenance on the newer roads is good; one maintenance man is assigned to each kilometer of road and it is his duty to keep that section in good shape. Compared to our busy roads, the traffic is light consisting largely of Fords, mule carts, pack trains and pedestrians, but it is now increasing rapidly. The advent of the automobile and the commercial need of roads are now such that the roadbuilding program may be expected to continue until thousands of miles of good highways connect all important points. Roads are most essential in these mountain regions because railroad construction is so expensive that automobile transportation over good roads is more economical.

From Stone Arch to Steel Bridges

In both countries the construction of picturesque stone arch bridges seems to have passed and in some sections, following an intermediate period of timber construction, the era of the American steel bridge is coming in. There is little doubt that the steel bridge will displace the older type almost entirely until the countries have developed to the point where they again desire and can afford picturesqueness or beauty in such structures. Then, perhaps, the modern stone and concrete bridge will come in. The people have a strong natural instinct for picturesqueness in their structures, and it is to be hoped that after we have given them the value of our steel-bridge developments, they can help return to us that which so many of our engineering structures

lack—the stamp of beauty and of fitness in their surroundings.

Railroads and Sanitation.—The topography and development of these countries have made for short railroad lines. Most of them are narrow gage and vary in length from about 8 to 150 miles. The typical railroad connects a river or seaport with the highway outlet from mountain district or with one of the larger interior towns. They are, of course, very important in agricultural and industrial development, but they seem miniature compared to our railroad systems. The older railroads are owned largely by European capital, but the newer projects are natively owned and operated. For the most part the locomotives burn wood. Some of the roads do not pay an adequate return on the investment and in certain instances much needed lines will have to await further development of the country or substantial government subsidies.

In the larger cities there are usually street railways of some sort. Some of these use storage battery power, and in one instance the steam railway leases the trolley tracks from the city and the wood-burning locomotives haul the tiny street cars over them at infrequent intervals.

Water Supply—Public Health

Water supplies in general are bad. They vary from rain water carried on mule back from house to house to stream water delivered through pipe systems and nearly always unsafe for drinking. A system that is not uncommon is to bring water from a stream of questionable potability through a town in an open ditch in the middle of the cobble pavement. Each householder takes his water from the ditch by hand and empties back into it his waste water and sometimes sewage, so that the people on the lower end of the line get the waste from the upper end. There seems to be no objection to filthy water for all household purposes.

The requirement for water is much less than with us. Baths are rare, little water is used for any kind of washing or for street or municipal purposes, there is practically no demand for industrial water, and little need for fire protection, as most structures are built of clay or stone. Under these conditions the frequent evidence of interest in new water-supply projects may be considered remarkable, but it is real and is bound to produce results.

Sewers are known in only a few of the larger towns, and there they are used only by a small upper class. The outdoor closet is uncommon and the few one sees are extremely objectionable. Usually both in the towns or in the country either an open or fenced enclosure in the rear of the premises or nearby is used, and the material deposited on the ground, sun and wind-dried, or removed by the fowls and the pigs. Crude as this may seem, it is not so objectionable as the water carriage or dry closets in the hotels. However, the effect of this method of sewage disposal in producing enteric and hookworm diseases must be severe. Garbage is generally fed to chickens or pige, even in the larger towns, so there is rarely any garbage problem.

There is no system of vital statistics in either country, so the author was informed, and it is therefore impossible to determine disease and death rates with any degree of accuracy. However, it is apparent that the people of these countries are sick a great deal, often from unidentified diseases as well as from those well known, and the death rate must be high. Yellow fever is practically gone, but malaria is widespread and nearly every one has it sooner or later. Mosquito eradication has not been undertaken to any extent.

Town Planning.—What seems to have been unconscious town planning has produced many communities with a certain stamp of picturesqueness and with utilities fairly convenient and fitting. The discounting features often met are too-narrow streets, dirt, crowded districts, and bad sanitation. One can readily believe that the people of these republics will demand beauty and convenience throughout their civic developments sooner than good sanitation. As a matter of fact, in spite of the dirt, odors and poverty in these tropical cities they often possess a general effect of better town planning than one usually finds in cities of the United States and Canada.

One discouraging situation was found in the case of a town of 20,000 people which was entirely destroyed by earthquake about fifty years ago (most of the towns are one or two centuries old) and rebuilt in imitation of American cities. The result is a rectangular street plan with wastefully wide, sun-scorched roadways, unadorned and barren, and leading pointlessly straight across the town; badly situated public buildings, and loss of the usual picturesque effect. The only gain seemed to be in a somewhat better ventilated city.

Industry and Agriculture.—There are a few small factories in the larger seaports, but the principal industrial activity is mining, and the great future development is oil. Colombia produces much of the world's platinum and most of the emeralds, and both countries are still rich gold producers. Both, it has recently been determined, have large, rich oil deposits. Already a few companies are shipping oil, there are a few refineres in operation, and many companies are exploring and starting operations. However, many of the oil deposits are so remote that they cannot be profitably exploited as yet. It seems certain that this territory is destined to be one of the great oil fields.

Irrigation Opportunities

Irrigation, often on a large scale, will be required for sugar plantations which promise to be one of the chief features of agricultural development to come. In this climate sugar requires from 5 to 10 gal. per minute per acre irrigated, the year round, or a total of from 80 to 150 in. per year. No hydrographic data are available and only meager empirical information about irrigation.

While there are many difficulties and annoyances to overcome particularly a severe tropical climate and its resulting insects and fevers, in some ways it is easy to work in Venezuela and Colombia. The individual American is treated with more consideration than almost any one else, and the people are usually ready to do business with him. Every phase of development requires engineers first of all, and American machinery and equipment. It seems that any qualified and intelligent engineer can make his fortune there if he is willing and able to put up with the discomforts and diseases for a number of years. This is, however, a rather severe requirement. It is to be remembered that work must be done and goods furnished faithfully and competently for the genuine good of the people there, if American engineering enterprise is to fulfill its destiny in these two rich Caribbean republics.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Another City That Recognizes Engineers

Sir—The letter of A. L. Dabney regarding engineers in the city government of Memphis, Tenn., and your editorial comment (*Engineering News-Record*, April 28, 1921, pp. 734 and 706) have been read with interest. I wish to call your attention to the members of the municipal government of the city of Miami Beach, Fla., who have engineering training or experience. On the City Council of seven members there are two civil engineers in active practice, a former practicing mechanical engineer and a former manager of large mines in the Cripple Creek district of Colorado. The city engineer is a graduate civil engineer; the water superintendent is a graduate engineer; and the city clerk, until occupying his present position, was an engineering draftsman and office manager.

The population of Miami Beach is about 525. It is one of the wealthiest cities per capita in the United States. Its assessed valuation for the past four years has been: 1917, $647,500; 1918, $832,745; 1919, $2,579,600; 1920, $3,933,700.

W. E. BROWN,
President City Council.

Miami Beach, Fla., May 5.

Deceptive Highway Propaganda

SIR—I know that *Engineering News-Record* will not willfully or intentionally misrepresent or make false statements. I am writing, therefore, to ask that you publish this in answer to the editorial appearing in your issue of April 28, p. 706, entitled "Deceptive Highway Propaganda." You state; "Alabama is another case in point. In the propaganda for a recent bond issue of $25,000,000 a circular issued by the Alabama Highway Improvement Association carried these statements: 'This is a 50-50 proposition. Uncle Sam puts up $1 and requires the State to match it. If Alabama fails or refuses to put up, the money goes to other states.'"

Then you state: "The plain inference here is that $25,000,000 of federal funds would be forthcoming in the event of an affirmative state vote."

If the circular contained that statement and that alone one would be justified in drawing your inference. In the same circular you refer to you will find in large type the following: "The $25,000,000 bonds will enable Alabama to cover Uncle Sam's offer dollar for dollar, *as it is offered*."

"The Federal Government already has appropriated nearly $6,000,000 to aid Alabama in the construction of good roads."

In the same circular there is a table showing the probable expenditure of the sum voted and anticipated, covering a period of twelve years. It certainly would have been poor judgment upon the advocates of good roads in Alabama to have submitted an amendment to the state constitution permitting the sale of bonds amounting to only the present federal apportionment, and not anticipate additional federal aid.

Amending state constitutions is no easy matter and we certainly do not relish the work of campaigning for an amendment every time the government apportions a sum of money to Alabama. No one was deceived in Alabama and from best information obtainable no one with the exception of yourself and a writer for the American Automobile Association have been able to make a mountain out of this mole hill.

W. S. KELLER,
State Highway Engineer of Alabama.

Montgomery, May 5.

[We are glad to learn from Mr. Keller that the issue in Alabama was clearly understood by the electorate. It is possible, however, that the circular referred to has, in some cases at least, not received the careful study which he has given it. In that event it seems that the wording of the sentences quoted in this journal's editorial might have caused a misunderstanding.—EDITOR.]

Protection of River Banks with Spur Dikes

Sir—It seems to me there is a difference of opinion regarding the length of spur dikes, the distance between them and their location with respect to the direction of the stream. It would be of general interest to learn the opinion of experts in this type of river protection.

The writer is familiar with the two following methods, very frequently employed to find the length of spur dikes.

Method I, Fig. 1.—If *AB* is the spur dike, the length of which has been predetermined, the water is supposed to strike at *AB*, leaving by *A* in the direction of *AC*, making a right angle with *BA*. It is obvious that the greatest stress will react at *C* and, therefore, the second spur dike should be located a little up stream from the point *C*. The same rule is followed for the other spur dikes.

SPUR DIKES FOR BANK PROTECTION

Method II, Fig. 2.—The distance between the spur dikes should depend upon the greatest curvature of the river bed, the assumed length of the spur and the *degree of safety desired*. As before, the length of the dike spur is assumed and then the greatest curve of the river is found. Let us assume that *ABC* is the said curve. At *B*, the point of greatest curvature, we place the spur of known length, as if it were the height of a segment. The cord *EF*, corresponding to this "height," will give us the distance between the spur dikes, when the protection does not require a great factor of safety. For protection with double the safety of the first one, we will take the cord *E'F'* to give the distance between the spurs. For a safety three times as big as the first one, one-third of the height should be taken, and so forth.

In reference to the location of spur dikes, their maximum efficiency as protection works, and their stability, I am of the opinion that, in general, they should be built against the stream, either forming an angle of 12 to 17 deg. with the river bank, or normal to this.

ENRIQUE RAMIREZ.

Tinogasta, Catamarca, Argentine, March 15.

Selling Cement Through Dealers

Sir—I was interested in seeing in your issue of April 28, p. 736, my letter to you of March 31 in regard to selling cement through dealers and the reply to a similar letter from the Atlas Portland Cement Co.

The answer of the Atlas Portland Cement Co. is interesting. Its statement about purchasing suits from Hart Schaffner & Marx does not carry a great deal of weight it seems to me. I am very sure that if the Atlas company wished to purchase one thousand suits of clothes, all of exactly the same pattern and made from the same cloth, Hart Schaffner & Marx would bid on the work as would many other suit manufacturers, and the Atlas company would obtain close figures because of competition.

The cement business is not handled in this way. All of the companies pursue the same policy of selling through the dealer as is pursued by the Atlas Portland Cement Co. It evidently is a sound policy for the cement companies but entirely eliminates competition in this very important building material. I know of no other building material that cannot be purchased in the open market on a competitive basis.

The Atlas Portland Cement Co. states very emphatically that it is not tied up by agreement of any kind. Neverthe-

less, if one wishes to purchase cement in quantity, he will receive exactly the same price on every brand of cement that is sold in any particular locality. There is certainly great unanimity of opinion between cement companies and the cement dealers even if there are no agreements.

One is naturally interested to know why of all the building materials cement is one which has to be bought through the dealer and cannot be bought even in the very largest amounts direct from the manufacturer.

The Atlas company states that the cement dealers also sell to the contractors sand, gravel and other building material. That may be so in some instances but it has never been true in any of our work, nor have we ever known it to be true. Sand, gravel and other building materials are purchased on competitive basis and not as cement is.

SAMUEL M. GREEN CO.

Springfield, Mass., May 11.

Expressways for New York Traffic

Sir—In connection with our recent correspondence regarding the matter of my paper on streets and parks (see *Engineering News-Record*, March 31, p. 547 and April 7, p. 577), I quote you from a letter received by me under date of April 25 from W. H. Breithaupt, of Kitchener, Ontario, Canada:

"Enclosed please find the copy you sent me of your paper on Streets, Parks, and Expressways. The latter seem to me the logical outlet for through automobile traffic to which and to bicycle traffic it should be devoted. I would make the approaches in spiral, or rather helix, form thus taking up minimum space, and make one at least every five blocks, that is four to the mile. The main way should be kept well above the tops of ordinary buildings, say 60 ft. or more above the surface. The traffic should be separated, of course, into fast and slow and uptown and down, with separate path for bicycles; motor cycles however would travel with the automobiles.

"There would be various new things in such a way. For one thing the pavement, adapted to the one purpose, could be steel plates or other absolutely durable material. For the helix approaches land off the streets would have to be taken and the surplus land would be easily and very profitably made use of as neighborhood garages.

"The more I think of the general idea the more there seems to be in it and I see no good reason why, with structural material now coming down, at least one such way should not be undertaken at once. There is a way something like the one contemplated at Los Angeles from the main city to the port. In Chicago about thirty years ago there was an idea, about which I was consulted, for an elevated roadway above buildings."

CHARLES W. LEAVITT,
Civil and Landscape Engineer.

New York, May 3.

Biological Action in Deterioration of Concrete in Sea Water

Sir—I enclose a few observations on the interesting discussion motivated by the article in *Engineering News-Record*, Jan. 20, 1921, under "More Observations of the Effect of Sea-Water on Concrete." The subject is of such importance and so complex that the more light thrown on it by personal investigation and observation of this subject may be instrumental in finding adequate means to minimize the evils attending the conservation of concrete structures, chiefly those in contact with sea water.

The attack on concrete constructions by sea water is not dependent on a single factor, but on the action of several elements co-ordinating to produce a rapidly deteriorating effect.

Whichever may be the elements entering into the composition of structures exposed to the action of sea water the disintegrating effects are similar, whether concrete, stone, brick, or other materials are employed.

The causes of deterioration of concrete structures are generally known, and are of several kinds. Let us take for granted that the mix is technically perfect, and that the structures are made in accordance with the best accepted rules. Soon after the structure gets in contact with sea water, marine growth of several species attaches itself to the surfaces penetrating the softer part of the concrete material. Lichens, fungi, and algae are the starters of this destructive work; this invasion of plant life is accompanied by that of lithophage organisms, of which some species can bore holes even in hard rocks, opening deep channels of attack to the chemical action of sea-water. In addition to these we find other agents of destruction in the numerous mollusca and cognate animal groups, secreting solutions of hippuric and sulphuric acids, which in the latter instance cause an active disintegration of silicates and aluminates forming the cement element of the concrete mixture. The ground is now admirably prepared for the chemical action of sea water on the silicates and silico-aluminates, and on the basic elements forming the cement. Among the constituents of sea water, sodium and magnesium chlorides attack rapidly the silicates. The sulphates, chiefly magnesium sulphate, is the most active constituent in sea water, and is taken up by the cement, forming calcium-sulpho-aluminate. The action of the first salt is accelerated in the presence of chlorides. Besides the foregoing instances of attack it must be added that concrete can also be disintegrated by the mechanical forces exerted by crystallization of salt in its pores.

The limit of penetration of salts and other corroding agents is not limited to 1 or 3 in.; it may progress from layer to layer up to the metal reinforcement, where active oxidation will set in with consequent breakdown of structures.

The writer had occasion to observe for a number of years the action of oil on concrete skin. There is good penetration and it seems to confer a distinct protection against marine growth and also against the destructive action of sea water. A preliminary oil treatment may be suggested as a possible cure to some of the evils arising from the activities of marine organisms, and from the effects of sea water on concrete structures.

BAXERES DE ALZUGARAY,
Consulting Chemist and Metallurgist.

New York City,
April 28.

Service Factors of a Water-Works from Layman Viewpoint

FOURTEEN points or factors, each having different weight, are used by the Illinois Public Utility Commission in scoring the various water-works systems of the state. Quality, quantity and fire service do not tell the whole story. The commission asked twenty men to give their grading on these service factors. J. H. Mathews, service engineer of the commission, gave the following typical table in explaining the rating points at the recent joint meeting of the Iowa and Illinois sections of the American Water-Works Association.

TYPICAL SCORING OF AN ILLINOIS WATER-WORKS

Factors	Weight	Grade	Score
Quality	30	95	2,850
Continuity and pressure	24	90	2,160
Adequacy of fire service	11	20	220
Adequacy of capacity	8	80	640
Provision for emergency	5	85	425
Construction and maintenance	4	60	240
Extension policy	3	50	150
Furnishing new services	3	70	210
Handling complaints	2	10	20
Adjustment of bills—billing	2	80	160
Meter testing	2	40	80
Meter reading efficiency	2	40	80
Consumer's attitude	2	0	0
Records of pressure—interruption—station	2	30	60
Records of complaints			
Records of meters and tests			
Final grades	100	..	72.95

HINTS FOR THE CONTRACTOR

Water-Filled Canvas Hose Forms Temporary Dam

EXPERIMENTS by Norwegian engineers have shown the possibility of successfully damming shallow streams by means of a large canvas hose filled with water as illustrated by the accompanying views. The

FIG. 1. HOSE ANCHORED ACROSS STREAM FOR FILLING

dam illustrated was constructed Oct. 26, 1920, across the Skjaersjo River, Maridalen, Christiania.

Where the dam was located the stream is shallow and has a rock bottom. The hose used was of cotton canvas and was 35 m. (115 ft.) long and 2 m. (6.56 ft.) in diameter. It was laid across the river as indicated by Fig. 1, enclosed in a rope net anchored by cables to bolts set in the rock bottom about 20 m. (65.6 ft.) up and down stream from the hose. Both ends were also anchored to the shores. One end of the hose was temporarily closed by a plank clamp and the other end was left open and was slightly elevated for filling. The hose was filled with water run into the open end by a small hose laid far enough upstream to get a filling head of water. It required about 20 min., with a 20 cm. (7.87 in.) filling hose, to fill the large hose to the condition indicated by Fig. 2, which shows clearly the nature of the dam, about 6 ft. high, which was formed.

For more permanent structure it is contemplated that the hose will be filled with liquid mortar. The method, which is patented, has been planned for various other uses in engineering construction. Johan Störe, civil engineer, Christiania, Norway, is the inventor. E. Randers, 4401 Armitage Ave., Chicago, represents the system in America.

FIG. 2. HOSE FILLED AND DAM FORMED

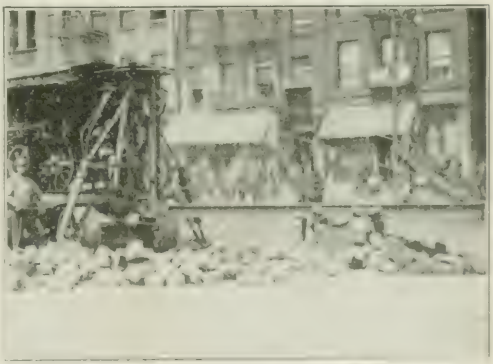
Quick Construction of a Footway Under a Crowded Street

DENSE traffic in a narrow street was a factor in planning construction of a footway 12 ft. wide, 8 ft. and 80 ft. long to connect the concourse of the Union Station, Chicago, with a cab and taxi yard half a block distant, the depth being too slight to permit of tunneling. The purpose of the footway is to relieve the present congestion due to taxis taking passengers at the station entrance on Canal St.

In the first place, a building opposite the station was jacked up the height of one story and the basement made a part of the footway, the sidewalk being tunneled and an open incline extended about 80 ft. to the cab yard in the rear. The station sidewalk was also tunneled from the concourse.

Grader Rips Up Stone Block Pavement

W. J. FITZGERALD, contractor for the repaving of South St. near South Ferry, New York City, is using a Keystone grader, model Four 21 to rip up the 8-in. stone block preparatory to repaving the street with 5-in. stone block. The machine is the same as is



GRADER [illegible]

used on ordinary excavation, no changes being necessary to adapt it to the unique use.

In ripping up the old pavement, the hydraulic jacks are set and one front wheel and one rear wheel blocked to allow the digging boom and bucket to exert the maximum amount of pressure. As the stone block is laid on a sand bed, the grader operator needs forcing the cutting edge of the bucket into the sand bed and a lift on the boom breaks up the block.

Motor trucks, loaded directly by the grader, carry away the block which is being recut for use elsewhere. The grader replaces at least twenty-five men. From 750 to 1,000 yards of stone are ripped up per day.

NEWS OF THE WEEK

New York, May 26, 1921

Tunnel Deadlock Continues

The deadlock on the Hudson River vehicular tunnel project, due to the "dismissal," by the New Jersey commission, of the board of consulting engineers and the refusal of the New York commission to recognize its authority for such action or to concur in it, continues at this writing. The matter will probably have to await an opinion by the attorney general of New York State as to the validity of the New Jersey body's independent resolution ousting the consulting engineers (see *Engineering News-Record,* May 12, p. 828).

At its meeting May 17 the New Jersey commission rescinded its action of May 3 appointing a "board of consulting engineers" of three members to advise it, and passed a resolution creating a "board of three technical advisors"—apparently a change only in the name of the new body. To the latter board George M. Wells and St. John Clarke were appointed at salaries of $10,000 each. No action was taken to fill the third place on the board left vacant by the refusal of Col. George L. Watson to accept appointment, as announced in last week's issue. Both Mr. Clarke and Mr. Wells have accepted appointment as New Jersey's technical advisers.

In a statement by Clifford M. Holland, chief engineer, the commissions were informed that the engineering department had practically completed the contract plans and specifications for the subaqueous portions of the two tubes and was ready, on authorization from the commissions, to call for bids on this work, according to the schedule in the chief engineers' 1920 annual report.

Compensation Report Approved by Am. Soc. C. E. Board

Endorsement was given to Engineering Council's committee report on classification and compensation of engineers by the board of direction of the American Society of Civil Engineers at its meeting April 24 in Houston, Texas. The proposed salary schedule is approved "not as an inflexible standard, but as indicative of the proper salary relation between the several grades of the classification; as proposing minima for the several grades which under ordinary circumstances are the least that can be considered reasonable and just, and as providing sufficient range between minima and maxima for making adjustments to suit variations in living conditions, kind of work and character of service, and for permitting adequate salary advances within the grades themselves."

Federal-Aid Road Act Amended

The Senate on May 16 amended the federal-aid road act so as to allow states in which the unappropriated public lands exceed 5 per cent to avail themselves of their allotments by appropriating smaller amounts of state funds. The bill was passed unanimously. It simply extends to the present fiscal year a provision which is contained in both the Townsend and Dowell bills, one of which it is hoped will be in effect by July 1. A similar bill was reported favorably but failed of passage at the last session. The Sells bill which passed the House at the last session contained an identical provision.

Eastern Superpower Plan Soon to Be Made Public

The superpower survey, authorized by the last Congress, is well along toward completion and the final report is expected by June 30. This survey of the possibilties of joining together in one interconnected line all of the electric power production of the northeastern section of the country has been in charge of W. S. Murray. The technical features of the plan are not causing as much difficulty as are the legal and financial, for while it can be shown that great savings will result from tying in all power lines in the district, the restrictions of state laws both as to export and import of power and as to profits of public utilities make difficult the questions of organization and promotion of any great power company.

Contend I. C. C. Has No Authority to Abandon Line

In a recent hearing before the Interstate Commerce Commission the Railroad Commission of Wisconsin, through its law examiner, A. H. Long, contended that the Interstate Commerce Commission has no authority to compel the abandonment of the branch line of the Green Bay & Western R. R. Co. into La Crosse. It is claimed by the Wisconsin commission that such action would constitute trespassing on state's rights and that the portions of the Transportation Act authorizing such action on the part of the Interstate Commerce Commision are unconstitutional. It is thought that the case may require trial before the Supreme Court. At this writing, no decision has been rendered by the Supreme Court in the Wisconsin case as to regulation of intrastate rates by the national commission. Forty-three other states supported Wisconsin in this action.

Senate Committee Starts Road Bill Hearings

July 1 Is Date Set for Having New Highway Law on Statute Books

Every effort will be made to have a new highway law on the statute books before July 1. On several occasions during the hearings in progress before the Senate committee Senator Townsend has expressed his determination to press his measure as rapidly as possible.

Thus far most of the witnesses who have appeared before the Townsend committee have been in favor of the Senate bill, although W. C. Markham, legislative representative of the American Association of State Highway Officials, confined his testimony largely to an explanation of the Dowell bill which the state highway officials favor.

Gray Silver, Washington representative of the American Farm Bureau, as this is written, is the only witness who has vigorously criticised the Townsend bill. His position is diametrically opposed to that of Senator Townsend in that he wants federal money so appropriated as to allow $1,000 per mile for each farm-to-market road in the country. It is contended that the Dowell bill represents the mean between these extremes.

George C. Diehl, representing the American Automobile Association, told the committee that he favors the Townsend bill because it recognizes the rights of the very wealthy states—states like New York, which have built and spent upward of $300,000,000 for highways—in that it provides for the construction of co-ordinating and connecting highways.

Commission Control Discussed

Senator McKellar expressed the opinion that a commission administration is frequently bad. "We would be in an awful fix if we had five presidents," he remarked. To this George M. Graham of the Pierce Arrow Motor Co. replied: "There is no essential difference between a highway commission in a state and a highway commission in the nation. The Secretary of Agriculture has said definitely that there is no way to conduct a highway system save by a commission."

Henry G. Shirley, engineer for Baltimore County, Maryland, in his testimony before the committee, said: "The width of the tire, the wheel load and speed are the three important things to control damage done to roads. We are getting isolated stretches of highway that are not connected. It is a patchwork. It is a disgrace. In some states

a state system has been laid out. In other states counties have been pauperized so that they will not be out of debt for a century."

Verbatim extracts from the testimony of Thomas C. Atkeson, representing the National Grange, are as follows: "The Grange believes that the time has come when all federal highway activities should be united in a single administrative department. There is probably no place where we can invest the taxes of the people more to their advantage than on the public highway, but this is limited to the extent that we can afford to pay the bill. The building of highways is going to involve the expenditure not only of millions of money but billions of money and ultimately hundreds of billions of money. The matter of administration is so gigantic that it seems to me that an independent commission which would have no other duties to perform would have its hands full in administering these federal activities in highway construction."

Will P. Blair, of Cleveland, among other things, told the committee that the great trouble about highway engineering in this country has been that we have had our minds directed wholly to the surface of roads. The injury to roads has suffered more from natural causes and lack of preparation than from traffic."

When the constitutionality of federal-aid legislation was questioned by one of the witnesses, Senator Townsend said: "There are three constitutional powers vesting in Congress this right to participate in the construction of roads. One is for the post offices and post roads. Another is for the national defense. The third is for the interests of interstate commerce."

At one point in the hearing Senator Townsend expressed uncertainty as to whether as much as $100,000,000 would be authorized as the Federal Government's contribution to road building.

Objections from Farm Interests

Mr. Silver listed his objections to the Townsend bill as follows:

(1) It creates a special commission [illegible] extravagant.

(2) It gives [illegible] the type, specifications and location of [illegible] at least one-half of the money.

(3) It [illegible] highways where there is a great amount [illegible]

(4) The necessary costly construction re[illegible]

Overloading Trucks Condemned

The Merchants Association of New York, at a recent meeting, passed a resolution condemning the practice of overloading motor trucks and operating them at excessive speed on the public highways. The association advocated a more rigid enforcement of motor vehicle laws.

Southwest Water Works Society Wants Operators School

Responsibilities of the water-works superintendent and how to educate him to meet them were stressed at the meeting of the Southwest Water Works Association May 9, 10, 11 and 12 at Oklahoma City. The Texas schools of two weeks' duration for operators were approved as was a measure by which the State of Oklahoma would provide $5,000 annually to educate operators in that state. Texas wants also to license operators.

Registration at the convention reached 250 and the average attendance at sessions was about 75. Discussions took more time than the papers and were entered into with enthusiasm by the many superintendents of the smaller plants. Following a paper on "Water Purification Methods" by C. Arthur Brown, a committee to revise methods of water analysis and standards of purification was appointed with instructions to confer with a similar committee of the American Water Works Association.

The main topics discussed at the six sessions were largely of interest to the superintendents of medium and smaller plants—state control, collections, regulations, reports, billing, operation needs, meter ownership and hydrant rentals. Representatives of the state boards of health of Texas, Oklahoma and Arkansas read papers outlining the needs of their boards and the meager financial support to meet them.

Technical Papers

One of the most valuable papers was on "Overhauling the Oklahoma Distribution System," by A. S. Holway, superintendent. The paper gave several instances of entire shut-downs due to lack of valves, or valves out of order when breaks in mains occurred.

A paper by H. V. Knouse described the ice business operated in conjunction with the Omaha Water Department, making an annual profit of $27,000 on an investment of $270,000.

Three prizes had been offered for the best record of collections for bills sent out. Seven contestants filed claims. The first prize was awarded to Winfield, Kan., which for a period of a year collected all of 60,000 bills with the exception of $1.55. The second prize went to Newton, Kan., for collecting 61,000 bills with the exception of one of $9, which was cancelled because that particular bill was a public charge. Manhattan, Kan., won third prize, having collected all but $13 for 50,000 bills sent out. A remarkably [illegible] made by the city of Independence, Oregon, [illegible] per cent [illegible] per cent.

The secretary, F. E. Fitzgerald, reported expenditures of $7,182 with $294 cash on hand for the association, and for the Journal an expense of $[illegible], with a cash balance of $[illegible]. [illegible] were admitted [illegible] the association.

To Celebrate Ridgway's Promotion

A testimonial dinner to Robert Ridgway, in celebration of his promotion as chief engineer of the New York Transit Commission, will be given at the Hotel Pennsylvania, New York City, June 9 at 7 p.m., J. Waldo Smith, chief engineer of the Board of Water Supply, is chairman of the committee in charge of the affair. Tickets at $5 each may be secured from W. J. Buhrendorf, Room 2224 Municipal Building, New York.

Bonds Approved for Bridge Over Mississippi at St. Paul

By a bill recently passed by the legislature of Minnesota, Ramsey County is authorized to issue bonds for $900,000 for the purpose of building, maintaining and repairing a bridge across the Mississippi River at Sibley St., St. Paul. Congress has authorized the structure, but approval of plans has not yet been obtained from the War Department. The bridge will provide a new and direct connection from the business district of St. Paul to the stock-yard industrial district in South St. Paul. It will be necessary to build the bridge close to high water level, as the street passes through a subway under the tracks of the St. Paul Union Depot Co. about 150 ft. from the east bank of the river. This will necessitate some form of movable span for passing navigation. The county will co-operate with the city in building the bridge. Oscar Claussen is ctiy engineer.

Joint Bridge Maintenance Subject to Commission Control

A decision just rendered by the Pennsylvania Public Service Commission establishes in effect that the obligation for maintenance of bridges in which railroads and cities or counties are jointly interested is subject to determination by the commission regardless of prior agreements between the parties. The decision was made in a case involving two industrial concerns, the borough of McKees Rocks, Allegheny County, the Pittsburgh & Lake Erie R.R., and a trolley line, and orders that the railway company make repairs to the structure, which had previously been declared unsafe, according to plans of the engineers of the commission. The county had disclaimed any interest in the structure, but is now required to pay a specified part of the cost. Amounts to be paid by the [illegible] and by any [illegible] company crossing the bridge after reconstruction are also fixed.

The newly elected officers are as follows: President, J. F. Carney; vice-president, J. H. Patterson; secretary-treasurer, F. E. Fitzgerald, Waco, Tex. The next meeting will be held at Hot Springs, Ark.

Commerce Chamber Committee for Unified Rail Operation

That the railroads, in order to re-establish firmly their financial stability, must make drastic reductions in operating expenses, notably in wages, and also must take measures to co-ordinate their services, principally in the terminals, are the conclusions reached by the railroad committee of the Chamber of Commerce of the United States in a report made public May 22. Emphasis is laid on the necessity of reducing operating expenses by increasing operating efficiency, and upon the fact that railroad wages must bear an equitable relationship to those paid in other industries.

The committee reports that every railroad company "must earnestly seek to adopt more economic methods of operation wherever changes in present practice promise to result in greater efficiency and economy. The first step toward the accomplishment of greater economies in the operation of railroads is the larger co-operation of the carriers with each other in the performance of their services. In terminal organization and management the co-operation of the carriers is especially urgent, and in this field undoubtedly many economies can be brought about."

Canadian Government Appoints New Grand Trunk Directors

The Canadian Government has appointed directors of the Grand Trunk properties in accordance with the act recently adopted giving the government control of the system, as noted in *Engineering News-Record* of May 12, p. 830. The following appointments to the government directorate have been announced: Sir Joseph Flavelle, Toronto; Howard G. Kelley, present president of the Grand Trunk Railway Co., Montreal; A. J. Mitchell, vice-president, Canadian National Railways, Toronto; E. S. Newcombe, Deputy Minister of Justice, Ottawa, and J. N. Dupuis, dry goods merchant, Montreal. The appointment of this board is understood to be temporary, preparatory to the bringing into force of the Canadian National Railways Act providing for the unified management of the government railways, but some of the temporary appointees are expected to be selected as members of the permanent board.

Housing Advisory Body Meets

An organization meeting of the advisory committee on housing appointed by Secretary of Commerce Hoover, as reported last week (p. 874), was held on May 16 and 17 at Washington. It was decided to enlist the advisory assistance of national engineering and similar organizations in order that the ultimate object of the commission's work, to aid in housing development, may be attained in the best and most rapid manner. Frank P. Cartwright of Rochester has been engaged as secretary to the commission.

Water and Sewers for Arlington Sanitary District

A report outlining plans and giving estimates for water supply and sewerage system, including treatment in each case, for the Arlington Sanitary District, comprising Arlington County, Va., adjoining the District of Columbia, has been submitted to the supervisors of Arlington County by David J. Howell & Son, civil engineers, Washington, D. C. The estimated cost of the first units proposed for construction is $1,026,000 for the water project and $225,000 for sewerage, but this includes only a part of the entire contemplated construction. It is recommended that all or nearly all of the water be metered. Sewage treatment would be by bar screens and sedimentation. The population of Arlington County was 16,040 in 1920 and the estimated population in 1950 is 38,700.

Power Commission Considers Other Water Rights

After listening to testimony from several witnesses, the Federal Power Commission on May 16 decided a further hearing would be necessary in connection with the application of C. E. Loose for permission to install a power development on the East Walker River in California, just across the Nevada boundary. The applicant proposes to use the power developed for mining purposes.

Irrigation interests appeared in opposition to the application, stating that the site could be used to better advantage for the storage of irrigation water. It was said that 12,000 acres of land could be made productive by devoting the water to their purposes. It was contended that the public would benefit immeasurably more by the irrigation project than by allowing the development of power in an arid region such as the one in question.

Chicago Engineer Reinstated

The Chicago city civil service commission has reinstated Thomas G. Pihlfeldt, city bridge engineer, who was dismissed last year on charges which led to a protest by the American Association of Engineers against the charges themselves and the manner of trying the case. (See *Engineering News-Record*, May 13, 1920, p. 937, and Aug. 12, 1920, p. 334.) The reinstatement is said to have been made on the recommendation of the commissioner of public works.

Engineer Corps to Get 7 Per Cent of West Point Graduates

A trifle less than 7 per cent of the officers who will be graduated from the United States Military Academy in June may be commissioned in the Corps of Engineers. The distribution of the commissions issued West Point graduates is based on the relative commissioned strength of the various branches of the service.

Recommend New Water Commission for Kansas City

Progress toward a new water supply for Kansas City was marked recently by a report of the Water Supply Committee ("Committee of 25") recommending a new administrative commission to take over the existing system and handle the proposed new work. The commission would consist of four members, two from each major political party. It would have authority to issue bonds, hold office for six years, receive $6,000 per year until the work is constructed but not longer than six years and would be named by the mayor before the bond and amendment election is held (probably in August). On the last point depends the outcome of the election because many organizations will work for the issue only if they know what the personnel of the commission is going to be.

The cost of the project, as recommended by Fuller & McClintock, consulting engineers, was $18,000,000, which was stated to be based on a ratio of 2.25 as compared with pre-war costs. The committee holds that the present ratio is 1.75, as evidenced by the U. S. Steel Corporation prices which are on a 1.63 basis and cement on a 1.75 basis in the Kansas City market. Within the 6 to 8 years required to build the new works the committee anticipates the lowest average price will reach a 1.25 ratio. On this basis it believes $11,000,000, or an average of 1.4 times the pre-war cost, will be sufficient.

With the consulting engineers, the committee agrees that the Missouri is the best source, that the water must be be filtered, that the present site and one in Missouri adjacent to the Platte-Clay County line are both practicable. Although the latter is favored, it is the committee's opinion that final decision should be left to the commission.

Engineers, individually and through the Kansas City Engineers Club, are co-operating with the Citizens Committee of Twenty-five.

Reorganization of Indiana Public Service Commission

Following the appointment of E. I. Lewis, chairman, Public Service Commission of Indiana, by President Harding to the Interstate Commerce Commission, the Indiana body was reorganized with J. W. McCardle, formerly a member, as chairman. The remaining personnel is as follows: Edgar Blessing, Maurice C. Douglas, George M. Barnard and Glenn Van Auken, commissioners, and L. C. Loughry, secretary. All are attorneys and new appointments except Mr. Van Auken, a court reporter.

No decided changes in policy are contemplated. Only one department head has been changed, Carl W. Wilde replacing M. D. Atwater as director of service. H. O. Garman, chief engineer will continue his duties with the new commission.

Indiana Court Decision Supports County Surveyor

A decision affecting county surveyors of Indiana was given recently by Judge T. W. Hutchinson, in the Clay circuit court, in the case of Frank E. James, surveyor, vs. Ralph H. Kattman, engineer and former county surveyor, and others, in favor of the plaintiff. Mr. James had sought an injunction to stop payment of money to Mr. Kattman for work on roads, to which project he had been appointed as engineer by the board of commissioners.

Several road petitions were acted on under the administration of Kattman, as surveyor. The commissioners asked Kattman to delay the work on account of finances, with a promise, it was said, that he would be appointed engineer on the roads, the fees of which would have amounted to approximately $15,000. Kattman was defeated in the Democratic primary election for the nomination, and James, a Republican candidate, was elected. James found the office an empty one, as the commissioners had appointed Kattman engineer on most of the roads to be built. James then brought suit to obtain the work which, he asserts, goes into the office of surveyor.

As a result of the ruling, Kattman will be compelled to turn over to the surveyor all papers and documents in connection with the roads on which he had been appointed engineer. Eleven roads, totaling more than 25 miles, are involved.

Public Health Association Moves to New York City

The headquarters of the American Public Health Association were moved from Boston to the Penn Terminal Building, 7th. Ave. at 31st St., New York City, May 1. Quarters on two floors will be occupied by the association together with eight other organizations having to do with public health matters and a liaison office of the United States Public Health Service. A common service committee has been formed and a joint library service is under consideration. The bringing together of these various health organizations is, in part, the sequel of the formation of the National Health Council in December, 1920.

Jamaica Bay Development Plans Approved by City

Plans, specifications, form of contract, and estimates of cost for dredging a channel at Mill Basin, Jamaica Bay, in New York Harbor, and for the building of a bulkhead were approved by the Board of Estimate of New York City May 13, following its authorization of April 1 for the expenditure of $750,000 for bulkheading Mill Creek to extend Flatbush Ave. across to Barren Island. Construction will be carried out under the Department of Docks of New York City, which drew the plans and specifications for the work. Dock Commissioner Murray Hulbert has announced that by June 1 it is expected to have dredges working on the channel.

The extension of Flatbush Ave. across to Barren Island will start to make available the 1,600 acres of city land which it is intended ultimately to develop as a deep water terminal site for which the Dock Department has made tentative plans for five piers, 800 ft. wide and 1,000 ft. long.

Authorize Construction of Two Short Railroad Lines

On May 14 the Interstate Commerce Commission issued certificates authorizing the construction by the Uintah Railway Co. of a line approximately 19 miles long northward from its present terminus at Watson, Utah, and by the Detroit & Ironton Railroad Co. for a line 15 miles long from Springwells to Fordson, Mich., on the western outskirts of Detroit.

In both cases request for authority to retain excess earnings, as provided in the Transportation Act, was granted.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York. Convention Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS. Public hearings. Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Engineers Club of Seattle, Wash., was addressed on April 15 by Dr. Yutaka Minakuchi on American-Japanese relations.

The Colorado Engineering Council is considering a project for an engineering building at Denver, Col. Resolutions of endorsement have been passed by the Colorado Society of Engineers.

The American Society of Mechanical Engineers announces the election to honorary membership of Henry R. Towne, head of the Yale & Towne Manufacturing Co., and Nathanial G. Herreshoff, naval architect and yacht designer.

The Rochester (N. Y.) Engineering Society, at its meeting, May 13, elected Edwin A. Fisher to honorary membership. Mr. Fisher has been in the city service for many years as city engineer and is now serving as consulting engineer and superintendent of Rochester's city planning bureau. At the same meeting the project for the affiliation of all of the local engineering organizations at Rochester was discussed. If the plan materializes there will be created a council composed of the presiding officers of the Rochester Engineering Society, the local sections of the national societies of electrical and mechanical engineers, the American Association of Engineers, the Rochester Society of Architects, and the Rochester Society of Technical Draftsmen.

The New York Section, Am. Soc. C. E., at its meeting in New York City May 18, elected Nelson P. Lewis, formerly chief engineer of the New York Board of Estimate and Apportionment, president and J. P. J. Williams, of the staff of the secretary of the American Society of Civil Engineers, secretary. Charles Gilman and Joseph J. Yates were chosen as directors.

The Iowa Engineering Society recently voted by letter ballot, 221 to 11, to join the Federated American Engineering Societies. The choice of the next annual meeting, also determined by letter ballot, resulted in 153 votes for Sioux City and 57 for Cedar Rapids. An employment service, recently initiated by the society, is handled by L. A. Canfield, secretary, Flynn Building, Des Moines.

Personal Notes

CURTIS Y. CLAWSON of Salt Lake City, has been appointed district engineer for Weber County, Utah, in charge of state road work.

NATHAN H. BAIER has resigned from the division of sanitary engineering, New York State Department of Health, to become operator and chemist with the new water purification plant at West Palm Beach, Fla.

HARTLEY ROWE, manager of the Detroit office of Lockwood, Greene & Co., engineers, has been made district manager of the Boston, Mass., office succeeding Kenneth Moller, who was recently elected into the firm of Lockwood, Greene & Co.

D. C. FENSTERMAKER, district engineer Chicago, Milwaukee & St. Paul Ry., has been granted a leave of absence to become associated with Peterson Brothers, Omaha, Neb., contractors, who will construct a new branch line in Cuba for the United Fruit Co.

EDWARD R. KNOWLES, consulting engineer and fuel expert, is now associated with Murrie & Co., Inc., New York, in charge of pulverized coal and gas fuel engineering work.

A. B. HARGIS, formerly owner in assistant engineer with Morris Knowles, Inc., Pittsburgh, has been appointed

city engineer and superintendent of waterworks of Jellico, Tenn.

FRANK H. WILSON, recently general superintendent of the third district, New York Central R.R., with headquarters at Cleveland, Ohio, has been elected president and general manager of the Cleveland Southwestern & Columbus Ry.

RALPH D. BALLEW, recently manager of the Grand Rapids, Mich., office of the Westinghouse Electric & Manufacturing Co., and before the war, city manager of Reidsville, N. C., has been appointed city manager of Grand Rapids.

DWIGHT PORTER, professor of hydraulic engineering, Massachusetts Institute of Technology, has resigned effective Oct. 1. He has been connected with the institute since 1883.

F. P. OBEE has resigned as chief deputy county engineer, Toledo, Ohio, to enter the highway and bridge contracting business with W. C. Stone at Ontario, Ore.

EDWIN R. QUIMBY, formerly chief engineer of the Consolidated Telegraph and Electrical Subway Co., New York City, and since then with All-American Cables, Inc., on special work in Mexico, has been appointed chief engineer of the International Clay Products Co., New York, and its subsidiary companies.

C. M. TALBERT has resigned after about twelve years of service as director of streets and sewers of St. Louis, Mo., to engage in a partnership in an insurance business.

C. H. FISK, in 1914 assistant sewer commissioner of St. Louis, Mo., and later chief engineer of construction for the city, has been appointed director of streets and sewers to succeed A. M. Talbert, resigned. During the world war he entered the construction division of the army as a major and was assigned to duty on warehouse buildings at Boston, Mass., and Brooklyn, N. Y.

PROF. HENRY P. TALBOT, head of the department of chemistry, has been named acting dean of Massachusetts Institute of Technology. Prof. Talbot was graduated from the institute in 1885. In the same year he became an assistant at the university, later an instructor, assistant professor, professor and since 1902 has been professor of inorganic chemistry in charge of the department of chemistry and chemical engineering. He is at present chairman of the faculty.

COLONEL H. W. CROCKER, who has been acting secretary of the American Society of Civil Engineers since the retirement of Dr. Hunt, and who was recently relieved as acting secretary by the election of E. M. Chandler, has left New York for Denver where he will resume his practice as consulting engineer. Colonel Crocker was in consulting practice in Denver for many years before the war and left there in order to accept a commission in the construction division of the army. His major assignment during the war was in charge of the construction of the Brooklyn army base.

LOUIS D. BLAUVELT has been appointed engineer for the Colorado State Highway Department.

JOHN J. SWAN, for the past two years with the Prest-O-Lite Co., Indianapolis, Ind., is now associated with the Engineering Business Exchange, New York City.

HOMER J. FORSYTHE, manager of the construction division of the engineering department of the E. I. DuPont De Nemours & Co., Inc., Wilmington, Del., has been transferred to the position of assistant general manager of the Hyatt Roller Bearing Co., Newark, N. J., a subsidiary of the General Motors Corp.

OBITUARY

THOMAS L. SMITH, founder, director and chief stockholder of the T. L. Smith Co., died April 29 in Milwaukee, Wis. He was born in England in 1855 and was graduated from Iowa State College in 1877. He later completed his engineering education at Massachusetts Institute of Technology. In 1920 Iowa State College conferred upon him the honorary degree of Doctor of Engineering. His early life was spent in drafting and engineering work with some of the large manufacturers of Milwaukee, including Allis-Chalmers Co., Filer & Stowell Mfg. Co., and C. J. Smith & Sons Co. Mr. Smith's interest in concrete mixers developed in 1898 and 1899 when he conducted a school of engineering and mechanical drawign in Milwaukee. In 1899 he invented the Smith tilting mixer and the first machine was manufactured in 1900. In 1905 he organized the corporation today known as the T. L. Smith Co., with assets of over $1,200,000. He developed the Sterling Wheelbarrow Co., West Allis, Wis., from a small concern to the largest and most successful of his holdings at the time of his death. The Smith Engineering Works, Milwaukee, manufacturers of Telsmith rock and ore crushers was also organized by Mr. Smith.

WILLIAM H. DAVISSON, for the past seven years assistant district engineer in the office of the Pacific District, Bureau of Valuation, Interstate Commerce Commission, San Francisco, Cal., died in Oakland, Cal., May 3. He was born in Kalamazoo, Mich., in 1862 and he was educated at Griswold College, Davenport, Ia. He entered the service of the engineering department of the Chicago, Rock Island & Pacific Ry. as chainman, later he became general roadmaster and, in 1906, assistant chief engineer. In 1907 he entered the service of the Chicago, Milwaukee & St. Paul Ry. in charge of construction work on the Puget Sound extension in the vicinity of Missoula, Mont. In 1910 he was appointed principal assistant engineer of the North Coast Railway, now a part of the Union Pacific System. In 1914 he was appointed field engineer by the Bureau of Valuation, Interstate Commerce Commission, in charge of roadway inventories of railroads in the Pacific District. Later he was promoted to assistant district engineer, which position he held at the time of his death.

FREDERICK W. DAGGETT, superintendent of the Trenton, N. J., filtration plant, died May 10 in Trenton. He had been connected with city water filtration plant since 1913, entering its service as erecting engineer.

DR. EDWARD B. ROSA, chief physicist of the U. S. Bureau of Standards, died May 18 in Washington, D. C. He was born in Rogersville, N. Y., in 1861 and was graduated from Wesleyan University in 1886. He received the degree of Sc.D. in 1906 from this university and the degree of Ph.D. from Johns Hopkins University in 1891. From 1891 to 1901 he was professor of physics, Wesleyan University. In 1901 he became connected with the U. S. Bureau of Standards as physicist and, later, was appointed chief physicist. He contributed to American and European journals of physics and electricity and the publications of the Bureau of Standards. He was in charge of the electrical division of the Bureau of Standards including investigations on standards of service and safety for public utilities. In the World War Dr. Rosa developed a number of scientific instruments of great value, among which were a sound-ranging device for locating big guns, the geophone for detecting mining operations and the development of aircraft radio apparatus.

FRANKLIN K. LANE, Secretary of the Interior for seven years, during the Wilson administration, died May 18 in Rochester, Minnesota. He was particularly proud of the fact that he was in charge of more engineers than any other administrative official, either public or private, in the world. While his position precluded his taking an active part in the campaign for a Department of Public Works, he made no secret of the fact that he approved such a step and he did much to encourage the movement. While not an engineer himself, he was firmly of the belief that the Secretary of the Interior, or the Secretary of Public Works, as he would like to have had it, should be an engineer. He frequently expressed his admiration for engineers as a class. On numerous occasions he declared that for result getting and thoroughness, the engineering profession led all others.

Business Side of Construction

Facts and Events that Affect Cost and Volume

National Conference Board for Building Industry Proposed

Establishment of a national conference board of the building industries is expected to result from a discussion of the matter before Secretary of Labor Davis in Washington May 11. The executive board of the Associated General Contractors of America adopted a resolution urging the establishment of such a board. The purpose is to have the board study working conditions, production, waste, costs and other matters which have a general application to the building industry. Secretary Davis, following the outline of the resolution, promised to appoint a committee to draw up tentative plans providing for the creation of such a board and to outline its activities. He will appoint three members to the committee from each of the following groups: Associated General Contractors, American Institute of Architects, American Engineering Council, the public and the building trades department of the American Federation of Labor.

The tentative plan is to be submitted within thirty days. Within ninety days, Secretary Davis will call a general meeting, at which time final consideration to the plan will be given.

Municipal Supply Scheme in London

(London Correspondence)

A scheme for inter-municipal trading on a large scale is under the consideration of the standing joint committee of the London boroughs. Under this scheme it is intended that the local authorities will become engineers, iron and brass founders, pavement makers, brick makers and colliery owners and producers and distributors of all kinds of materials used by municipal authorities. The various boroughs are to apply for Parliamentary powers to establish depots for mutual supply and for purchasing on a co-operative basis. The scheme includes all kinds of building materials, road materials, metals, stoneware, stone, gravel, cement, tar and timber.

April 1921 Automobile Shipments 70 Per Cent of April 1920

According to information given out by the traffic department of the National Automobile Chamber of Commerce, reports from factories representing three-quarters of the total automobile production indicate that the shipments for the month of April exceeded the previous month by approximately 27 per cent. The April, 1921, shipments were, it is estimated, at least 70 per cent of the figure attained in 1920.

Low Bid on Cleveland Reservoir Is $2,205,248

Thirteen contractors submitted bids for the construction of the 125,000,000-gal. concrete reservoir which is to serve both as a clear well for the Baldwin filtration plant to be built and as a distribution reservoir for the low-service district of Cleveland, Ohio. The low bidder was the Mellon-Stuart Company, Pittsburgh, the low bid being $2,205,247.90. The high bid was in excess of $2,800,000, or 31 per cent above the low bid. The engineer's estimate for the work was $2,250,000.

Notable in the unit prices were the bids upon concrete for various purposes. In concrete for wall foundations the per cubic yard bid of the low bidder was $11.78 and the unit prices of all bids ranged between $10.99 and $16.95 per cubic yard. On concrete for walls, pilasters and conduits a low unit bid of $12.20 per cubic yard and a high bid of $18 per cubic yard were registered. In concrete for sub-floors and column foundations the low bid was $9.87, the high bid being $17.04 per cubic yard. Bids for concrete for groined and barrel arches ranged between $17.04 and $28, the Mellon-Stuart bid for this type of work being $19.81. For concrete floors, the low bid was $11.15.

There are forty-two items included in the work, the largest of which are as follows: Concrete, 114,100 cu.yd.; reinforcing steel, 3,500,000 lb.; fill and embankment, 120,000 cu.yd.; tile drains, 26,000 lin.ft.

The Guild of Builders in England

(London Correspondence)

The British Minister of Health has stated in Parliament that approval has been given as an experiment to the carrying out of thirteen housing schemes under the building guild system. At the present it is not proposed to extend this system, not because the government has any hostility toward the guilds but, unless building guilds can erect dwellings on an economic basis, they will not be employed. It has been stated in Parliament that under the system of building by direct labor each brick laid costs 1 shilling.

On one estate, near Manchester, it is estimated that each house built by the guild costs £120 less than when built by private contractors. In another district, Heywood, the housing committee recommended the acceptance of the tender for houses submitted by the guild which was £26,000 below that of the local builders and £16,000 below one submitted by another housing contractor.

A meeting of the Manchester trade unions is shortly to be held to consider the practicability of the extension of the building guild system.

The Present and Future of the Building Industry

Trend in Contracts Let This Year—What the Construction Needs of Industry Are

Construction work is essentially dependent upon the necessity for the extension of public works, upon increased requirements of transportation interests, including those pertaining to highways, upon the need for added office and housing space, and upon the ability of basic industries to expand, due to the increased demand for manufactured products. When any slump in business occurs the contractor is among the first to suffer, inasmuch as lack of business means lack of extensions and the practical cessation of all building. Therefore, the contractor today is spending a great deal of time investigating the opportunities for keeping his organization busy which this and that field of construction offers.

What the future is in these various classes of construction can best be found out by analyzing the trend in contracts let so far this year and by appealing to the various industries for information as to future plans. No account will be taken here of the influences of labor and materials on, or the attitude of financial interests toward, construction work.

Analysis of Contracts Let

Analysis of the contracts let, as reported in *Engineering News-Record*, for the first four months of 1921 reveal at least three well-defined situations: First, that industrial building, aside from a general program of steel and concrete garage building, is not to be compared with the activity noted during the early part of 1920; second, that the building of apartment houses, educational institutions, churches, bank and office buildings, and theatres and other amusement places, has this year shown marked activity; and third, that street and highway construction is not far behind the 1920 program. The extreme lack of public educational facilities due to inaction in that class of building during the war years, has led to a great amount of public school building within the past few months. Within the past few weeks considerable impetus has been given to apartment house construction, the most notable increase in this class of work being noticed in New York City, where a tax exemption ordinance became effective more than two months ago. This miscellaneous building, including the classes of construction mentioned above, has been going on during the past three months at the rate of $[illegible] per month or more, the greatest activity having been noticed during the past month, when [illegible]

weeks the value of contracts let ranged between $12,000,000 and $15,000,000.

Highway construction has been and apparently will continue to be for the season carried on extensively by the larger and more populous states. New York, Pennsylvania, Ohio and Illinois are the states leading in this class of work, though less extensive programs of highway development are being carried out systematically by many other states. Though New York suspended its highway construction program during the 1920 season there has been enough of a recession in prices to make it worth while for that program to be actively carried out this year. In New York contracts have been let on practically every bid so far advertised this year and for from 85 to 90 per cent of the estimates made by the engineers. Considerable extensions in county highway work have also been noted. On the other hand the repaving programs of municipalities have not been as large as apparently they should be to overcome the inactivity of war years. Street and road construction has been going on during the past four months at a rate of from $35,000,000 to $45,000,000 per month, which, under the present circumstances, is considered not unsatisfactory when it is remembered that approximately $750,000,000 represents the approximate total available for road construction this year.

Public works construction is recovering slowly. There is apparently plenty of funds with which to carry on large programs of sewer and water supply construction. Some municipalities have made extra efforts to begin and prosecute vigorously public works construction programs in order to relieve local unemployment. Despite apparent backwardness public works extensions cannot be deferred much longer without seriously endangering the public health.

Industrial Building

In industrial building, extensions in factory and warehouse space for the automobile industry are not expected, at least during the coming 18 months. Most of the automobile factories were considerably extended during the war and the changing over of much of this war-factory equipment and space was not entirely accomplished until late in 1920. That space then became available for the manufacturers of automotive vehicles. Unless the unexpected happens from a sales end, not all of the space thus provided will be needed during 1921

Inseparably associated with possible demand for expansion of textile manufacturing facilities must be opinions and evidences as to demand for manufactured products. Not long ago a man who is very close to conditions in the textile industry asserted that "the textile industry is experiencing the most remarkable come-back in its history. Every mill isn't running to 100 per cent capacity, but by far the majority of mills have sold enough merchandise to keep them comfortably engaged for some months to come. It is generally conceded that the normal demand for American-made textile products is in excess of present facilities to produce. On this basis, therefore, I think it can be safely stated that the textile industry will show an approximate increase for the next few years of about 250 new plants annually."

No great amount of building in the machinery industry is expected within the next few years. Some builders of electrical machinery, many builders of printing machinery and a few producers of textile machinery have been kept fairly busy, but otherwise the industry is working on short time. The majority of machine-tool builders find themselves with large, modern plants equipped with up-to-date machinery but little prospect of securing enough orders in the near future to occupy the plants to capacity. The tremendous expansion in the manufacturing capacity of the machinery industry during the war has made it unlikely that considerable extensions will be made in the next few years.

Metals, Chemicals and Coal

The serious drop in the metal market has made it impossible to give any forecast of new construction in the metal-producing industry. While the present depression exists financing of new projects will be difficult. At present several large companies have important programs under way, but these were practically all entered upon before the metal market dropped. Various small construction jobs are also under way, but these are comparatively unimportant.

In the chemical and related industries much of the construction carried on during the war was of a temporary character which undoubtedly will have to be replaced with permanent structures. On the other hand these industries were much overbuilt as a result of the expansion during the war and it is true that many structures have since been sold for other purposes. Nevertheless the chemical industry is adhering to its slogan that "it is never built but always building."

Construction and development work in the bituminous coal mining industry is below normal and is confined almost entirely to the work on properties of the larger and stronger companies. There was a great expansion in 1920 among the smaller operators, the majority of whom are not operating at all now, or only for a few days a week. New incorporations are no more in number now than last year, nor in any year, and not all these new incorporations finally result in construction and development of mines but many do, and new mines are being opened in every field to meet the inevitable need for replacement of property worked out and abandoned. In the anthracite industry construction and development work is proceeding practically on a normal basis.

Water Movement of Western Lumber to Atlantic Ports

Pacific Northwest lumber shipments through the Panama Canal to Atlantic Coast markets increased 3,435 per cent the first quarter of 1921 as compared with the same period of 1920, according to a report recently issued by the West Coast Lumbermen's Association. During the first three months of 1920 only 1,202,229 ft.b.m., of Pacific Northwest lumber were shipped to Atlantic Coast points by water, although at that time west coast mills were shipping to those markets more lumber than had ever before been sent east of Buffalo and Pittsburgh. For the first three months of 1921 Atlantic Coast cargoes of Pacific Northwest lumber totaled 42,495,579 ft.b.m.

Maricopa County Considers Building Cement Plant

Maricopa County, Arizona, is considering the construction of a cement plant with a rated daily capacity of from 1,000 to 1,200 barrels. Whether the county can legally operate a plant in competition with private concerns is a question which the county attorney is now investigating. A bill passed by the last legislature authorized the issuance and sale of bonds for the construction and maintenance of industrial plants, which gives Maricopa County authority for construction of a cement plant for public building only.

It is believed there is ample room for a plant constructed and operated by public money, inasmuch as during 1919 the total state consumption was 366,000 barrels and in 1920, 515,000 barrels. If legal, it is possible that the plant will be constructed partly with public money, then leased to a private company to operate with the provision that the county be furnished cement for a certain period at a price 5 cents per barrel in excess of the production cost.

Wholesale Prices Fall

A further decline in the general level of wholesale prices was noted during April according to information gathered in representative markets by the United States Department of Labor through the Bureau of Labor Statistics. The Bureau's weighted index number dropped from 162 in March to 154 in April, a decline of approximately 5 per cent. The April figure is nearly 42 per cent below that of April, 1920, and about 43½ per cent below the high peak of last May.

New York Price of Dynamite Same as in April

Through a typographical error, 40 per cent gelatin dynamite was quoted at 22¾c. per lb. in New York, instead of 32¾c., in the Monthly Prices of Construction Materials in the May 5 issue of *Engineering News-Record*. On March 3 the price was 33¾c., and since our issue of April 7, 32¾c.

Building Trades of Philadelphia Eager to Improve Status

Through its committee on education and information the Council of Associated Building Trades of Philadelphia and vicinity is carrying on a campaign of education whereby it hopes to strengthen its organization and impress upon the minds of the public that it is a thoroughly responsible institution. The organization is endeavoring to co-operate with the Master Builders' Exchange in Philadelphia in the settlement of all questions of mutual interest with the smallest loss of time and effort. In addition, certain educational courses are given, in order that the efficiency of the individual workmen may be increased through added knowledge and experience.

The efforts of the trade unions to make their organizations more attractive to the nonunion men, to improve

DO YOU KNOW
That the BRICKLAYERS of Philadelphia

maintain a General Committee for the promotion of the art of bricklaying, which includes the following sub-committees?

1. **Health and Safety.**
2. **Materials and Methods.**
3. **Efficiency and Production.**
4. **Co-operation** (with Architects, Engineers, Contractors and Manufacturers)
5. **Statistics** (on wages, working conditions, etc.)
6. **Public Information**
7. **Elimination of Unemployment**
8. **Education and Information of Apprentices and Journeymen.**

Our General Committee and Sub-Committees stand ready at all times to assist the public either in an active or informative way. We want you to understand that our purpose is to serve the public to its best interests and to our mutual satisfaction.

There is great need for and we will welcome an engineering analysis and survey of our industry to overcome intermittent employment, which will prove the fairness of our position regarding wages and living conditions.

Bricklayers' Local No. 1
707 N. Broad Street
Telephone, Poplar 2990

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FACSIMILE OF ADVERTISEMENT

their status, to increase the efficiency of their members and otherwise establish the public confidence in organized labor have been greatly aided by the co-operation of architects and others inspired by the efforts and vision of G. Knickerbacker Boyd, a Philadelphia architect.

Included in the program of education of the Philadelphia union are certain suggestions made at a recent conference of the building industry called by the industrial relations committee of the Philadelphia Chamber of Commerce, by W. S. Hays, a Philadelphia industrial engineer and consultant on industrial relations. How the unions might improve their status was summarized by Mr. Hays as follows:

(1) Obtain the confidence of the employers by proving that the status is not of 1920 peak wages, if it is.

(2) Develop the small job market to stabilize employment.

(3) Remove any union rules and any other restrictions which may be causing unnecessary costs and delays.

(4) With employers and material men co-operatively strive to lower unit costs and devise better methods.

(5) Educate building trades to a pride in craft.

(6) Develop a classified wage incentive system above the basic minimum wage to attract new men to the building trades and give all the impetus to become efficient and proficient workers.

(7) Create with employers a tribunal or board jointly maintained which will develop industry as a whole and eliminate waste of the unemployment in building trades by promoting year round construction programs and co-ordination of new public and private construction with maintenance and repair work.

Several of the various locals included in the Council of Associated Building Trades of Philadelphia are carrying on extensive advertising campaigns to increase their number. For instance, Bricklayers' Local No. 1 maintained a [illegible] for the promotion of the art of bricklaying, including the sub-committees noted in the advertisement running in the local newspapers, a facsimile of which is shown herewith.

City of New York Will Not Pay Contractors' Claims

Although a bill was recently passed and signed by Governor Miller empowering the city of New York to pay claims filed by subway contractors for additional costs due to increases in wages and materials incident to the war, the city does not intend to pay any of the claims, according to the assistant corporation counsel. Such claims put in by contractors exceeded $7,000,000.

The new law signed by Governor Miller amends the Walters act of 1918 and a subsequent act introduced by Senator Charles T. Lockwood, which was passed to facilitate completion of contracts by granting relief. The act affords no opportunities to recover profits.

Car Loadings Decrease

Reports received by the car service division of the American Railway Association from the railroads of the United States showed a decrease of 3,972 in the number of cars loaded with revenue freight during the week ending May 7. Total number of cars loaded was 718,024, 125,000 below the number for the corresponding week in 1920, and 35,000 below the figure for the corresponding week of 1919.

Increases were reported in the loading of grain and grain products, live stock and ore, but decreases in coal, coke, forest products and merchandise and miscellaneous freight which include manufactured products. Decreases were reported compared with the corresponding week of 1920 in the loading of all commodities except grain and grain products, merchandise and miscellaneous freight.

Deferred Construction Extensive

In a meeting of the executive board of the Associated General Contractors of America, Frederick L. Cranford, vice-president of the A.G.C., had the following to say regarding the outlook in the construction industry:

"We believe that in the present industrial depression the construction industry is an important factor, because it is not only a preliminary step to any new development or enterprise, but because there is a vast delayed program to be performed. Ten years or more ago, E. H. Harriman stated the railroads were in need of an expenditure of a billion dollars a year for five years; that expenditure has not been made and it is probable that the need today is for even a greater amount.

"Hydro-electric development has been retarded, due to the withdrawal of all public lands from entry for such use some fourteen years ago.

"The development of all public works and utilities was largely stopped upon our entering the war, and financial difficulties have prevented any considerable extension of them since.

"Reclamation and irrigation projects have been quiescent since 1914.

"With 1,100,000 young men reaching the age of 21, and somewhat less than that number annually being married, it seems safe to estimate that during the last six years there has accumulated a housing shortage of over a million, possibly a million and a quarter homes.

"Adding the delayed public works of our cities, and states, roads, terminal facilities, docks, warehouse, factory, home and business building construction, canals, and waterways, it is quite easy to figure a delayed construction program in the United States of $15,000,000,000."

Ex-Service Men in British Building Trades

(London Correspondence)

The government scheme for the absorption of 50,000 ex-soldiers into the building trades, which has been approved by the building employers, provides that the scheme shall be worked through local committees made up of members of the Association of Master Builders, and if the unions agree to the scheme, of representatives of the various trades unions. These committees will select men from the register of their local employment bureaus and will advise on that branch of the trade in which each candidate is likely to show most promise.

A two-years' contract of service will then be made between each man and his employer, with a clause that the contract may be broken after a three-months' probationary period should either party be dissatisfied. Another clause provides that the candidate may be transferred, with his consent, from one employer to another. An employer may, at any time during his two years' service, agree to be responsible for a

service, apply to his employer for a proficiency certificate, which will entitle him to a higher grade of pay. Each district committee will deal with any compaints and will supervise, in a general way, the service contract.

These rates will be in force under the government scheme:

1. For first six months of contract, 50 per cent of the district skilled rate plus 10s. per week.

2. For second six months, 65 per cent of the district skilled rate plus 5s. per week.

3. For third six months, 80 per cent of the district skilled rate.

4. For last six months, 90 per cent of the district skilled rate. After this 100 per cent.

The government will contribute toward the wage payments made by the employers 10s. per week for the first six months and 5s. per week for the second six months. This contribution will be paid for a full week even though the man may be working short time, always provided that he present himself for work on the days on which he is required.

If during the first twelve months the employee receives more than 65 per cent of the district rate, the government subsidy will cease from this date.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.35	+$4.25	$4.50	$3.25	$3.51	$4.65	$4.35	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.25	3.25	3.75	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	45%	5%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.00	64.10	67.80	70.00	85.90	72.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80 (del.)	3.00	2.60	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	−3.50	2.75	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	2.75	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	2.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	40.00	50.00	55.00	38.00	47.00	27.00	25.50@28.50	120.00
Lime, finishing, hydrated, ton	21.00	22.50	+27.50	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	3.00	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.50	16.00	12.00	18.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	13	12	10	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	....	15	.13	09½	.10	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	+.80	+.70	+.90	.82	+.91	+.95	+.94	.79	−.70
Common Labor:									
Common labor, union, hour	.75@.80	.35		1.00	.50	50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.35@.45	.40@.50	.50	.37½@.50	.50@.55	.40@.45	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

Business in the construction materials market is extremely light, and pronounced activity is hardly expected before August. Materials are available and prices in many instances are surprisingly reasonable, but the habit of doing nothing presses heavily upon the buying public. In New York cement is at the lowest price commensurate with safe business for the dealer. It can go lower only if cement manufacturers will it. Although there is no change in the official quotations of sand and gravel, sand can be bought, delivered in Manhattan, at $1 per cu.yd.—probably this week only.

On May 12 we called attention to the stiffening of the linseed-oil market, and predicted a rise. On that date oil in New York was available at 70c. per gal., in 5 bbl. lots. Today the price is 80c. This week we announce further advances in Atlanta, Denver, Minneapolis, Dallas and San Francisco. The oil is scarce and seeds are high.

Very little activity is evinced by either the metals or the iron and steel markets. The steel mills accumulate orders until there are sufficient to warrant changing the rolls. Ordinarily, this policy would turn business to the warehouses, but demand is almost nil.

The lumber market is about the same as last week, but Atlanta predicts a stronger tone. Lath in Atlanta is up $2, and dealers reflect greater optimism and money appears to be easier. Our Atlanta correspondent warns that quotations on all materials are by no means absolute and that it is a buyers' market.

As to labor—Chicago predicts settlement of the wage controversy next week. In San Francisco seventeen building crafts are on strike, while the others have been locked out. Builders in the Bay region, outside San Francisco, have notified unions that from May 23 wages would be as decided by the San Francisco arbitration board.

All Minneapolis building crafts are "theoretically" on strike. A meeting between representatives of unions and employers resulted in nothing, because the closed shop, and not the 20 per cent reduction, was made the first issue. The closed shop was refused, and labor men withdrew from the meeting.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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Vital Tests

HOW vital and numerous are the bacterial tests made at well operated water-treatment plants is little appreciated even by the general run of water-works men. The number runs into thousands a year at single plants and upon the care used in making and interpreting the tests largely depends the health of millions of people. Certain questions having arisen as to a new standard for bacterial tests, this journal has made a country-wide survey to find how much this test—the B. Welchii—is used and in what regard it is held. The results of the survey are appropriately presented in this issue which will go to the Cleveland convention of the American Water-Works Association. A variety of other articles that will appeal to water-works men and to broad-minded engineers are printed in this issue.

Gary Hopeful

IT IS generally conceded that the U. S. Steel Corporation is the best managed of our giant industries. In fair weather and foul it has kept on a consistent course, predicated on a thorough understanding of conditions. In consequence Judge Gary's views are accorded unusual weight and attention. Right now, therefore, when business is below normal, it is worth noting the tone of optimism in his address last week before the Iron and Steel Institute. He is not at all discouraged. Business is improving. "Patience, courage and a fair disposition will bring satisfactory conditions in due time." True, others have said these things recently, but it is well to repeat them when so competent an authority holds the same views.

Meeting Water and Sewer Costs

BESET with difficulties to provide money for long over due improvements, as all municipal authorities now are, welcome may be expected for the article presenting a new plan for meeting both capital and operating costs of water and sewer systems, printed on p. 944. The plan is already being applied in Maryland and deserves study and test elsewhere. Its authors consider it applicable to extensions as well as to the new works for which it appears to have been originally designed. A commendable feature is that it presupposes a wide use of meters.

Road-Building Plant

THE principal defects of concrete road construction equipment named by B. H. Piepmeier in the article on p. 949 are that the individual machines break down too easily and are too cumbersome and expensive. Incidentally it is urged that standardization has not been pursued sufficiently. Since they are based on two seasons' observation, these conclusions deserve attention. It is of particular interest to note that a radical change in paving mixer practice is considered important. Small, quick-acting mixers are advocated and the possibility of batch observation during mixing is held essential. In the small mixer, output capacity, heretofore secured by increased size, is to be sought by hastening the mixing operation by a more intensive mixing action. Obviously some nice problems in the mechanics and the commercial manufacture of mixers are introduced by these requirements. Nevertheless it is fairly well known that one large mixer company has long been experimenting with a mixer that would fully meet the requirements laid down. The argument is sound in its broad contention that concrete road-building plants exhibit in practice a haphazard selection and design of equipment units. Some sound study has been given the subject, but there is need for co-ordination, standardization and certainty of operation. Road building deserves more consideration as the routine manufacturing process it is fast becoming.

Controlled Coagulation

MUCH qualitative but little quantitative information is available on the flocculation of turbid waters by aluminum sulphate. Prof. W. F. Langelier (p. 924) finds that the agitation of water with only 0.5 to 0.8 gr. of alum, or half to a third of the usual amount, will, within limits, effect coagulation regardless of the amount of turbidity. Further, that higher alkalinities require more alum; that an acid alum rather than basic, upon which operators have always been so insistent, is probably better for most waters; that the higher the velocity of the water in traversing the mixer the speedier the floc forms; that agitation gradually reduced gives better results than violent agitation followed immediately by a comparatively quiescent state. All of these conclusions have market value in dollars and cents in filter-plant design and operation. The experiments on short circuiting of water from inlet to outlet also suggest a promising line of experimentation. Such experiments in large tanks were undertaken at the Spring Garden Testing Station in Philadelphia years ago but unfortunately the results were never made public. Salt was used but was found to have too high a chemical diffusive ability to make the results reliable. The temperature of the water in plain sedimentation basins was found to be one of the most important factors; a warm incoming water could be traced from inlet to outlet by a thermometer. Mechanical agitation would seem to be almost the only method of effective dispersion if approximately complete displacement is to be obtained. Baffling to raise the velocity to a point giving equal results causes heavy expense for constant pumping to overcome loss of head. While Professor Langelier's figures are admittedly tentative they at least reduce the matter to a quantitative basis. The Secretary's results are far reaching but they should be checked by others since some of them are so contrary to generally accepted theory.

Shall B. Welchii Displace or Supplement the B. Coli Water Test?

BETWEEN the water consumer and water-borne disease germs stands the bacteriologist, ever on the alert to detect and to warn of danger. The layman supposes that the water bacteriologist searches for a specific disease germ, but what the water analyst looks for is an indicator of pollution—generally recent pollution—that may be expressed by a quantitative index number, having also some qualitative significance. After years of pure research and of routine water tests the B. Coli test stands today as the accepted standard index of water safety. That a more specific test would be welcomed is no secret but no substitute has yet been found that is so universally available, both as to technique and interpretation.

Of all the substitutes or supplements thus far tried the one that seems to stand out most prominently is the test for B. Welchii in this country and for B. Enteritidis Sporogenes in England—organisms considered by many to be identical or at least unquestionably of the same group of anaerobic spore formers. To learn how widely the B. Welchii test is used, and to get opinions as to its value and also on B. Welchii as a possible cause of water-borne intestinal troubles, *Engineering News-Record* has made a country-wide survey, the first installment of the results of which begins on p. 929 of this issue. That most of the fact and opinions gathered from 66 engineers, bacteriologists and sanitarians are negative as to the value of the test and the danger from this germ is all that needs be said at this point, in view of the summary given in the article.

A remarkable summing up of the case for the B. Coli test, all the more significant here because a number of our correspondents have referred to the use of the B. Welchii equivalent test (B. Sporogenes) in England, and to Sir Alexander Houston (better known to Americans as Dr. A. C. Houston) as a user of the test, is found in his "Water Supply" (London, 1913; p. 168). It reads:

> The B. Coli test is by far the most reliable and speediest method of judging the degree of efficiency of the particular water purification process under investigation, *and when a sterilization treatment is in operation the certified destruction of B. Coli should afford absolute proof, practically speaking, of the devitalization of all the microbes of epidemic water-borne disease.* [Italics ours.—EDITOR.]
>
> All the counts in the indictment charged against the B. Coli test when fully marshalled amount to no more than this: the test is only, or mostly, of relative, not absolute, value, and therefore the results should be interpreted with discretion.

Sir Alexander touches but lightly upon the B. Sporogenes test. If it be urged that the book was written eight years ago, it may be noted that in his Thirteenth Research Report, published in 1920, Dr. Houston summarizes numerous Coli tests of the various London supplies, but no Sporogenes tests.

From all the information we have been able to gather during an inquiry extending over several months we can draw no conclusion that warrants more than the tentative or experimental use of the B. Welchii test, nor the condemnation of a water supply because it sometimes contains B. Welchii.

To accept the assumption that B. Welchii is a water-borne disease germ, as more than one of our correspondents has urged, would lead to nothing short of a revolution in the theory and practice of providing safe water supplies. It would mean millions or billions of added expense for potable water, and that at a time when our typhoid and other vital statistics all point to the practical elimination of water-borne diseases, wherever sound engineering advice has been followed in the selection of a source of water supply, the provision of purification works, if needed, and in the *maintenance* of the works at a reasonable state of efficiency.

In conclusion, it should be pointed out that with the practical elimination of typhoid, wherever well-accepted principles are followed, an attack may now be made on the occasional and relatively minor intestinal troubles, if it can be shown that these come from water and are due to anything but accidents arising from sheer negligence—accidents that should be eliminated without regard to the main question. No large waterworks capital outlays or operating charges will be warranted for an attack on these intestinal disturbances until it can be shown that they are water-borne. Here is an unworked field for health boards and every progressive practicing physician.

Change in Plan of Lockwood Inquiry

THE Lockwood Committee which has been investigating the building situation at New York has abruptly terminated its inquiry into alleged illegal combinations of building materials dealers, producers, and contractors because the committee's counsel, Samuel Untermyer, believes that fines are of no value in breaking up the alleged illegal combinations. The New York judges have been imposing fines instead of sending the guilty to jail.

It is hard to say whether the public is to be congratulated or condoled with because of the termination of this phase of the committee's inquiry. Some good has been accomplished in uncovering bad practices. On the other hand, unwarranted suspicion has been cast on many branches of the construction industry. The procedure has been of a star chamber kind. No evidence in rebuttal was allowed and no cross-examination. Counsel for the committee guided the testimony solely to strengthen the case he desired to make. Such is not the way of justice.

It is significant that two days before the committee's decision to change the course of its inquiry there was heard in New York a defense of the principal business instrumentality attacked by the committee—the open-price association—and the speaker was none other than the Secretary of Commerce. What he said, incidentally, is full endorsement of the position that *Engineering News-Record* has taken upon the usefulness and purpose of open-price associations. Said Mr. Hoover, "Today many students of combinations in restraint of trade are much exercised over the creation of open-price associations, but every single one of these associations that I have been able to investigate originated from the rightful desire on the part of those engaged to secure accurate, complete information on the volume of production, on stocks, on consumption, and on price." The Secretary would undoubtedly admit that these associations may be made a means of circumventing the public, but interchange of price information upon closed transactions furthers the stability of industry and thus proves of general benefit. Their usefulness can be further enhanced, and wrongdoing prevented, if, as this

journal has already pointed out, the statistics that are supplied to members are furnished simultaneously to the public, through the government and the press.

It is further worth while to note that the judge at whose action Mr. Untermyer became incensed made the point, in imposing the fines, that the evidence did not indicate that the public had been harmed. Said Judge Davis, "I have made a thorough examination of the accounts submitted to me—submitted under oath—and I can find no evidence that the defendants have been guilty of profiteering. Nor does it appear that they have made exceptionally large profits as a result of their criminal combinations." Closing his comments he added, "There is absolutely no evidence before the court that in carrying on this illegal combination anybody was coerced or threatened as a means of compulsion."

For one result, aside from the illegal combinations exposed, the Lockwood Committee must be given credit —for shocking into a sense of their responsibility the prominent contractors whose activities gives them a better insight than anyone else into what is going on in the building trade. With them must rest the responsibility for preventing the growth again of the bad conditions disclosed.

Action Needed in Federal Government Reorganization

THOUGH plans for the reorganization of our national government have been under consideration before, no time has ever been as propitious for action as the present. There is a country-wide demand for retrenchment in expenditures, and for a more logical rearrangement of the government's functions. In addition, the war shock and the post-war contraction have created a condition more favorable to change than has existed for many decades.

But there is danger that we may let the golden opportunity slip by. Already it is rumored that Cabinet officers who took their places as professed believers in the need for reorganization are beginning, under the pressure from bureau chiefs, to begin to doubt the need for reorganization, or at least for as extensive changes as they at first believed to be necessary. At best the reorganization job is bound to be beset with difficulties. Bureau chiefs long entrenched have very considerable political influence. Aiding them are tradition and the necessary inertia of a huge government machine. The game of the entrenched forces will be to play for time, and in that game they seem already to be making a score, for it is likely that the Smoot committee on reorganization will not report for a full year. Six months or a year more will be wasted on the legislative dickering, allowing not more than two years for putting into effect whatever plan may be evolved. Even if a good plan is then evolved, enthusiasm for reorganization will have worn off, the Cabinet officers will have fallen into the old line routine—and visions of the more efficiently functioning government will go into the limbo of forgotten campaign aspirations.

"The way to resume is to resume." The way to reorganize is to reorganize. As Edwin F. Gay, of the *New York Evening Post*, has expressed it, it will be a good thing "to smash something quickly, so that a year or more will be required to pick up the pieces." In such a process mistakes will be made, but to have some mistakes is far better than inaction. If we wait for a perfect plan, nothing will ever be done.

The moral of this is that bodies like the Federated American Engineering Societies, which is backing the Department of Public Works idea, industrial associations, civic organizations and influential men generally must bestir themselves and put pressure on Congress to get results quickly. The present enthusiasm for governmental reorganization must be capitalized.

A Presidential Tribute to the Press and to Business

NEVER has the press of America been paid a greater tribute than when, on Monday of last week, the President of the United States, the Vice-President, and the Secretary of Commerce spoke in New York at the banquet in honor of the 125th anniversary of the founding of the *New York Commercial*. With them at the speakers' table were the Secretaries of War and of the Interior. Each of the speakers extolled the work that the press, in general, has done for the country, but the President and Mr. Hoover addressed themselves particularly to the service the business press has rendered.

Business was their topic. They viewed it broadly—as an opportunity for service to the whole community. They related its prosperity and its depressions to the welfare of the people. They argued for stabilizing influences. The Secretary of Commerce enlarged upon the need for "accuracy and completeness of commercial intelligence" for such stabilization. The President declared for such treatment of industry as would encourage its fullest development, while safeguarding the rights of the community. And, after expanding on business development with a vision and a soundness that have been absent from official lips for many a day, they generously laid at the feet of the press, and particularly of the business press, a great measure of credit for the solid things that have been done to develop business along the lines of which they spoke, and to stabilize it in the interests of the whole people.

Their coming to New York, however, developed far beyond a mere occasion for honoring the business press or the press in general. It turned out to be the occasion for giving a new charter to business. The President pictured it not as an object for government persecution and meticulous legislation, but as an essential of national life needing cultivation and encouragement; he held that the business man is not to be prejudged as a criminal and treated accordingly, but one who will respond to an appeal to regard his business not as an instrumentality for personal profit, but as a means of service to the community.

It is recognized that these are high ideals, and that there are those in the business world who will fail to deserve the high confidence thus reposed in them, but as a method of approach to the greatest single, all-pervading influence in our lives, it must be conceded that it is far more certain of getting results than the policy of distrust and suspicion.

In saying, therefore, that the *New York Commercial's* anniversary banquet on May 24 was a signal tribute to the press of America, we must properly add that it was a tribute also to American business. The President's words should prove heartening to those strenuously striving to bring business back to a healthier functioning.

Coagulation of Water with Alum by Prolonged Agitation

Qualitative Data Obtained by Experiment Leads to Redesign of Coagulating Methods for Sacramento Filters—Contrary to Widely Held Theories Prolonged Agitation Is Highly Desirable

By Wilfred F. Langelier
Assistant Professor of Sanitary Engineering, University of California; Consulting Chemist and Bacteriologist, Filtration Division, Sacramento, Cal.

EXPERIMENTS on the coagulation of the turbid waters of the Sacramento River by rapid, controlled, prolonged agitation have resulted in revisions of the early designs for the filtration plant at Sacramento. Briefly, the method of coagulation to which the results led provides for the passage of the treated water through a series of circular tanks, each of which is equipped with a mechanically-driven, rotating paddle capable of imparting to the water a uniform well-ordered rotary motion of an approximately definite and controllable velocity. It is believed that the method possesses marked advantages over the usual method of agitation produced by rapid, but generally non-uniform, flow through a baffle basin. Within reasonable limits the same dosage of alum was found to coagulate water over a considerable range of turbidity and alkalinity; the latter appearing to be the greater factor. Close baffling was found to be nearly as effective as agitation by paddles but it is not so flexible. The higher the velocity the speedier the coagulation. Experiments on short-circuiting in circular tanks, and different arrangements of inlets and outlets, were also made. Several factors influence the effectiveness of coagulation and although much information of a qualitative nature has been accumulated, there seems to be a great need of more precise quantitative data. It is known, for example, that the character of the water as indicated by turbidity, color, alkalinity and colloids, the chemical nature of the coagulant and the method of its application, are all factors which influence the minimum dosage necessary for effective treatment. The relative importance of each factor is not well known because practically all of our observations have been made in connection with existing or experimental plants wherein the scale of operation has been so large as to render adequate control of each factor impossible. With this in mind, experimentation on a purely laboratory scale was begun in the Sanitary Engineering Laboratory at the University of California nearly two years ago. The work is still in progress and although only a few of the factors have been investigated, results have been obtained which are considered significant and which furnish a better understanding of observed phenomena. In addition, similar studies were undertaken last summer in Sacramento in connection with the proposed filtration project for that city. This article discusses primarily these latter studies.

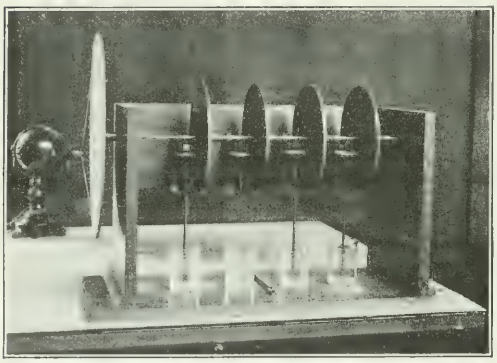


FIG. 1. IMPROVED STIRRING DEVICE WITH VARIABLE SPEEDS FOR STUDY OF COAGULATION PHENOMENON

Perhaps the most important, readily controllable factor in the coagulation of water with alum, and the one about which there seems to be the greatest difference of opinion, is that which relates to mixing or agitation. In plants designed for the use of lime and iron sulphate an extremely rapid and thorough mechanical mixing of the coagulant solution and the water should be thorough and prolonged; whereas plants designed for the use of alum as a coagulant show little uniformity in this regard. The importance of this feature of plant design is pointed out by Ellms in his "Report of Experiments on the Purification of the Milwaukee Water Supply" (1920). After elaborate experimentation, he proposes the "hydraulic jump" as a means of securing adequate mixing. He states that the method "provides an extremely rapid and thorough mechanical mixing of the chemical solution and the water to be treated," and further: "Immediately following the jump the water is allowed to flow quietly to a settling basin in which the physical action of coagulation can take place with the least possible amount of agitation and thereby reduces to a minimum the breaking up of the floc during its formation." Most engineers favor the idea that only the slightest agitation possible is desirable after an initial, reasonably thorough mixing of the alum with the water. This theory is not in accord with any of the experimental data which we have obtained. Our results, checked many times under varying conditions, indicate that prolonged agitation is not only not objectionable, but is highly desirable in increasing the efficiency of the process. A description of the experiments and some discussion follow:

The apparatus used to determine the ideal conditions of agitation consists of a wooden frame on which are mounted four rotating paddles or propellers, each geared to a horizontal shaft driven by a small electric motor. The water is held in cylindrical glass jars 5 in. in diameter and 10 in. deep. A later modification of the device is designed with friction disks which permit the operation of each paddle at a speed independent of the others. The same effect of variable agitation can be produced in the original apparatus by using paddles of different sizes. These simple devices have proved extremely useful in studying coagulation phenomena. Similar apparatus could with profit be included in the laboratory equipment of all water purification plants using coagulation.

With this device the Sacramento River water could be effectively coagulated with dosages of alum varying between 0.5 and 0.8 gr. per gallon for a considerable range in turbidity and alkalinity. Without agitation, other than that required initially to thoroughly mix the coagulant solution with water, these same dosages failed to coagulate the

FIG. 2. CLOSELY BAFFLED EXPERIMENTAL COAGULATING BOX

water at all. Observation showed that an increase in turbidity from 20 to 200 p.p.m. had practically no effect on the speed of coagulation, and that but slightly larger doses of coagulant were necessary with the more turbid water to secure the same final clarification. An increase in alkalinity, other conditions remaining constant, necessitated either a more prolonged period of agitation or an increased dosage of alum. The velocity of the water during agitation in the different trials was made to vary. The actual velocities were estimated to range from 0.2 and 1 ft. per second. Later studies showed that velocities up to 2 ft. per second, or even higher, could be prolonged for a considerable period without breaking the floc or reducing the efficiency of the process. In general, the highest velocities produced the most rapid flocculation. The period of agitation in these experiments varied between 10 and 20 minutes.

The description of a simple experiment, the results of which are typical, will furnish a clearer conception of the course of coagulation of a turbid water under varying degrees of agitation. Four thin, clear glass tumblers, each holding 200 c.c. of water having a turbidity of 200 p.p.m. were used. Agitation was produced by paddles of different sizes rotated at 150 r.p.m. Velocities were obtained ranging from a very slow, almost negligible movement in the first jar, up to 3 ft. per second in the fourth jar. Intermediate velocities obtained in the second and third jars were estimated at 0.3 and 1.5 per second respectively. A dosage of 0.3 gr. per gallon of chemically pure aluminum sulphate was added to each jar. Observations of each jar, summarized in the following table, were made at definite time intervals and a number of 1-c.c. samples were withdrawn and observed under the microscope.

CHARACTER OF FLOCCULATION AFTER AGITATION

Time Intervals, Min.	Jar 1	Jar 2	Jar 3	Jar 4
	Estimated Velocities, Feet per Second			
	0.1	0.3	1.5	3.0
5	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	fair	fair
15	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	fair
30	[illegible]	[illegible]	[illegible]	[illegible]
50	[illegible]	[illegible]	[illegible]	fair
70	fair	[illegible]	[illegible]	fair
90	fair	[illegible]	[illegible]	fair

The results were even more unfavorable than is indicated by the excessive period required for coagulation. Although the character of the flocculation in jar 1 was recorded as fair, the combined efficiency of coagulation and sedimentation was relatively poor, for each particle of floc settled out as soon as it had attained a certain definite size and before coagulation was complete. Under the microscope this floc appeared much more irregular in outline, more fragile and less compact than did the floc from the other test jars. On removing the paddles the floc in jars 2 and 3 settled rapidly, leaving a perfectly clear supernatant water. The rate of sedimentation in jar 4 was lower and the water above was left slightly opalescent. Practically no clarification was produced in jar 1, although the deposit of sediment in the bottom of the jar was nearly as great as in the other jars. Aside from determining the ideal velocity and period of agitation for a given sample of water, this experiment shows clearly that if the velocity is too low, the precipitate of aluminum hydroxide will settle before it has had sufficient opportunity to gather into clusters a maximum number of the fine particles which give the water its turbidity and which it is desired to remove. It is believed that this condition obtains in many existing water purification plants, and that in such instances more adequate baffling would result in greater efficiency and economy of operation.

One of the most important observations that has been made in connection with these studies is the part played by the "reaction" of the water or what chemists term "hydrogen ion concentration." Aluminum hydroxide is least soluble, and consequently most quickly and completely precipitated, in a medium the reaction of which is close to true neutrality. The reaction of raw water is usually alkaline. This, however, depends not merely upon the alkalinity as determined by titration with an acid, but rather upon the ratio of this potential alkalinity to the amount of free carbon dioxide present. With water low in CO_2 the dosage of alum necessarry to produce approximate neutrality is the amount that will

FIG. 3. THIRTY-INCH TANKS FOR CONTINUOUS FLOW OPERATION

reduce the alkalinity one-fifth. Therefore, if the alkalinity of the water is low, the alum necessary to raise the hydrogen ion concentration to approximate true neutrality, and thereby induce rapid precipitation and coagulation, is correspondingly low. It is apparent, then, that more often an acid, rather than a base, should be employed as a means of inducing rapid coagulation with alum. It would appears, moreover, from an extensive series of observations that we must revise our ideas in regard to the desirability of a "basic" alum.

The ideas regarding agitation, which were developed from these earlier experiments in glass jars, seemed to warrant further experimentation on a large scale. It was desired, particularly, to learn whether extensive baffling of a rectangular basin would yield similarly good results and also whether mechanical agitation could be used on a large scale and adapted to the "continuous flow" method of operation. For this purpose a shallow baffle box and a series of circular tanks were constructed. A description of the box and tanks and the experiments follows:

The box was made 4 x 12 ft. in plan and 8 in. deep, and was fitted with 120 crossing baffles each 1 in. apart. Loss of head occasioned by the passage of the water through the

box (a linear distance of travel of 480 ft.) was partly provided for by supporting the box in a slanting position. The results of coagulation obtained in this box were equal to those obtained in the jars at corresponding velocities (0.1 to 0.2 ft. per second). It was not possible, on account of excessive loss of head, to experiment with the box at the much higher velocities which appeared desirable from the jar experiments. Higher velocities were obtained by the removal of some of the baffles, but this diminished the retention period below the minimum necessary. The results obtained were of such character as to indicate that mixing by this method could be depended upon to produce satisfactory coagulation provided there could be maintained an adequate velocity for a sufficient period of time.

Three 30-gal. galvanized sheet-iron tanks were built and operated in series, with the connections between the tanks made of relatively large diameter (2 in.) in order to maintain a low velocity and preserve the flocs. Each tank was provided with a rectangular rotating paddle 18 in. long (horizontally) by 4 in. wide, fitted to a vertical shaft. The paddles were rotated by means of a system of pulleys operated by a small variable-speed motor. For a time the series of circular tanks was operated in parallel with the baffled box in such a manner as to permit of direct comparison between the two devices.

The results obtained from many trial runs under varying conditions demonstrated conclusively that the very rapid and efficient coagulation obtained in the glass jars could be duplicated in larger tanks provided with mechanical rotary mixing or agitation and operated on a continuous flow basis. With dosages of alum averaging about 0.7 gr. per gallon, an excellent flocculation was obtained repeatedly. The natural turbidity of the raw water at no time exceeded 200 p.p.m., but artificial turbidities up to several hundred parts per million required only a slight increase in alum dosage. The floc particles were of such size that in a sedimentation basin rapid settlement occurred.

Granting that the results obtained by this method are at least as good as can be obtained by the same degree and period of mixing produced in the ordinary way by means of a comparatively rapid flow through a baffled basin, it will be apparent that the method offers at least one very decided advantage, namely, that of greater flexibility. The fact that any desired velocity can thus be maintained, and that this velocity is practically independent of variations in flow through such tanks, would seem of itself to justify a departure from standard practice in the design of coagulating basins. It is believed, moreover, that this type of mixing tank would in many cases eliminate the necessity of a grit basin and the trouble experienced in cleaning a thoroughly baffled mixing basin. No careful estimates of the relative costs of these two types of basins have been prepared, but it is believed that the saving in concrete permitted by the use of relatively thin walls in circular tank construction, together with the elimination of the extensive baffling which otherwise would be required, will more than offset the cost, both investment and operative, of the driving mechanism necessary in connection with the circular tanks, as proposed. The cost of power for operating the paddles should be low. In any event, it should not be much in excess of the cost of delivering water through the additional height necessary to overcome loss of head if baffled mixing basins are used.

The results of these experiments, covering a wide

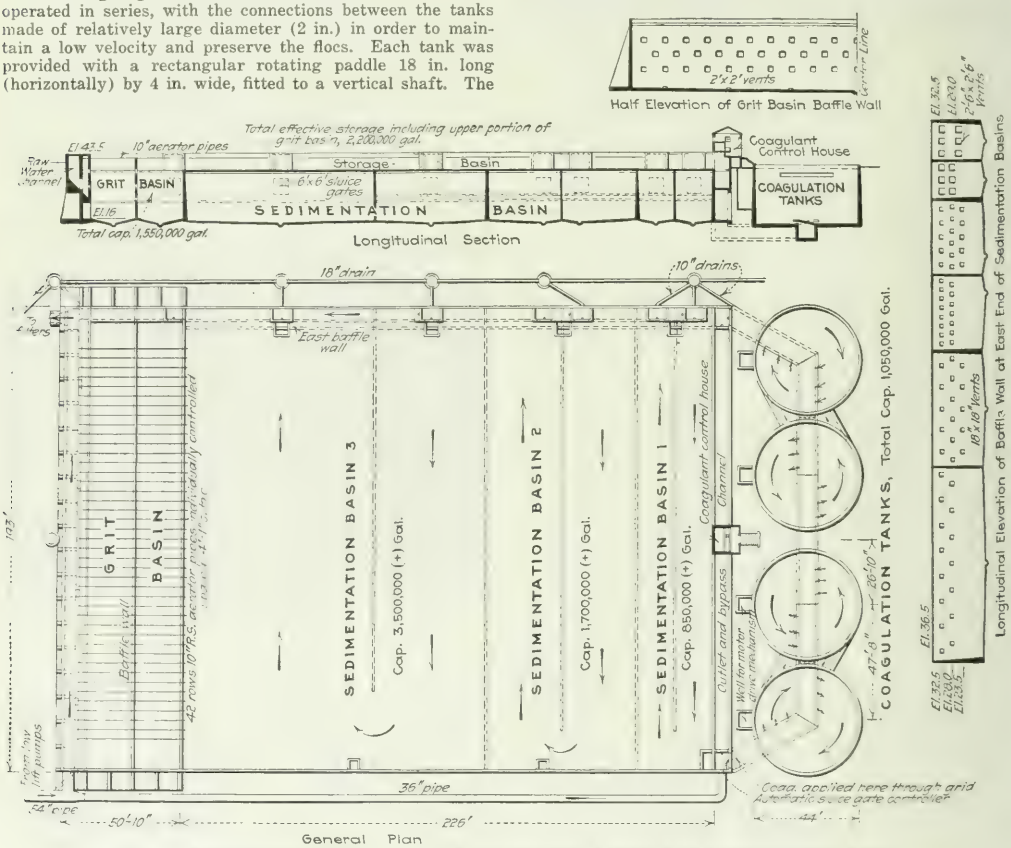


FIG. 1. SACRAMENTO GRIT, STORAGE AND SETTLING BASINS AND COAGULATION TANKS

range of turbidity and alkalinity, have been so consistent, and the conclusions which have been drawn therefrom so rational, that the engineering staff of the Sacramento Filtration Division has redesigned the coagulation and sedimentation features of the new treatment works in that city in complete conformity therewith. These features of the new works had been completely designed on lines more in accord with current practice. Nevertheless, it seemed to be in the interests of efficiency and progress to abandon these earlier designs and to adopt a completely new design, which in many particulars is perhaps without precedent. Certain features of the new design are not related to the utilization of the principles outlined herein. The design of the grit basin with special aërators above it and of a storage basin as an extension of the grit basin, located above the sedimentation basin, has been in a measure induced by local conditions.

Further discussion of some of the more important conclusions developed from these experimental studies, particularly from the standpoint of design, follows:

Number and Capacity of Tanks — For the purposes of design it is necessary to know (1) the period of time necessary to coagulate the given water with a minimum dosage of alum and (2) the extent to which short circuiting is influenced by the tank capacities and the number of tanks used. The former can be determined by simple experiment and the latter can be approximated by computation. Our experiments indicate that in general an actual mixing period of 20 to 30 min. is somewhat more than ample, but on account of short circuiting (which must occur in any type of continuous-flow basin) provision must be made for a somewhat longer theoretical retention period, say 40 min. Our experimental plant was operated on the basis of 40 to 45 min. of theoretical retention. Attempts to determine the extent of short circuiting with the aid of a dye (Uranin) were made, but the results were only partly successful. The time required for a trace of the dye to pass from the inlet of the first tank to the outlet of the last was easily determined, but the proportion of the water that was thus short circuited could not be determined in this manner. It is possible by making certain assumptions (which our dye experiments seemed to indicate as conservative) to compute the proportion of water likely to remain in the tanks a given interval of time for any assumed number of tanks of given capacity. The assumption which it is necessary to make relates to the period of time required for diffusion of a unit volume of water throughout the tank. Under conditions likely to obtain, this may vary from practically zero to perhaps 2 or 3 min. Under the conditions of our experiments, this time interval varied between 1 and 2 min. For the purpose of simplifying the computation, we have assumed an instantaneous diffusion and the results obtained by the proposed formula should be interpreted accordingly

Let Q = Capacity of each tank in gallons
R = Flow of water in gallons per minute
n = Number of tanks
t = Minutes actual retention in a tank
x = Proportion of water remaining in tanks t min. (or longer).

$$x = 1 - R/Q$$

Using the above symbols the following equations [illegible]

x^n = proportion remaining t min. (or longer) if $n = 1$

$1 - x^n$ = proportion passing in t min. (or longer) if $n = 1$

$1 - x^{n-1}$ = proportion passing first tank in t min. (or longer)

$\left(1 - x^{n-1}\right)^n$ = proportion passing all tanks in t min. (or longer)

$1 - \left(1 - x^{n-1}\right)^n$ = x = proportion remaining in tanks t min. (or longer).

Curves have been prepared to facilitate solving this last equation for different values of x, n and t. From these curves a series of values of x may be obtained for different values of t under any given condition of operation (x and n being constant). Retention period curves computed in this way, for the coagulation basins as designed for Sacramento

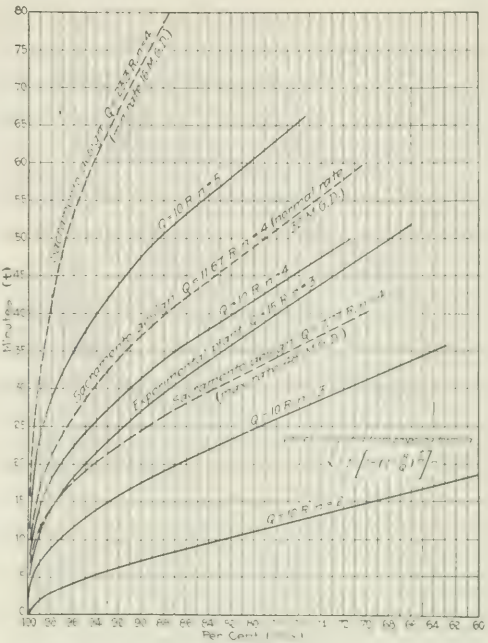


FIG. 5. CURVES SHOWING THE PROPORTION OF WATER RETAINED IN COAGULATION TANKS FOR GIVEN TIME

are shown in Fig. V. The experimental plant curve and also curves satisfying the condition $Q = 10\ R$ for four values of n are included for the purpose of comparison. These curves indicate that the displacement efficiency increases very rapidly with each additional tank, but that good results can reasonably be expected with the use of four tanks if each provides a theoretical retention period of 10 min.

Coagulation and Sedimentation Velocities — Our experimental data indicate that in the coagulation of water with alum, and its subsequent sedimentation, there should be a gradually diminishing velocity throughout the entire period of flow. The initial velocity should be fairly high, say 2 ft. per second. In each succeeding tank the velocity should be reduced gradually until, in the last tanks, the minimum velocity shall be just sufficient to keep all of the floc in suspension. In the sedimentation basin the velocity may properly vary from, say, 0.15 ft. per second at the inlet to perhaps 0.02 ft. per second at the final outlet. The velocities, as given, are substantially those that will obtain under normal operation (32 m.g.d.) in the Sacramento plant. Sedimentation in the Sacramento design is provided for in baffled rectangular basins. There would appear to be no reason why in certain cases circular tanks similar to the coagulation tanks, but with provision for lower velocities, could not also be used for this stage of the process.

Hazen and others have pointed out that clarification by means of sedimentation is independent of the depth of basin, and that floor area rather than retention period is the real criterion of efficiency. Our observations made in connection with the operation of a small and extremely shallow basin confirm this view, but owing to limited data and local conditions with respect to topography and foundation the idea of a relatively shallow sedimentation basin for Sacramento could not be seriously considered.

Inlets, Outlets and Connecting Conduits — The circular coagulation basins recommended permit of a variety of possible inlet and outlet arrangements. Most of our experimental runs were made with simple side inlets and outlets. The water was admitted through a 4-in. circular open-

ing near the bottom on one side and withdrawn through a similar opening on the opposite side near the top. This arrangement seemed to give results equal to those obtained with more complicated center top or bottom inlets. In either case diffusion of the water throughout each tank took place in from 1 to 2 min. Perhaps the simplest and most economical design would provide for the placing of the tanks in contact with one another in such a way as to eliminaet connecting conduits. The Sacramento design is more elaborate but, it is believed, will most effectively reduce short circuiting to a minimum. Whatever arrangement is used, it is important that the water should flow through the tanks without sudden changes in velocity as this may cause a breaking up of the larger particles of floc.

Type of Paddle and Driving Mechanism — The type of agitating mechanism used should be such as to produce as nearly as possible a smooth, uniform motion of the stated velocities. Both high- and low-speed agitators have been considered. It was thought that a flat circular disk revolving at high speed might be preferable to a slowly revolving paddle, such as was used in the experiments, but our general observations indicate that any high-speed device would break up the floc and therefore would be objectionable.

The Sacramento studies in coagulation were made under the direction of Prof. Charles Gilman Hyde, consulting engineer, and C. G. Gillespie, resident engineer of the Sacramento Filtration Division. Other members of the engineering staff, notably H. B. Foster and Harry N. Jenks, have been intimately connected with the work. The latter was in charge of the experimental plant during the last few weeks of its operation and secured many of the operating data which have been used in the design of the coagulation and sedimentation basins. The mechanical features of agitation are being investigated by Prof. B. F. Raber, assistant mechanical and electrical engineer.

The General Contractor

Extract from an address delivered at the dinner of the executive board, Associated General Contractors, and guests, Washington, D. C., May 10, by W. O. Winston, president.

THE general contractor, in common with the engineer, architect, mechanic and laborer, is a cog in a machine that makes for civilization and progress. He is both proud and happy to be in such company for such work. He is not concerned whether his cog be large or small, but whether it be large or whether it be small, he is concerned in having it so function that the master may say, "Well done, good and faithful cog."

In a nutshell, it is the rule and not the exception that the first concern of the general contractor is for his reputation — reputation for skill and integrity — realizing that on that, more than on anything else, depends not only his success, but his happiness in business.

And now for a few minutes I shall speak about some things which are not germane to my text.

The construction game is not what it was when I sat in some forty-five years ago. The cards are different, the rules are different, and, speaking generally, the players are cleaner and squarer. In this time I have seen the steam shovel take the place of the pick and shovel, locomotives and cars of large capacity take the place of the wheelbarrow and the horse cart, and so on down the line. Through the instrumentality of these improved implements of construction, it is possible to do in three months now what would have taken twelve months then, and yet it will surprise many of you when I say that the unit cost of work has increased rather than decreased.

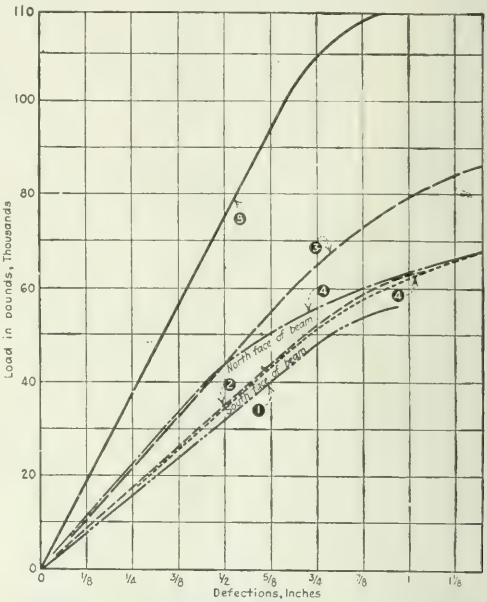
Fifty years ago, at least in the state of my birth, contracting was not considered to be a vocation of a gentleman. It was work for the roughneck and overseer. But now there as well as elsewhere, it is an honorable profession, second to none

It is distinctly a creative and strenuous profession and that is why it appeals so strongly as it does to men of vision, courage and guts.

Tests of Timber Dock Stringers

By M. O. Fuller
Asst. Professor of Civil Engineering, Lehigh University, Bethlehem, Pa.

RECENT tests of old creosoted pine stringers that had been in service for about 34 years have shown good records of strength. Two stringers were taken from a dock of the Lehigh Valley R.R. at Perth Amboy, N. J., being southern yellow pine timbers creosoted in 1886 by the railroad and in service from 1886 or 1887 to October, 1920. The timbers were in fairly good condition, showing the beneficial results of the creosoting



FLEXURE OF OLD AND NEW YELLOW PINE STRINGERS

treatment. A new untreated yellow pine timber was tested at the same time. These tests were made at the Fritz Engineering Laboratory of Lehigh University, Bethlehem, Pa.

Beams Nos. 1 and 4 were originally one piece, as also Nos. 2 and 3. The specimens were placed in the 300,000-

FLEXURE TESTS OF YELLOW PINE STRINGERS

	Old Creosoted Timbers				New Untreated Timber
	1	2	3	4	5
Breadth, in.	7¼	7½	7¾	7½	8¼
Depth, in.	15	14¾	14¾	15	16
Span, ft.	12	11½	11½	11½	11½
Yield pt. from curve, lb.	48,000	50,000	60,000	40,000	Not reached
Do., lb. per sq. in.	3,500	3,800	4,600	3,200	Not reached
Max. load, lb	58,500	64,370	86,500	68,750	119,750
Mod. of rupture, lb. per sq. in.	4,300	4,900	6,700	5,400	6,600
Max. total shear at failure lb.	35,950	39,880	53,590	34,370	74,190
Ave. unit shear, lb. per sq. in.	309	366	501	295	545
Max. hor. shear, lb. per sq. in.	464	549	751	443	817
Failure	Tension	Tension	Tension	Hor. shr.	Hor. shr.

lb. Olsen testing machine, the loads on Nos. 1, 2 and 3 being applied at the same points as in service. No. 4 was tested with third point loading. No. 5, the new untreated stringer, was tested the same as Nos. 1, 2 and 3. Deflection readings were taken at the point of maximum deflection and then these readings were plotted against the loads. The load at the yield point was determined from the curve and the stress then computed.

B. Welchii As Test for Safe Water and Cause of Water-Borne Diarrhea

Survey Shows Only One Laboratory that Condemns Water on B. Welchii Finding, One Using Test for Comparison and a Few Occasionally—No Proof that B. Welchii Cause Intestinal Outbreaks

B. WELCHII tests of the filtered and chlorinated water supplied to Montclair, N. J., from the Little Falls plant of the Montclair and East Jersey Water companies figured last year in expert testimony on the quality of the water and this year in repeated advice by the Montclair Board of Health that the water be boiled before use for drinking. Officially, semi-officially and otherwise a campaign of condemnation of the supply has been conducted. The use of bottled waters and waters from local wells and springs, after certification by the health officer, has been encouraged. B. Welchii has been held up as a cause of water-borne diarrhea. In view of the part that the B. Welchii test has played in this campaign against water from one of the best known and most highly regarded water purification plants in the country and the far-reaching questions that the incident raises as to the safety of filtered and chlorinated waters in general and as to the sufficiency of the standard B. Coli test, *Engineering News-Record* has made and here summarizes a country-wide survey of the use of the B. Welchii test and of opinions as to B. Welchii as a possible cause of intestinal disturbances other than typhoid fever. Most of the replies are negative or doubtful. Nearly all show great interest in the subject. Many indicate the desirability of further study—at least of the anaerobic spore formers.

Experts in the Montclair Case

Experts testifying either in favor of the B. Welchii test or against the quality of the Montclair water, or both, were the late Prof. W. T. Sedgwick, Prof. M. J. Rosenau, Earl B. Phelps and Charles E. North, all in support of an application by the Montclair Town Commission to the State Conservation and Development Commission for a permit to take water from Split Rock Pond. Following the denial of the permit, the re-establishment of the Montclair Board of Health, the engagement of H. B. Larner as health officer, and the reopening and expansion of the health board laboratory, daily tests for both B. Coli and B. Welchii were begun about December, 1920, and have been continued since. Although the B. Coli tests have rarely been positive, B. Welchii were indicated from time to time, notably after cold spells. In mid-February, a telephone canvass of physicians disclosed 187 cases of diarrhea in Montclair—in a population of 30,000 or less. The B. Welchii findings, the earlier allegations as to the pollution of the water supply, the diarrhea cases, not only in 1921, but also an outbreak of some 1,625 cases three years earlier, led to the circulation of a notice that all water used for drinking and cooking be boiled for 30 minutes. This advice has been renewed from time to time, on the strength of occasional findings of B. Welchii. The earlier diarrhea outbreak mentioned was attributed to the dislodgement of deposits in the 51-in. feed main supplying Montclair and other communities, due to a 50 per cent increase of velocity caused by war emergency and cold weather consumption demands. At the same time, it is understood, the filters were by-passed, so that for some weeks water that had been chlorinated only, was supplied. Montclair and Glen Ridge, which got the first dose of the water under the conditions named, were the chief sufferers from the outbreak. It may be added that for years past there has been very little typhoid in Montclair—no deaths for more than three years; only three cases in 1920, all "contracted out of town" and only two cases thus far in 1921.

The 66 replies to our B. Welchii inquiries (nearly every one appealed to replied) have been tabulated in three groups: (1) Federal and state health authorities; (2) Water-works and board of health laboratories; (3) Private laboratories and consulting sanitarians. Numerous supplementary statements, some of much length, are given.

Results of Survey Are Given in Brief

Briefly, the replies, which come from Massachusetts to California, and Ontario to Texas, show that Montclair stands alone in depending upon the B. Welchii test as index of the safety of its water supply and almost alone in holding that there is a proved relationship between B. Welchii and intestinal outbreaks. Jersey City, after a period of occasional use, has tested for B. Welchii since Montclair citizens were advised to boil their water, but this is due to the feeling of Dr. McLaughlin that since Jersey City has a supplementary supply from the same source as Montclair it is desirable to be able to make B. Welchii comparisons between the filtered and chlorinated Passaic water and the regular main supply from the Rockaway (a tributary of the Passaic), which is chlorinated only. The only report of any extensive series of B. Welchii tests is from Dr. Hale, New York City, in 1917-19, but he now uses brilliant green to eliminate B. Welchii from interference in the B. Coli presumptive test. A few others report that the B. Welchii test is or has been made occasionally and two or three hope to make it. To save repetition and space, a number of statements of lack of knowledge of the use of the test in America have been omitted, as well as some references to its known use in England (under the name B. Sporogenes or B. Sporogenes Enteritidis). For the same reason, many detailed expressions of doubt as to the value of the test, or as to B. Welchii causing diarrhea, have been omitted.

Much of the omitted opinion appears to be based on data presented by Dr. J. P. Simonds in a monograph presented in 1914 to the Rockefeller Institute of Medical Research and published by the Institute in 1915 as "Studies in Bacillus Welchii, with Special Reference to Its Classification and Its Relation to Diarrhea." (Unfortunately out of print.) It should be noted that this monograph contains neither specific mention nor even a hint that diarrhea is water borne, whether caused by B. Welchii or otherwise.

Without attempting to distinguish between facts and opinions on B. Welchii given by Dr. Simonds and by our own correspondents the following highly condensed summary is given: B. Welchii is widely distributed in

USE OF THE B. WELCHII TEST FOR THE SANITARY CONTROL OF PUBLIC WATER SUPPLIES AND

1. The Federal and State Health Services	B. Welchii Test — Made*	B. Welchii Test — Advisable*	Cause of Intestinal Trouble*
U. S.: *Dr. R. H. Creel*, Asst. Surg. Gen., Pub. Health Serv., Washington, D. C.	No	.....	.....
Dr. G. W. McCoy, Dir. Hyg. Lab.	.....	.....	Doubtful
ME.: *P. C. McGuldrick*, Dir. Lab. Augusta	No data	No data	No data
VT.: *H. B. Stone*, Dir. Lab., Burl'n.	No	No	.....
MASS.: *H. W. Clark*, Dir. & Chem., W. & S. Lab., Boston	Sometimes [2]	Occasionally	.....
R. I.: *S. De M. Gage*, Chem. & San. Engr., Providence	No	No [3]	Not proven
CONN.: *J. F. Jackson*, Dir. Bu. Eng., Hartford	No	No [4]	.....
N. Y.: *T. Horton*, Chf. Engr., Albany	No	Not proven [5]	Not proven [5]
W. F. Wells, Biol. & Sanit'n, Cons'n Com., Albany	In past	Not yet [6]	Not proven [6]
N. J.: *R. B. Fitz Randolph*, Chf. of Lab., Trenton	No	Proposed [7]	Not proven [7]
PA.: *C. A. Emerson, Jr.*, Chf. Engr., Harrisburg	No	Prefer Coli-Aerog. Group [8]	Not proven [8]
DEL.: *C. H. Wells*, Spec. H. Comr., Wilmington	No	.....	No proof [9]
MD.: *R. B. Morse*, Chf. Engr., Balt.	No	No [10]	Not proven [10]
VA.: *R. Messer*, Chf. Engr., Richm'nd	No	.....	.....
W.VA.: *E. S. Teasdale*, Chf. Engr., Charleston	No	No data	No data
N.C.: *J. W. Kelloug*, State Lab. Hyg., Raleigh	No	No	No evidence
S. C.: *Dr. F. A. Coward*, in. Chg. Lab., Columbia	Once	Sometimes as adjunct	Debatable [11]
E. L. Silby, San. Engr., Columbia	.....	Possibly with B. Coli [12]	.....
FLA.: *G. W. Simens, Jr.*, San. Engr., Jacksonville	No	.....	Not proven
ALA.: *G. H. Hazelhurst*, Chf. San. Engr., Montgomery	No	Doubtful	Not proven
LA.: *J. H. O'Neill*, San. Engr., N. O.	No [13]	.....	Probable [13]
OHIO: *W. H. Dittoe*, Chf. Engr., Col.	No [14]	No [14]	.....
MICH.: *C. C. Young*, Dir. Lab., Lansing	Sometimes [15]	Valuable adjunct	.....
ILL.: *H. F. Ferguson*, Chf. San Engr., & *M. W. Cowles*, Analyst, Dept. Pub. Health	Few special studies [15]	.....	No conclusion reached [15a]
Miss M. Perry, Bact., State W. Surv., Urbana	No	May study	.....
WIS.: *M. Baker*, State San Engr., Madison	No	.....	.....
IOWA: *J. J. Hinman, Jr.*, Water Analyst, Iowa City	No [16]	Doubtful [16]	Doubtful [16]
MINN.: *H. W. Whittaker*, Dir. Div. San., Minneapolis	No	.....	.....
Dr. A. J. Chesley, Act'g Ex. Off., Div. Prev. Diseases	No	.....	See note [17]
TEX.: *Dr. M. Graham*, Bacteriologist.	No	No	No proof
CAL.: *Ralph Hilscher*, Dir. Bu. San. Eng., Sacramento	Once [18]	.....	.....

2. Water-Works and City Board of Health Laboratories	B. Welchii Test — Made*	B. Welchii Test — Advisable*	Cause of Intestinal Trouble*
NEW YORK CITY: *Dr. W. H. Park*, Bd of H. Lab	No [19]	Doubtful [19]	.
Dr. F. E. Hale, Dir. Lab., Dept. W. Sup	In past [20]	No	. .
JERSEY CITY: *Dr. G. E. McLaughlin*, San Adv. & Bact., Bu. Water	Yes [21]	See note [21]	Not proven [21]
MONTCLAIR, N. J.: *H. B. Larner*, Health Officer	Yes	Yes	Yes
TRENTON, N. J.: *F. W. Daggett*, Supt. Filtration	No	No	....
PHILAD'A: *C. E. Davis*, Chf. Bu. Water	No	.....	
J. A. Vogelson, Chf. Bu. Health	No	.....	
BALTIMORE: *J. W. Armstrong*, F'n Engr.	Sometimes [22]	.....	
Dr. W. R. Stokes, Dir. Bu. Bact., Health Dept.	No	.....	No proof
PITTSBURGH: *W. C. U. Baum*, Chf. Analyst, Bu. Water	No [23]	No	No
CINCINNATI: *C. Bahlman*, Chf. Bact., F'n plant	No [24]	See note [24]	.....
COLUMBUS: *C. P. Hoover*, Chem. in Chg. F'n	No [25]	See note [25]	.....
INDIANAPOLIS: *H. E. Jordan*, Supt. Filtration	No [26]	See note [26]	.....
CHICAGO: *Dr. J. D. Robertson*, Comr. Health	Sometimes [27]	See note [27]	.....
MILWAUKEE: *Dr. G. C. Ruhland*, Comr. Health	Sometimes [28]	.....	.....
MINN'LIS: *L. I. Birdsall*, Supt. F'n	No	Doubtful [29]	Not proven
ST. LOUIS: *A. V. Graf*, Chem. W. Div.	Sometimes [30]	Doubtful [30]	Not proven [30]
TORONTO: *N. J. Howard*, Bact. Water F'n Plant	No [31]	No [31]	.....

1. *McCoy*—Most of the evidence seems to show lack of correlation of B. Welchii with water-borne intestinal troubles. The usual presence of the organism in normal stools in considerable numbers must be considered.

2. *Clark*—About six years ago we studied the B. Welchii test quite extensively. It did not seem to pay for the extra work. In the past two years we have made occasional B. Welchii and B. Coli comparisons in such waters as the filtered Lawrence supply and once or twice in connection with intestinal outbreaks thought to be due to water but we have seldom found B. Welchii and do not seem to have gained much information. The test may occasionally be of value in connection with others.

3. *Gage*—So long as we lack a proved relationship between B. Welchii and water-borne intestinal troubles I do not see the wisdom of adding this test to our routine or substituting it for the B. Coli test.

4. *Jackson* — Until our knowledge of the B. Welchii organism is more complete, I very much doubt if it will be used generally as a substitute for the B. Coli test.

5. *Horton*—The more I study outbreaks of gastroenteritis the more I am convinced that most of them, at least, are water-borne. Whether it is infection by B. Welchii or some other bacterium, or infection by a protozoan, or whether the trouble is due to irritation from physical, chemical or organic substances I do not know, but I am inclined to think that a specific organism is the cause. It seems to me that much bacterial work would have to be done, not only regularly, but also during epidemics of gastro-enteritis, thereby showing the distinctive prevalence of B. Welchii during epidemics, to substantiate the B. Welchii theory. If it should be found that B. Welchii, B Coli and a high total bacterial count are co-existent it might not be necessary to multiply our technique, to determine pollution. Studies of the subject might well be made by the U. S. Public Health Service or by some of the state health departments equipped for research work.

7. *Fitz Randolph*—We do not propose to make routine B. Welchii tests unless it can be shown much more clearly than has yet been done that the germ in water indicates danger to health. We plan B. Welchii tests of some of our water supplies. This will take some time to complete, but I think will give us information of value. Any surface water from an inhabited watershed may be expected to show spores of B. Welchii at times. These spores are resistant to heat and, so far as I can ascertain, are not destroyed by chlorination at ordinary rates. Being small, some B. Welchii spores will pass through an ordinary rapid sand filter. Therefore it is to be expected that a filtered and chlorinated water from a rather thickly populated watershed, on which are a number of sewage disposal plants, will sometimes show B. Welchii. B. Welchii in filtered and chlorinated water, like chlorine above normal, indicates past pollution but throws little light upon purificant plant efficiency.

8. *Emerson*—We make routine tests for the Co'i-Aerogenes group, as preferable to the specific test for B. Welchii. Quite frequently, in surface waters, the Aerogenes group is found when B. Coli is absent in differential examinations. We consider such supplies doubtful but feel that further studies should be made before either approving or condemning a supply—such as checking physical field investigations, additional analyses or both. Usually in dysentery outbreaks we have been able to find rather definite causes, either by physical examination or by establishing a field laboratory on the site and searching for the specific dysentery bacteria.

9. *C. H. Wells*—If a water contains B. Welchii in considerable numbers it would be reasonable to suppose that intestinal troubles in the community using it were caused by the water. In such a case the stools of some of the patients might well be examined to find the predominating type of organism or at least whether it resembles those found in the water.

10. *Morse*—The B. Welchii test has so many difficulties in technique that its adoption is not likely to be general. It often seems more reasonable to attribute intestinal outbreaks to anaerobes in milk rather than in water supplies. In most of the apparently water-borne gastro-intestional outbreaks, the poor condition of the water supply has been reflected in the current B. Coli tests. At Camp Meade, several years ago, it was reported that B. Coli tests gave no evidence against the water yet B. Dysentery (either Flexner or Shiga type) was isolated from the water.

11. *Dr. F. A. Coward*—Sometimes the B. Welchii test would be a valuable adjunct but it could not safely displace the routine official test. Four or five years ago at Abbeville, S. C., there was a very mild epidemic of a peculiar diarrhea, resembling sprue. I found B. Welchii in stools at the decline of the epidemic, which was self-limited. Epidemiological study, by exclusion, pointed to the city water supply.

12. *Silby*—Since B Coli and B. Aerogenes are often confused, tests for B. Welchii might be employed in addition to B. Coli. In a recent investigation at Greenville, S. C., the laboratory findings were quite varied and confusing.

13. *O'Neill*—In the summer of 1919, by request, the city bacteriologist of Shreveport tested for B. Welchii and found it in the Red River and Bayou water after rapid filtration and liquid chlorination. B. Coli is seldom found in the treated supply, but a large number of samples examined ferment lactose on the presumptive test. I believe there is some relation between these lactose fermenting organisms (probably in many cases B. Welchii) and the incidence of enteric diseases other than typhoid, but I have no definite data.

14. *Dittoe*—We believe no gas formers should be found in 10 c.c. of filtered or ground waters. In field work we make the presumptive test only, but in the laboratory partly confirmed tests are made. We do not think it is necessary to differentiate between B. Coli and B. Welchii, as either form would cause gas in broth incubation and indicate an unsatisfactory water. With a surface water we might, in a particular case, differentiate gas producing organisms but ordinarily, even in such cases, we would accept gas formers as confirmation of findings based on sanitary examination.

15. *Young*—We occasionally look for the B. Welchii group when the B. Coli test is negative but anaerobic gas formers are present.

17. *Chesley*—Last year there was considerable intestinal trouble in Minnesota, both where the water was and was not chlorinated.

18. *Hilscher*—The only study B. Welchii in California that has come to my attention was at Sacramento about four years ago. [See statement from F. Bachman.—EDITOR.]

19. *Park*—My impression is that B. Coli is as good an indication of water pollution as any other organism.

21. *McLaughlin*—For some two years before Jan. 1, 1921, I made tests for B. Welchii in fermentation tubes showing gas but which did not plate positively for B. Coli on endo; that is, where fermenting aerobic bacteria were suggested. Since Jan. 1, I have

OPINIONS ON THE RELATION OF THE ORGANISM TO WATER-BORNE INTESTINAL TROUBLES

3. Private Laboratories and Sanitarians	B. Welchii Test Made	B. Welchii Test Advisable	Cause of Intestinal Trouble*
S. C. Prescott: Prof. Ind. Biol., Dept. Biol. & Pub. Health, M. I. T. Cambridge	Sometimes	In addition to B. Coli 32	Possibly 32
M. J. Rosenau: Prev. Prevent. Med. & Pub. Health, Har. Univ. Med. School, Boston	.....	Probably in device Coli 33	Uncertain 33
R. S. Weston, San. Engr., Boston	In past 34	Probably 34	.....
M. C. Whipple, Instructor San. Chem., Eng. School, Harv. Univ. Cambridge	Have used 5	No	.....
Frank Bachman: Chem. Engr., Dorr Co., New York City	In past 36	Doubtful 36	Doubtful 36
W. S. Coulter, Con. Engr., N. Y. City	In past 37	Doubtful 37	Not proven 37
N. S. Hill, Consult. Engr., N. Y. City	Sometimes 38	Sometimes 38	Not proven 38
D. D. Jackson: Prof. Chem. Eng., Columbia Univ., N. Y. City	Yes 39	Yes 39	Yes 39
G. A. Soper: Consult. Engr., N. Y. City	.....	Scientific 40	.....
Dr. H. D. Pease, N. Y. City	See note 41	See note 41	Not proven
J. M. Caird: Chem. & Bact., Troy, N. Y.	No	No	No
Dr. W. W. Ford, Assoc. Prof. Bact., Johns Hopkins School Hyg. & Pub. H., Baltimore	Sometimes 42	No 42	No 42
J. W. Ellms: San. Engr., Cleveland, O.	No	See note 43	See note 43
Dr. R. S. Perkins: Dept. Hyg. & Bact., School of Med., Wn. Res. Univ., Cleveland	.....	Doubtful 44	No more than B. Coli 44
Dr. E. O. Jordan: Prof. Hyg. & Bact., Univ. Chicago	.....	Doubtful 45	Doubtful 45
M. F. Stein: Civil Engineer, Chicago 46	No	For Filt. & Chlor. W 46	.....
Max Levine: Assoc. Prof. Dept. Bact. & Hyg., Ia. State Col., Ames	No 47	No	Doubtful
W. F. Morfest, Consult. Chem., St. Louis	No indication of use in this section.		

* Responsibility for condensing some long statements to a word or two rests with the Editor. In many cases more detailed statements are given in the text.

made B. Welchii tests regularly on both our Rockaway and our supplementary Passaic supply from the East Jersey Water Co. I have tested the Passaic supply because of Montclair's claims of finding B. Welchii in the same water. The tests of both supplies are made more to compare the two waters than because I attach any great value to finding B. Welchii, for at most I regard this organism as indicating remote pollution. I believe our B. Welchii test is fairly accurate for our purpose, but it does not show which of the many strains of B. Welchii is present nor whether the one found is pathogenic. The latter determination would entail considerable work and is unnecessary unless there is some decided reason for it. B. Welchii has been found in our Rockaway water at times, but as it seems to be incapable of producing ill effects, at least in our chlorinated water, it does not appear to be of much importance compared with B. Coli. All attempts of which I know to produce diarrhea by feeding cultures of B. Welchii have met with little or no success. The germ is present in a large percentage of milk samples tested but I am aware of no epidemic of diarrhea proved to be due to B. Welchii. As to B. Welchii being a cause of disease when found in water supplies my opinion is "not proven."

32. *Armstrong*—On a number of occasions we have found B. Welchii in our raw water in large numbers, but the test has been too infrequent to draw conclusions as to the effect of the germ upon potable water.

33. *Rolleston*—For the last three years we have been differentiating B. Coli into the so-called fecal and non-fecal types (the Methyl red test). Beginning Jan. 1, 1921, we have elaborated these tests and are now using besides the Methyl red test, the Voges-Proskaur reaction and also studying the correlation of these tests with growth or non-growth in Koser's urine acid medium. This work will give us an idea of the relative proportion of typical B. Coli, B. Aerogenes, and allied bacteria in our water. Probably we will consider B. Welchii tests at some future time, but it will be at least a year before any results of our work can be summarized.

35. *Hoover*—It is our policy to remove all gas-forming bacteria and we believe this is possible in any well equipped water purification plant. I think many water filters are being used simply as strainers, dependence for satisfactory bacterial results being placed on chlorination. The policy at most of the filter plants in Ohio is different. A filter plant is supposed to produce a filtered water of such purity that four out of five 10-c.c. portions give negative Coli results. Such a water, treated with from 0.3 to 0.5 p.p.m. chlorine, should be free from all gas-producing bacteria and absolutely safe.

36. *Bachman*—Since Jan. 1, our laboratory has made a few B. Welchii tests, so far with negative results.

37. *Coulter*—Our routine practice is to test for B. Coli. We are making tests for B. Welchii whenever the water shows considerable fermentation, or when there is an increased report of cases of intestinal trouble. B. Welchii is not so frequently found here as are members of the colon dysentery group. We are now running a culture on which we are about to make the [illegible] test to determine identity.

In our heavily contaminated Lake water we have found quite [illegible] B. Coli [illegible] genes. Aurea[illegible] [illegible] Hemolytic [illegible] for widespread intestinal infection [illegible] place much reliance upon the [illegible] such instances there ought to be other and confirmatory evidence. Sometimes it is impossible to get any but laboratory indications of a water impurity because it has laboratory significance only. Outside studies do not show that polluting material enters or that the water does harm. People should not be ordered to boil water unless there is actually ground for judging it to be dangerous. It may be a cautious thing to do, but it entails a great deal of trouble, and if it is not necessary people soon find it out, and come to look upon the health authorities as no authority at all.

43. *Ellms*—English bacteriologists regard the isolation of B. Welchii as of value but American bacteriologists seem to think it no more indicative than B. Coli. My confidence in public water supplies that have been chlorinated only has been shaken considerably of late. The B. Coli test does not seem to tell the whole story of pollution, and we may yet be forced to extend routine work for the isolation of bacilli found in polluted waters. I feel that chlorine may be quite unreliable as a disinfectant in some waters and is not of the same value at all times in the same water. Typhoid fever is rather heavily leaned upon in judging a public water supply, which is, of course, quite proper; but I believe that we must also give a great deal more weight to other intestinal troubles, especially gastro-intestinal troubles in infants.

44. *Perkins*—The literature shows that B. Welchii in water, like nitrates, indicates previous pollution. The spore-bearers do not develop under ordinary water conditions, nor are they affected to any marked extent by chlorination, so that tests will show them to be in treated waters which prior to treatment showed also aerobic fermenters. For this reason regular tests for these organisms are not made in most laboratories, especially as the detailed technic makes the labor excessive for the results obtainable. Broadly speaking, when in working out the presumptive into confirmed tests for B. Coli, no colon can be isolated and sub-cultures in fermentation tubes continue to show gas, anaerobic fermenters can be considered as present, among which B. Welchii is the most frequent. As far as diarrhea or other intestinal troubles from B. Welchii are concerned, it would seem on a priori reasoning that they should be no more likely than similar troubles from B. Coli, inasmuch as they are both intestinal organisms.

45. *Jordan*—The only direct experimentation on B. Welchii that I know about is the work Glynn published some twenty years ago (Thompson Yates Laboratory Reports, 1901, III, p. 131). This showed that large numbers of the bacilli could be swallowed by a healthy man without the production of any immediate ill[illegible] effects. The growth of the anaerobes has developed greatly in the [illegible] and such experiments need repetition, with due attention to vertical differences. Herter and his collaborators are inclined to believe that the presence of B. Welchii in excessive numbers in the intestines was connected with the production of an anemic condition in children and adults. The use of the relative abundance of B. Welchii in [illegible] of this organism in soil does not seem to render it particularly suitable as an indicator of [illegible] origin.

nature, including soils and waters. It is a normal inhabitant of the intestines of both men and animals. It is a spore former, and therefore, like nitrates, an evidence of remote rather than recent pollution. Since it is a spore former, it may escape chlorination. B. Welchii—or perhaps a whole group, or it may be a number of strains, of lactose-splitting, spore-forming anaerobes—has been studied under ten or a dozen different names: Welch and Nuttall (Johns Hopkins University, 1892) giving the earliest full description as B. Aerogenes Capsulatus; Klein (Germany, 1895), using the name B. Enteritidis Sporogenes; various Englishmen, including Sir Alexander Houston using either the last preceding name or B. Sporogenes. These many terms and possible strains give rise to confusion, which, combined with difficulties in technique, cause doubt as to the past work and also as to the wisdom of making the test at present. Besides this, it may be inferred from the meager data at hand, that many of the tests reported as B. Welchii are merely presumptive. Some of those reporting think there is more cause for attributing non-typhoid intestinal outbreaks to milk than to water and it is pointed out that the extensive and growing use of milk pasteurization gives B. Welchii or related spores a comparatively free field in milk supplies.

Statements supplementing the tabular summary are presented as foot notes or, where too long, as text with reference numbers to the table. Even with the utmost condensation feasible some of the longer statements, and also data on the technique of B. Coli tests, have to be held for later issues. The longer summaries follow:

6. *W. F. Wells, Albany, N. Y.*—In the winter of 1910-11 while at Grand Forks, N. D., Dr. G. F. Ruediger and I isolated B. Welchii from river water treated with hypochlorite of lime. Whereas B. Coli was found in 0.1 c.c. quantities, before disinfection, B. Welchii was almost always found to be present in 5 c.c. quantities after disinfection. The change from a filtered to a disinfected water for several months did not seem to affect the health of the community in any way.

The Potomac River Investigation

During the investigation of the Potomac River watershed in 1914-15, I again had a chance to study the distribution of these organisms, while serving under Surgeon (now Surgeon-General) Hugh S. Cummings, U. S. Public Health Service. It had been noticed in the areas of high sewage pollution where B. Coli was present in large numbers that little difficulty in the isolation by ordinary methods was experienced. As B. Coli decreased, however, the percentage of gas forming organisms which proved not to be B. Coli, also diminished. It suggested a similar phenomenon to that of Grand Forks, N. D., except that the death of B. Coli was due to natural causes instead of artificial disinfection. Following out this clue I made a rather extensive survey of the Potomac River to determine the natural distribution of these organisms in a typical river. (See pp. 97-105, "Investigation of the Pollution and Sanitary Conditions of the Potomac Watershed," Hygienic Laboratory Bulletin 104, U. S. P. H. S., Washington, D. C., 1916). It was shown that the gas forming anaerobes are generally distributed throughout the whole region in small numbers, and because they do not die off as rapidly as B. Coli they persist even after B. Coli have disappeared. In other words, they seem to be rather generally distributed in a polluted river in small numbers, without great variation in number as compared to B. Coli.

Furthermore, the studies at Fishermen's Island, Va., in areas remote from sewage pollution, revealed the presence of these organisms in small numbers in sea water and in fairly large numbers in the mud areas. It seems likely that wherever organic matter is undergoing putrefaction these organisms flourish. Tests made on the rapidly fermenting sediment in the Chesapeake and Ohio Canal at Cumberland, Md., show the presence of 500,000 spores per cubic centimeter.

Houston, in England, has done much work on the distribution of this organism in river water and has accurately described the same phenomenon. Savage, in summarizing large numbers of results by different workers, shows their general distribution. They are found commonly in milk and various foodstuffs. The common infection of wounds in trench warfare of the Great War also indicates general distribution in soils. Dr. Creel of the U. S. Public Health Service found a large percentage of treated waters on trains to contain this organism in small numbers. In the International Joint Commission report its occurrence in large numbers in the St. Johns River is also noted.

Broad Classification Better Than Fine Distinction

Until more definite methods for classifying the B. Welchii group of organisms are developed it seems better for the impartial water-works operator to make a broad classification and not attempt to go into finer distinctions. Until some particular member of the group is discovered to have a pathogenic effect when taken in small numbers in drinking water it is only logical to assume that the wide distribution of the general group, and its common occurrence in drinking waters without any distinct result having been observed, makes its presence no cause for alarm. Unquestionably, if some of these organisms become lodged in a portion of the body which will permit the development of anaerobic organisms, they may cause a very serious condition. Ordinarily, therefore, it seems probable that the organism may be taken in small numbers in drinking water without serious danger. Furthermore, its significance is an indication of the sanitary condition of water entirely different from that of B. Coli, and its presence cannot be accepted as an indication of a dangerous water supply.

15a. *H. P. Ferguson and M. W. Cowles, Springfield, Ill.*—For the past year we have been making examinations at regular intervals of filtered and sterilized water from several Illinois plants. Many of the samples of filtered water, with or without sterilization, especially where the raw water was rather highly polluted, showed a considerable number of gas formers on presumptive tests, but confirmatory tests on endo medium failed to produce any growth whatever in many of the samples. In some supplies it was possible to have the dose of chlorine increased, but the percentage of gas formers was not substantially reduced.

At Quincy, where daily control tests on Mississippi River water, filtered and then sterilized by liquid chlorine, were carried on by Mr. Gelston, superintendent of water-works, the number of gas formers present on presumptive tests increased considerably in 1920. An increased dose of chlorine failed to reduce the number of tubes showing gas formation. On account of lack of sufficient personnel we could send no one to Quincy to make daily tests for B. Welchii or other organisms of the same group but a few samples sent to our laboratory at Springfield were inoculated into litmus milk, in anaerobic culture, and organisms of the B. Welchii group were found present. In about a month the amount of gas present in presumptive tests began to diminish suddenly and special tests failed to show the presence of B. Welchii in large numbers, even in the raw water. From the local records it appears probable that these organisms will not again appear in the raw water until the fall of 1921, when it is hoped that a more complete investigation may be made.

The presence of these organisms has also been suspected in water obtained from Rock Island, Alton and at times from East St. Louis. At Rock Island and at Alton the sterilizing agent is added to the raw water and it could be expected that an increase in the amount of chlorine would produce a smaller effect on the resulting effluent than if the sterilizing agent were added after filtration. The filter plants at the four cities mentioned have to treat water polluted by sewage, in some cases from communities many miles up stream, and in other cases by relatively fresh

sewage. It is hoped that as soon as sufficient personnel is available that detailed field investigation may be carried on in these four cities and at filtration plants where similar conditions exist.

The literature indicates that B. Aerogenes (as distinguished from B. Coli), B. Aerogenes Capsulatus, B. Enteriditis Sporogenes, and B. Welchii are so nearly alike that only complete morphological and cultural tests will distinguish between them, and that the organisms may be found in sewage in varying quantities. From the results obtained in confirmatory tests made in this laboratory on endo medium and on eosin methylene blue agar, it appears possible the aerogenes colonies, as distinguished by Levine, may at times represent a very resistant group of organisms which are possibly directly and closely related to the spore-forming organisms of the B. Welchii group but considerable detailed laboratory investigation will be necessary to determine if this relationship exists.

At this time, no definite information can be given relative to the harmful effect or disease producing power of the spore-forming organisms of this type when present in a water used for drinking.

16. *J. J. Hinman, Jr., Iowa City, Iowa.*—Material I collected in 1917 for my paper on American Water Works Laboratories (*Journal* Am. W. W. Asso., June, 1918) shows no reference to any one making a routine search for the Clostridium Welchii, and I do not know of any laboratory at the present time that regularly makes this examination. Recently in checking up the results with fermentation tubes from 15 Iowa water supplies filtered and chlorinated (no reports of intestinal trouble from any of the corresponding communities) I found the following distribution:

Tubes showing B. Coli type	391
Tubes showing B. Aerogenes type*	85
Tubes showing atypical gas formers†	1,902
Tubes failing to show gas formations	8,188
	10,566

*During a part of the series B. Aerogenes was not differentiated from B. Coli.

†Most of the atypical forms refused to grow aerobically on the confirmatory plates. They appear to have been commonly spore-forming anaerobes.

Lately I have tried a modified Weinzirl anaerobic spore-former test, using a dried milk medium and planting in it either 10 c.c. of the water or a few drops of the liquid from positive fermentation tubes. For all practical purposes this test is the same as the Botkin test for Clostridium Welchii. In a number of tubes I obtained gas production, stormy fermentation, and butyric acid odor. I did not carry the work further.

Welchii Trouble from Milk Rather Than Water

The Clostridium Welchii is so frequently found in milk that if there were any great danger of intestinal infection due to its presence in the normal human intestine, we could expect continual trouble from the milk supply, rather than from the purified water supplies, where the concentration is certainly much less than in milk supplies. The work of Kendall and others indicates that Clostridium Welchii, chiefly from cow's milk, in all probability, has caused diarrhea in young children. Kendall and Day claim that two factors are necessary to the multiplication of the organism in the intestines: (1) excess of utilizable carbohydrates, and (2) deficiency in lactic acid forming organisms, since the production of the acid tends to inhibit the growth of the Clostridium Welchii. The diarrhea has been ascribed to the irritant action of butyric acid formed by the Clostridium. Perhaps a soluble toxin is also involved.

If it is believed that these occasional difficulties, probably due to milk-borne infections, are sufficient ground for demanding that public water supplies shall be free from these organisms after purification, an enormously heavy burden will be put upon the plant. The different strains of the Clostridium Welchii react [illegible] differently to heat. Heating to above 80 deg. C., or even to boiling, cannot be expected to kill 100 per cent of the spores, nor can chlorine in practical concentration remove all of them. Greatly improved filtration practice would seem to be the only way of removing all these spores.

When polluted water has been treated, finding in the effluent an organism known to be much more resistant than the ordinary pathogens can have little value as indicating sewage contamination. Unless it is necessary to exclude the Clostridium Welchii for its own pathogenic properties, a more useful search is the examination for the B. Coli type organisms, imperfect though our knowledge of this group may be.

New York City Gave Up Routine B. Welchii Tests

20. *F. E. Hale, New York City.*—When D. D. Jackson first devised the use of lactose bile for the presumptive test for B. Coli, we knew that B. Welchii also gave this test and believed it to be the only form in addition to the B. Coli group which produced gas to any extent in that media. We had accessible the original article by Dr. W. H. Welch, Johns Hopkins University, and obtained cultures from him which we compared with cultures of Sporgenes (so-called) obtained from Klein in London. The latter culture proved to be the same as that furnished by Welch, but later work indicated that there was an entirely different form which we isolated from water and which could be classed under the name Sporogenes and did not ferment lactose. We had also available Klein's original literature.

As B. Welchii is always present in small amounts in feces of human beings and animals, Jackson felt that the fact that B. Coli gave this test in presumptive media did not detract from the B. Coli test, since either was of equal significance. As it was easy to isolate B. Welchii, in case one cared to, from the bile tube we frequently did so. It was only necessary to make a hanging drop when long chains of large bacteria, non-motile, were visible, and usually a plate made from a tube in which Welchii was present and incubated at 37 deg. C. would prove sterile, Welchii overgrowing the other forms in the bile and not appearing on the plate, as it was anaerobic. Different workers have found that B. Welchii interfered with the study of efficiency of chlorination plants, owing to the spores not being killed by chlorination. Since these spores might exist in the soil or elsewhere for a year or more, it was felt that their presence did not signify recent contamination and consequently arose the change in Standard Methods (which I personally considered a step backward) by the dropping of bile and the use of the lactose broth with confirmation of the B. Coli group (and since then it has been recommended to differentiate the fecal from so-called non-fecal forms of B. Coli in order to narrow down the evidence).

I think the work involved was too great for the value received in these various isolations *as routine* and have given more attention to the tests for B. Typhi, etc. Owing to the trend of opinion against B. Welchii as of any significance a new media has been developed at this laboratory and used for nearly two years past—a modification of the lactose peptone bile by the addition of brilliant green, which eliminates B. Welchii from the presumptive test.

The following table showed the relative number of tests for specific bacteria which we made during the last four years:

	1917	1918	1919	1920
[illegible] (total count 47 [illegible])	10,673	11,518	13,377	13,349
[illegible] (presumptive)	1,[illegible]74	11,537	13,377	13,357
[illegible] Typhi	[illegible]	1,325	708	728
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	238	72	

From April 1, 1917, to April 1, 1918, the presumptive test for B. Coli was confirmed and identification of B. Welchii made with the result that out of 5,283 samples examined B. Coli was positive in 1,493 samples and B. Welchii was present in only 1 per cent of the total samples. It also indicated that 4 per cent of the presumptive B. Coli tests contained B. Welchii, or vice versa, that 96 per cent of our presumptive tests were certainly B. Coli.

We have found B. Welchii in ice in the absence of B. Coli and the intestines of sea-gulls exposed dead to very cold weather to the exclusion of B. Coli. Samples of water containing B. Welchii when tested for several days in succession have very soon shown the disappearance of Welchii, indicating that the spores may develop in water supply and die out, and that Welchii does not form spores in water.

23. *W. C. U. Baton, Pittsburgh, Pa.*—I have made some studies of B. Welchii but never arrived at a point where I placed any practical value on the results obtained. In 1911-12 we made quite an exhaustive study of the presumptive test for the colon group. (See 1912 report of the Bureau of Water, Pittsburgh.) We ran into an anaerobic gas-forming bacillus which caused a disturbance in the smoothness of the presumptive colon test. This organism we called the "gas bacillus" because we were unable to make it check up satisfactorily with our conception of B. Welchii; it was probably closely allied to that organism. We were unable to devise a means of absolutely eliminating or including it in the presumptive test. It did not appear with regularity. As nearly as we could determine, it seemed to appear more frequently during periods of low than high temperatures of the water. It will appear in any presumptive test, but is eliminated from confirmed colon tests because it will not develop on the isolation plate. About this time the 1912 edition of Standard Methods, A. P. H. A., outlined the test for B. Sporogenes. We made considerable trial of this test to see if it appeared to have any practical value locally. As I remember it, we were able to get an occasional isolation, but the test did not promise to be useful in routine work and was discontinued.

It is my opinion that B. Welchii or B. Aerogenes Capsulatus as well as B. Sporogenes (sometimes named B. Enteritidis Sporogenes) and the organism above referred to as the "gas bacillus" are all closely allied.

See No Substitute Yet for Colon Test

As yet I have seen no method of getting away from the colon test, but I believe it can be greatly improved in value by careful confirmation and by determination of the main species of the group. Some four or five years ago we did considerable work on the Colon-Aerogenes group, as found in fecal matter and other sources. As time permits, we are still working on improved methods of separating the Aerogenes from Coli in routine tests. We believe we are able to make better interpretations of results than formerly.

I believe the time is not far distant when interpretation of bacterial water analyses is going to be on a very firm foundation and the experienced man is going to be able to classify the sanitary quality of waters within quite narrow limits. When this is done we shall probably find ourselves cut loose from arbitrary standards and rule-of-thumb methods.

I have no personal evidence that B. Welchii causes waterborne diarrhea. I can conceive from the nature of the organism that in numbers it might cause considerable disturbance in the intestinal tract.

26. *H. E. Jordan, Indianapolis.*—We have found from time to time in the chlorinated filtered water, during the cold months, organisms (named by us F-11-21) which produce initial fermentation in lactose broth, are not recoverable on the ordinary sub-culture plates and require a commensal to bring their various reactions.

During the winter of 1919-20, Indianapolis, and a good many other cities in this part of the country, had a considerable amount of infection which, according to the views of some physicians, manifested itself in certain cases in the respiratory tract and in other cases in the intestinal tract. The winter of 1920-21 was relatively free of both types of infection.

Available literature indicates that those who studied B. Welchii and possibly identical or related organisms in the earlier days found it associated with soil pollution. Studies of intestinal outbreaks, I believe, can nearly always be correlated with irregularities of filter operation or mishaps to distribution systems which would be shown if the volume of work done in the control laboratory was large enough to make it deserve the term "control."

In my recent paper on "Fifteen Years' Filtration Practice in Indianapolis" there is an extensive series of tabulations of B. Coli counts. The figures were presented to convey to those interested in this kind of work some idea of the feeling that I have that we should not deny the presence of fecal organisms in purified water supplies. It is not a question of the presence but of the concentration of fecal organisms that is significant. I have repeatedly suggested in conversation that in bringing a purified water from surface sources, as long as the supply receives pollution from intestinal disorders, we must take it for granted that it is only a question of drinking a large enough quantity of water until the individual takes in organisms associated with every type of such disorders. It is only when the mass action of a large group of fresh individuals having intestinal disorders occurs that we have the transmission of the troubles to uninfected individuals.

Possible Test Methods

I have very little doubt that the inhabitants of every city that uses a purified water drink B. Welchii in greater or less numbers every day. The question is whether or not these organisms are virulent and whether their concentration is great enough to produce sickness. With this in mind we have been giving much thought to methods that might be followed to make a fairly accurate numerical estimation of the kinds of organisms present, doing this by the dilution method. The fundamental in this would be the elimination of non-spore forming organisms. Whether these should be eliminated from the raw water by chlorination or heat sterilization is a question. Another procedure would be to inoculate various tubes of plain peptone broth with dilutions from the original sample—this broth, according to the concensus of opinion found in textbooks on bacteriology, being the medium in which B. Welchii is more likely to form spores. After an opportunity has been given to spore-forming organisms to reproduce themselves, then the medium could be subjected to partial sterilization and the procedure of the deep endo plate and milk tubes carried on. I believe that it is a comparatively simple matter for non-spore forming organisms that have a tendency to overgrow to be eliminated.

We are going to try the matter out in our laboratory, but it will probably be a year or two before we make up our minds as to the best procedure in order to take in at least one season's variations in bacterial flora.

[*To be continued June 9, with statements by N. J. Howard, S. C. Prescott, M. J. Rosenau and others listed with reference numbers in group 3 of the table,* p. 929.—Editor.]

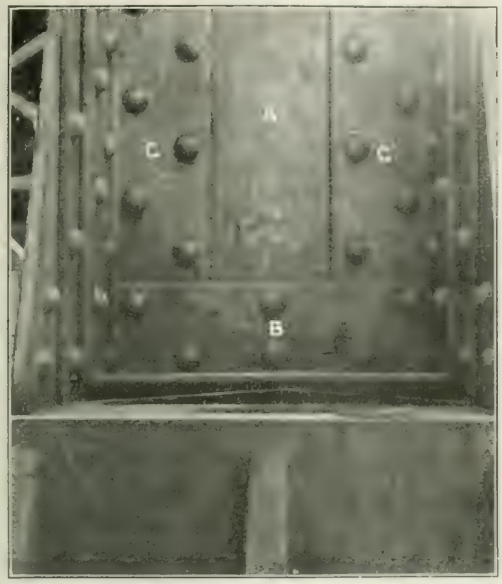
Montreal Retains Mayor-and-Council Charter

By a majority of some 17,000 in a vote of 68,000 out of 147,000 possible votes, the electors of Montreal on May 16 voted for a mayor-and-council city charter, with (1) an executive committee of five councilmen, chosen by the council, and (2) a director of municipal services, also appointed by the council, with such duties as the council may assign to him from time to time. The councilmen will be elected by plurality vote, one each from 35 wards. The defeated alternative charter provided for a council-manager plan, the council to consist of 15 members chosen by proportional representation, five each from three districts, and the general manager to be appointed by the council. Under the plan adopted the mayor will be paid $10,000 a year and councilmen $1,500, with extra pay of $1,500 for the chairman and $1,000 for the members of the executive committee. The rejected plan was drawn by a charter commission appointed by the Provincial Government and the adopted plan was the work of local members of the Provincial Legislature. For some two years Montreal has been governed, in most respects, by an Administrative Board, appointed by the Provincial Government, the old mayor and council remaining in office, but having little power. The new charter will go into effect Nov. 1. The alternative plans are outlined in parallel columns in the *Canadian Municipal Journal* for April.

Freezing Action of Water Distorts Steel Column and Base

By C. P. Bohland
St. Paul, Minn.

THE accompanying photograph, indicating the tremendous force which may be exerted by the freezing action of water upon structural steel and cast-iron members, is of a cast-iron base supporting a structural steel column recently erected at St. Paul, Minn.



DISTORTION OF STRUCTURAL MEMBERS DUE TO FREEZING OF WATER IN CAST IRON BASE

On March 28 steel and cast-iron members were exposed to a heavy downpour of rain which was accompanied by a driving wind. On the following day the temperature dropped rapidly and by the morning of March 29 had reached zero. The rain, being driven against the steel column ran down the columnn web *A*, and on down between the ends of the filler plate (between the angle *B* and the web *A*) and the angle *C*. As the oval opening in the top of the cast-iron base lay directly under this flow of water and under the outstanding leg of angle *B* the cell in the cast-iron base became filled with water.

As the water froze the top of the cast-iron base was sheared along the inner web and was also deflected upward, bending the horizontal leg of the angle *B* upward a distance of 1¼ in. An inspection revealed that no injury had been done to the web nor had the top of the cast-iron base been distorted where the column web and the flanges took bearing.

Author of Log Flume Article

In the article on log flume construction in *Engineering News-Record*, May 5, 1921, p. 790, the author, V. K. Woods, was given as a member of the firm of Palmer, Pearson & Woods, Salt Crescent, Wash. This is an error. Mr. Woods is no longer a member of the firm. He is now located at Cranbrook, B. C., Canada.

Traffic Problems of the State Highway Department

Statement of Main Factors Which Should Determine Economic Development of Highway Systems

By Charles J. Bennett
State Highway Commissioner of Connecticut

Paper presented May 23 at the Conference on Highway Traffic Regulation held under the auspices of Yale University, New Haven, Conn.

THE past ten years have seen a complete transformation in the problem confronting administrative officials in the state highway departments. In the early days of highway development indications pointed to a simple problem. Traffic was not a serious factor and was not considered extensively in the location and design of highway systems. The lack of vision shown in this approach to a tremendous activity was lamentable. At that time the administrative officer was generally a man who knew how to lay out highways simply with a view to improve their general condition satisfactory to local interests and to the accommodation of light vehicles. The result is that the state highway systems of those states which have participated for a longer time in the improvement of highways have been improved to an inferior degree of excellence and are not satisfactory to the traffic which is developing.

For this reason the highway administrative engineer at the present time should have become a student of transportation rather than of detail highway construction. In other words, traffic has become the most important factor in the administration of public funds used for the development of highway systems. The highway engineer should be interested, furthermore, not only in transportation as it affects highways but in all classes of transportation in order that he may determine to what extent and for what facilities the highway program should be developed.

Over-Development of Vehicle

No one at the present time has any proper or correct conception of the place in the transportation scheme which the highway must fill. Due to several contributing causes, the development of highway transportation has proceeded along abnormal lines. There has been, naturally, a tendency to over-develop highway transportation. This over-development has been in the vehicle, generally, at the expense and to the detriment of the road. There has been a very consequent slacking off in the development of railroad facilities, due partly to the over-development of the motor vehicle as well as to the lack of funds and material used in the enlarging of railroad activity.

We have had a very serious reduction in the rail transportation of passengers and freight. Some of this decrease is due to the proper development of the motor vehicle and some of it to an abnormal or unusual use. In the near future we must come to realize the proper place for each method of transportation in the general scheme, and, as stated above, the highway engineer is vitally interested in this problem. If we know to what type of traffic the highway is to be subjected, our problem is somewhat simplified.

For purposes of discussion, let us, therefore, dissect this subject, assume certain things regarding the traffic problem of the state highway departments and discuss facts or suggestions which may come from the division. Traffic may be divided roughly into two classes: (1) commercial traffic, including the motor trucks, and (2) passenger or pleasure traffic, which includes all motor vehicles using the highway for carrying passengers. With slight exceptions, it may be stated that the class of highway suitable for the carrying of commercial traffic will be adequate for the use of passenger vehicles. Our study of the commercial vehicle and the use and the suitable highway for this agency must, therefore, be the more careful.

In order properly to outline this problem we must know definitely several things about commercial traffic. It is evident that the motor truck has a proper place in the scheme of transportation and must be operated, to be economical,

within certain limits. Figures show conclusively that, under the present cost of operation of motor trucks, the maximum limit for the economic operation of motor trucks is approximately 125 miles. At this point, under present conditions and with freight rates as they exist, the cost of transportation by motor truck begins to exceed the cost of transportation by rail. Consequently, here is one definite limit, under present conditions, for the operation of the motor truck. As conditions change, however, this particular limit may be lowered or raised. For instance, if we increase materially the license fee on motor trucks, the economic limit of operation will be reduced. Conversely, if freight rates decline, the economic short haul limit for rail will be reduced. Connecticut, which lies midway between Boston and New York, is almost entirely within the above-mentioned economic truck operation distance from both New York and Boston. This is interesting and an indication of the condition which materially affects our railways in their transportation of local freight.

Service Rendered as Basis for License Fees

An analysis of the daily cost of truck operation shows that out of a total operating cost of $26.09, 11c. is spent for the license fee, or for that portion of the operating expense which pays for the use of the road. From the standpoint of road service it has been found by certain experiments that the operating cost per mile on a hard, smooth pavement is approximately one-half of the cost on an ordinary earth road. If the direct operating cost for the above-mentioned truck, including the cost of gasoline, oil and tires, is taken into consideration, the cost for these items is approximately $6 a day. If one-half of this sum is saved by road improvement, a daily saving of $3 will be made which, reduced into yearly license, would allow a maximum license, based on the saving in operation during 250 working days per year, of $750 as against (with the 11c.-a-day fee) $27.50. These figures throw a new light on this phase of the problem.

The problem of Connecticut, of course, is not the problem of Iowa or California. We have no immense distances. We are not developed agriculturally to any extent. The development of our highway system for the two classes of traffic mentioned above demands a return from the traffic using the road, because there is but slight local benefit accruing to abutting property owners. This, then, is the traffic problem of Connecticut, so far as the highway department is concerned.

We are concerned only incidentally with safety of traffic. This is the responsibility of the motor vehicle department. Our general concern is with the development of our highway system in order to accommodate the commercial and passenger traffic and to develop this system by means of the funds secured from the agency which uses the highways—the motor vehicle. We are not prepared to say just what proportion will ultimately be paid by each type of vehicle. We hope to establish a definite relation between the commercial vehicle and the passenger car. We must not attempt to secure from the passenger car an amount in excess of the cost of service rendered. We should not, in the case of the commercial vehicle, subsidize it at the expense of the state and to the detriment of the railroad. We must endeavor to find out the proper place for each type of transportation so that we may be sound in our conclusions.

We know that the motor truck has come to stay. We realize that Connecticut is one of the most advantageous fields for its development. We consider it no more than fair to collect from the commercial vehicle a sufficient amount of money to provide for the extra service rendered by the highway to this agency. This is the traffic problem of the state highway department so far as it concerns that department itself. The width of highway, the type of highway and the ruling grade are merely incidents which can be properly related to the economic vehicle limit when the same is found. I do not attempt to solve this problem, but merely to state it, and even then in only a nebulous manner.

The future holds a great many problems. Before these may be solved they must be expressed in definite form. To secure definite factors to include in these different equations information must be secured. We have a two-fold problem: We must find the volume of traffic which may ultimately use the highways to be developed and we must also construct a type of highway for the accommodation of this traffic which is satisfactory and suitable. Information at hand is meagre. The effects of different types of traffic on different types of road surface must be secured. The volume of traffic must be taken at different seasons in the year at different points and a forecast of the ultimate traffic made therefrom. Studies of impact stresses and innumerable things suggesting themselves from the general situation must be made.

It will be interesting here to inject a statement as to the volume of traffic using the roads of this state on a particular three-day period. Early in May, for 72 hours, the total number of vehicles counted at 56 points in the State of Connecticut was 240,900. These were divided into 204,300 passenger cars and 36,500 trucks. This information is simply preliminary. The volume at particular points is intense; at other points, the volume is light. Collecting these data and drawing inferences from them, we should be able eventually to find the proper solution of the highway construction problem from the traffic standpoint and determine the types of highways to be constructed at different points.

When it comes to the relation between amount of traffic and the cost of highway repair we have another factor. It may be shown that eventually certain highways will need certain types of pavements from the forecast made by the cost of maintenance under certain volumes of traffic and by the volume of traffic which may be determined as eventually using this road. The problem is complicated. The underlying principle which should be stressed is that, in order properly to develop our traffic, we must secure from that traffic a sufficient payment in license fees to pay for the service rendered. Much has been said regarding the advisability of taxing a particular agency for the upkeep of roads. When it is thoroughly understood, however, that the roads are built for the automobile and without particular regard to any other type of traffic, it seems fair to lay the burden of the cost of financing these improvements on this agency, which is the most benefited.

Research Bureau Essential

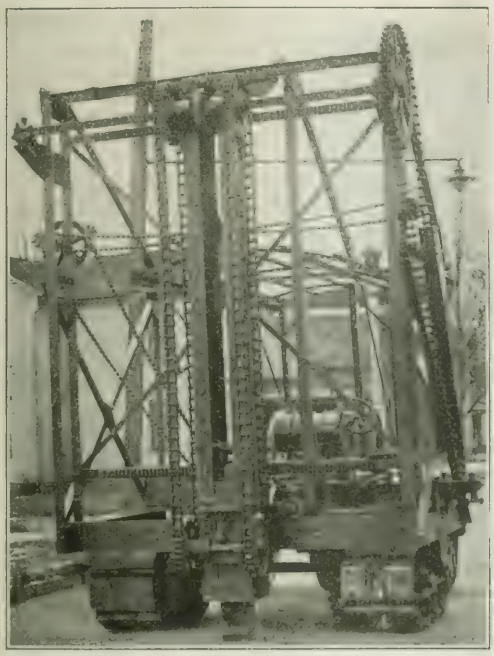
What is needed more than any other information is a thorough understanding of the relation between traffic and the highway, and it seems imperative that means for securing this information be established. A bureau of research is needed. This bureau should investigate the detail relations between traffic and highway, and should not stop at this particular point, but should extend its work to a thorough investigation of the transportation problem from all standpoints, including all means of freight and passenger transportation, having in mind the development of waterway, railway, trolley, highway and possibly the air. It is a big job and of vital importance to the welfare of the country. The sums of money spent in highway improvements are tremendous. The effect of this expenditure on the public is manifold. Money spent on one agency cannot be spent on the other. Unnecessary work done in highway development will mean curtailment of expenditure in other sources, particularly for other means of transportation. The problem should be stated in simple terms and solved in the interests of the general public.

Board of Estimate and Control for New York State

A State Board of Estimate and Control has been created for New York by an act passed by the Legislature and approved by the Governor. The board will consist of the Governor as chairman, the state controller and the chairman of the Senate and Assembly Finance Committees. Besides preparing an executive budget, the board is directed by the act to consider the administrative departments of the state for the purpose of increasing efficiency and economy in state matters.

Pavement Breaker for Starting Water-Works Trenches

FOR cutting trenches through pavements a machine resembling a small mounted pile driver has been developed in Detroit by the engineering department of the Board of Water Commissioners. In pipe extension work, of which no less than 141 miles was done during 1920, frequent cuts have to be made through 6 and 10-in. concrete pavement base. The concrete breaker, which



DETROIT CONCRETE AND PAVEMENT BREAKER

is shown in the accompanying views, is expected to prove a great labor-saver in this work.

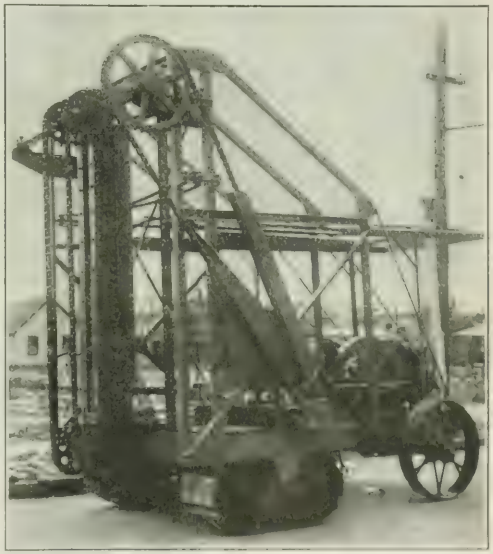
The machine is carried on two short crawler tractors and two wheels. On the forward end of the frame is a gasoline engine, and on the rear end is an automatic hammer. The chisel or cutting edge of the hammer is shown set crosswise of the machine, but in practice the edge is generally turned parallel to the trench. The hammer leads can be moved transversely while the hammer is being raised. The machine is built to break a surface 6 ft. wide; wider openings require several trips.

With over-all dimensions 9 x 15 ft. x 14 ft. 2-in. height, the concrete breaker weighs 14,000 lb. Its wheel base is 6 ft. 9 in. The traction base has 21 x 10-in. tread plates. The hammer, weighing 1,225 lb., has a removable bit 14 in. long by 9 in. wide with a 90 deg. beveled cutting edge which may be placed lengthwise or crosswise of the hammer. The bit is a steel casting, 0.40 to 0.50 per cent carbon, casehardened to prolong its life.

The hammer has a hoisting speed of 76 ft. per min., strikes 14 blows per min., and has a crosswise travel of 6 ft. at the rate of 35 ft. per min., which permits a shift of 1¾ ft. between blows. It is picked up by three tiltable spurs on the hoisting chain; these spurs are held out to engage lifting lugs on the hammer by an angle-iron track bolted to the leads, and trip automatically at the upper end of this track. The track is in removable sections 10 in. long, which permits increasing or decreasing the drop of the hammer. The maximum drop of the hammer is 7 ft. The cross-travel of the leads is controlled by a friction clutch. The hammer may be held suspended by a ratchet on the hoist shaft, which permits the machine to be moved about from job to job. The road speed is approximately one mile per hour and the breaking speed approximately 15 in. per minute. The engine is 8¼ x 12 in., developing 15 hp. at 350 r.p.m.

During the past winter two of the machines have been used to break frozen ground in unpaved streets. Up to April they had been used more for this purpose than to break pavements. Experience indicates that they will break 500 ft. of clay frozen to a depth of 18-in. for a trench 6 ft. in width in an 8-hr. day, and about the same length of 8-in. concrete pavement. They work well on any pavement, but better on asphalt when the surface is cold and hard. In hot weather, when the asphalt is softened, it tends to stick to the cutter.

One operator with a laborer following handles the machine. The gasoline consumption is 1½ gal. per hour,



SIDE VIEW OF BREAKER HAMMER LIFTED

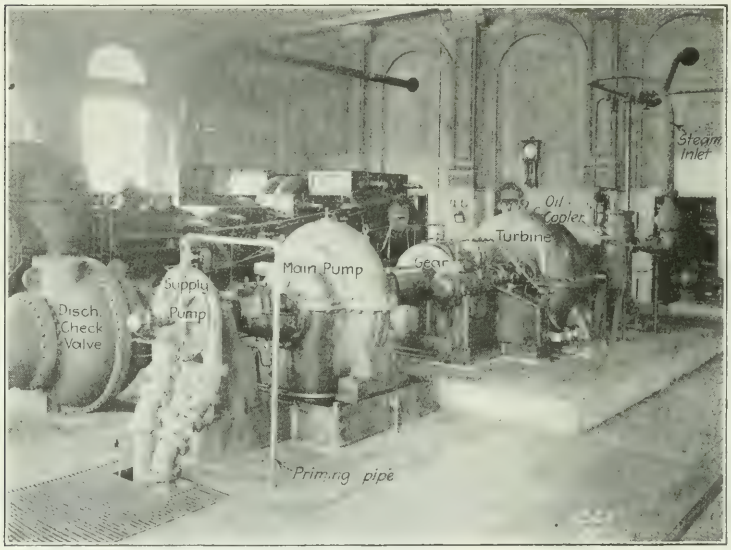
and 1 qt. lubricating oil is consumed per day. At the close of the 1920 season the operator was paid $1.04 per hour, but later the wage was reduced to 90c. Cost records are not yet available.

While the design of the machines is new, the principle on which they operate has been tried out by the department for more than a year. The original machine require the operator to raise the hammer each time a blow was struck, and it was not possible to shift the hammers sidewise. The old machine is still in use, has been fitted out with rubber-tired wheels, and is towed by truck to various parts of the city to break small cuts.

George H. Fenkell, superintendent and general manager, Board of Water Commissioners, states that Henry Cousino, engineer of power machinery, is largely responsible for the design of the breakers.

Baltimore Pump Sets New Duty Record for Centrifugals

A NEW duty record for centrifugal pumping engines has been established by a 30 m.g.d. unit in the Mt. Royal Station of the water-works of Baltimore, Md. The official tests showed a maximum duty of 170,250,000 ft.-lb. per 1,000 lb. of steam at 175 lb. gage pressure, 60° superheat and a water temperature of 70° F. The Baltimore unit comprises a 30 m.g.d. single-stage centrifugal pump with 30-in. inlet, 24-in. outlet and 36½-in. impeller driven by a 1275-hp. Curtis type steam turbine through reduction gears in solid bearings. The turbine exhausts to a waterworks condenser with 4,000 sq.ft. cooling surface. On the end of the pump shaft is a special design of 5-in. supply pump for the condenser air pump—which is an "eductor" type. The air pump is operated, at starting, from a connection to the suction main of the unit, this being under about 40 lb. pressure. Condensate is drawn from the condenser hotwell by a two-stage 2-in. 1360-r.p.m. pump driven by a 3½-hp. Pelton wheel. The condensate and the discharge of the hydraulic auxiliaries is received in a vented sump. The turbine weighs 31,000 lb. and the pump and bed plate 26,000 lb.

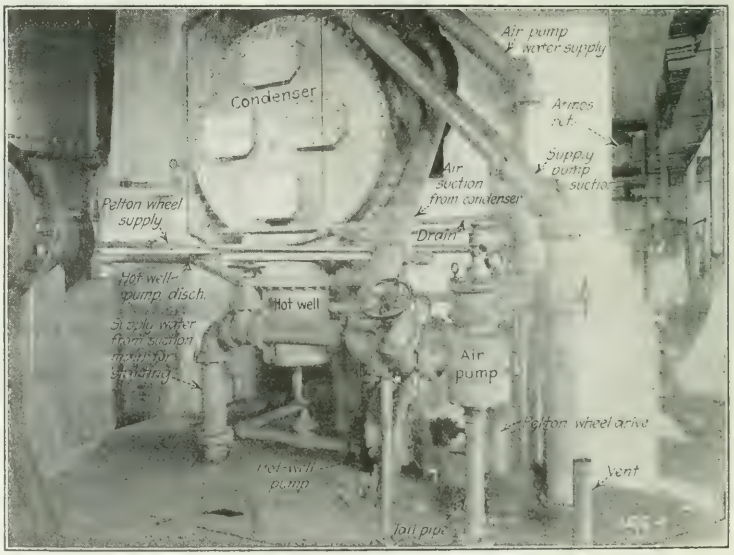


THIRTY MILLION-GALLON CENTRIFUGAL PUMPING UNIT, MT. ROYAL STATION, BALTIMORE

The contractor for the complete unit was the Worthington Pump & Machinery Corporation, Harrison, N. J. The pump and condenser equipment were built at the Worthington works, and the turbine was built at the Lynn works of the General Electric Co.

The accompanying table shows the official test results of the City of Baltimore. The head and duty results have been plotted in the accompanying curves. The tests were made jointly by the city and contractor under the direction of F. Howard Cronin, superintendent Mechanical Division Baltimore Water Department, and Robert W. Allerton, superintendent Erecting Department of the Worthington Corporation.

In making these tests the condensate was caught and weighed. Suction and discharge quantities were measured by a pitometer. Steam pressure was read from a calibrated gage at the main throttle and temperature was taken by thermometer in a well at the same point. Vacuum pressure was measured by mercury column attached close to the turbine and exhaust temperature by a thermometer in a well close to the condenser. Temperature of the inlet water was measured near the condenser. The suction water pressure was measured by calibrated gage near the condenser inlet, and discharge pressure was taken close to the pump discharge outlet. Velocities of flow were computed.

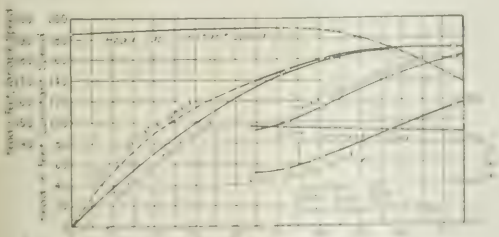


CONDENSER AND AUXILIARIES OF MT. ROYAL CENTRIFUGAL PUMPING UNIT

OFFICIAL TEST DATA AND RESULTS OF 30,000,000 GAL. CENTRIFUGAL PUMP AT MT. ROYAL PUMPING STATION, BALTIMORE, MD.

			1	2	3	4	5	6	7
1	No. of test								
2	Date	August, 1920	4	4	4	6	6	6	6
3	Duration	Hrs.	2	4	2	1	1	1	1
4	Atmosphere pressure (elev. 111 ft. Baltimore datum)	In. hg. 32° F	30.12	30.07	30.06	30.06	30.04	30.00	29.98
5	Temperature of room	Deg. F.	83.4	86.84	85.57	84.14	88.2	88.8	88.28
6	Throttle steam pressure gage	Lb. per sq. in.	174.76	174.3	172.9	172.3	174.4	173.3	172.5
7	Throttle steam pressure absolute	Lb. per sq. in.	189.54	189.06	187.65	187.05	189.15	188.00	187.22
8	First stage steam pressure gage	Lb. per sq. in.	78.2	81.07	88.9	114.1	57	50.5	46.66
9	First stage steam pressure, absolute	Lb. per sq. in.	92.98	95.8	103.7	126.9	71.8	65.25	61.4
10	Temperature of throttle steam	Deg. F.	412.4	420.8	426.48	429.3	413.1	409.9	403.6
11	Degrees superheat of throttle steam	Deg. F.	35.0	43.6	49.92	52.98	35.84	33.2	27.21
12	Vacuum exhaust outlet of turbine	In. hg. corrected	28.956	28.937	28.94	28.955	28.974	28.962	28.946
13	Vacuum exhaust outlet of turbine	Lb. per sq. in.	14.217	14.208	14.21	14.22	14.226	14.221	14.211
14	Back pressure absolute	Lb. per sq. in.	0.572	0.556	0.549	0.539	0.523	0.509	0.509
15	Temperature corresponding to vacuum	Deg. F.	83.8	82.99	82.54	82.0	81.06	80.2	80.2
16	Temperature of exhaust, actual	Deg. F.	80.9	81.0	80.0	80.0	78.0	78.0	78.0
17	Temperature of condensate	Deg. F.	78.7	78.88	78.07	74.4	74.38	75.77	76.75
18	Wt. of condensate from turbine, including leakage	Lb. per hr.	12,011.5	13,087.7	13,839.5	17,282	10,484	9,263	8,250
19	Wt. of condenser leakage	Lb. per hr.							
20	Condensate chargeable to turbine	Lb. per hr.	12,011.5	13,087.7	13,839.5	17,282	10,484	9,263	8,250
21	Suction pressure, inlet to condenser	Lb. per sq. in.	40.86	39.72	38.72	37.12	37.918	38.88	39.12
22	Suction pressure, inlet to condenser, including vel. head	Lb. per sq. in.	46.21	45.41	44.23	43.40	45.94	46.47	47.34
23	Discharge pressure at nozzle	Lb. per sq. in.	121.82	118.869	110.12	111.78	104.16	102.37	101.38
24	Discharge pressure at nozzle, including vel. head	Lb. per sq. in.	122.36	121.19					
25	Distance between suction and discharge pressure gage	Ft. of water	1.229	1.229	1.229	1.229	1.229	1.229	1.229
26	Distance between suction and vol. pressure gage	Ft. of water	15.104	15.104	15.104	15.104	15.104	15.104	15.104
27	Velocity head at inlet to condenser	Ft. of water	0.484	0.741	1.115	1.602	0.682	0.510	0.358
28	Velocity head in discharge nozzle	Ft. of water	2.444	3.75	5.641	8.114	3.468	2.582	1.814
29	Net velocity head	Ft. of water	1.96	3.009	4.526	6.512	2.785	2.072	1.456
30	Total test head based on pressure gages	Ft. of water	190.36	187.19	170.83	180.34	157.16	150.08	146.63
31	Total test head based on vel. gages	Ft. of water	191.164	190.304					
32	Temp. of water at inlet to condenser	Deg. F.	73.4	73	73	71.9	71.9	71.9	71.9
33	Temp. of water at suction inlet to pump	Deg. F.	75	74.77	74.51	72.75	72.48	72.27	72.25
34	Water pumped by pitometer in suction main	M.G.D.	25.12	31.62	38.50	46.20	31.920	27.13	22.386
35	Water pumped by pitometer in discharge main	M.G.D.	25.50	31.54	38.70	46.38	30.325	26.20	21.934
36	Water pumped by suction main Venturi meter indicating	M.G.D.	24.5	30.43	37.18	44.87	29.6	25.94	21.74
37	Water pumped by suction main Venturi meter integrating	M.G.D.	23.58	29.52	35.83	44.16	28.96	24.96	20.6
38	Water Hp. by discharge main pitometer	Hp.	851.0	1,035.0	1,159.0	1,466.0	835.8	689.0	564.0
39	Duty per 1,000 lb. of steam test conditions	Millions ft. lb.	140.2	156.7	165.92	168.0	156.5	144.7	132.75
40	Duty per 1,000 lb. of steam test, contract conditions	Millions ft. lb.	144.5	160.2	169.0	170.25	160.8	148.7	137.3
41	Temperature of oil entering cooler	Deg. F.	106.9	107.83	107.5	106.17	100.5	99.17	98.58
42	Temperature of oil leaving cooler	Deg. F.	98.1	98.43	98	95.5	91.2	90.37	90
43	Nozzle press. Pelton water wheel	Lb. per sq. in.	118.43	116.66	108.01	108.30	103	102.22	101.11
44	Hurling water pump suction pressure	Lb. per sq. in.	8.469	8.469	8.469	8.651	7.517	7.585	7.62
45	Hurling water pump discharge pressure	Lb. per sq. in.	25.17	25.157	25.92	29.95	16.66	15.529	14.807
46	Press. hurling water at air pump	Lb. per sq. in.	30.6	30.1	29.8	35	37.22	38.3	37.66
47	Water used by Pelton wheel	Gal. per min.	62.1	61.6	59.4	59.5	58.0	57.7	57.4
48	Water used by air pump	Gal. per min.	552.0	548.0	547.0	591.0	608.0	655.0	613.0
49	Speed of main pump	R.P.M.	736.6	732.9	729.2	784.6	665	640.2	629.5
50	Speed of turbine	R.P.M.	3,208	3,192	3,176	3,417	2,896	2,788	2,741
51	Speed of Hotwell pump	R.P.M.	1,504	1,490	1,401	1,352	1,340	1,342	1,354
52	Total water pumped by main pump	M.G.D.	25.59	31.633	38.78	46.47	30.40	26.28	22.02
53	Total water Hp. obtained	Hp.	854.0	1,037.5	1,160.5	1,469.0	837.5	691.0	566.0
54	Brake Hp. at main pump shaft, estimated	Hp.	1,133.0	1,250.0	1,350.5	1,701.0	998.0	856.0	756.0
55	Efficiency of main pump	Per cent	75.1	82.8	85.8	86.2	83.7	80.5	74.6

The speed of the main pump was measured by tachometer and checked by a hand counter; the turbine speed was computed by the gear ratio (4.36). Pressure at the Pelton wheel nozzles was taken by gage and the discharge from nozzle rating.



PUMP CHARACTERISTICS OF MT. ROYAL CENTRIFUGAL [illegible] FROM OFFICIAL TESTS

During the tests, the unit was run steadily for two hours at each point and readings taken every 5 min. for the more variable data (pitometer, gages, etc.) and every 10 min. for the steadier data (temperatures). Constant speed runs were made first at the 25.1, 33 and 38.5 m.g.d. rates. As the 33 rate was nearest to contract conditions this run was for 4 hours with readings at 10- and 20-minute intervals. The variable speed runs were made at delivery rates of 46.5, 30.5 26 and 22 m.g.d. During runs 5, 6 and 7, on account of the reduced speed, hurling water was taken from the suction main and correction made in the readings. The supply pump then furnished water to the oil cooler and bearings only.

Since the test, this unit has been run steadily and for the past two months continuously at a 40,000,000-gal. rate.

Traffic on English Railways in 1920

In a recent statement of the British Ministry of Transport on the operation of the railways in 1920 it is shown that net income in that year was 5 per cent greater than that in 1913, with a decrease in general merchandise tonnage of ½ per cent and a decrease in fuel tonnage of 20 per cent. Rates on general merchandise slightly more than doubled and rates on fuel increased more than 50 per cent. Passenger rates increased about 80 per cent. Receipts and expenditures for the two years were as follows:

	1913	[illegible]
Total receipts	£[illegible]	£[illegible]
Total expenditure	£87,500,000	£[illegible]
Net income	£[illegible]	£[illegible]

The number of passengers carried in 1920 was 1,566,834,000 compared with 1,507,117,000 in 1919, 1,184,196,000 in 1913. Season-ticket holders increased from 584,000 in 1913 to 1,015,000 in 1920. In 1913, 67,744,000 tons of general merchandise freight were carried; 225,554,000 tons of fuel, and 70,864,500 tons of "other minerals." In 1920 the freight record was: General merchandise, 68,658,500; fuel, 181,166,000; other minerals, 68,053,000 tons.

How One Consulting Engineer Got a Job

Sidelights on the Business Side of Engineering in Designing Schoolhouses for the City of New York

By Elwyn E. Seelye
Consulting Engineer, New York City

Engineers lately have been awakened to the fact that one of the reasons for their mediocre material success, as a class, is their lack of supplementary business ability. Many of them are in a state of economic bondage, because they are selling their time on a salaried basis rather than their engineering product as a commodity. Therefore, a little light on the subject may be of value. The relation between some of the ABC's of commercial engineering and the XYZ's of structural engineering is brought out in the following account of how an engineer sold his abilities to the contractor on New York Public School No. 50.

The typical school building in New York is T-shaped, the top of the T consisting of a five-story classroom wing with double rows of class-rooms and corridors down the middle. The leg of the T is the auditorium wing, which is two stories high. The auditorium itself extends under the five-story wing and a heavy girder of about 60 ft. span is required to support the third, fourth and fifth stories of the class-rooms above. The average structure contains about 100,000 sq.ft. of floor surface.

After the armistice, the architect of the Board of Education decided that the best interests of the city demanded that alternate bids be permitted on a reinforced-concrete frame for school buildings, though formerly the schools were designed with a fireproof structural steel frame. The alternate allowed the bidders full latitude regarding concrete system and spacing of columns but required the design to be made in accordance with the building laws and also that the architectural requirements be strictly adhered to.

The wisdom of the architect's course in taking concrete alternates may be appreciated when it is considered that after the armistice there was a country-wide shortage of structural steel and that schools located outside of the city had long been built of concrete to the exclusion of structural steel. What is to be particularly commended is the fact that the architect, by leaving the design open, permitted a full play for engineering talent.

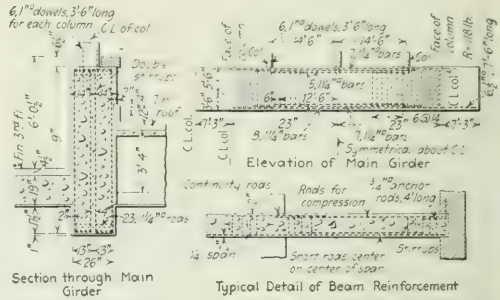


FIG. 1. DETAILS OF REINFORCED-CONCRETE BEAMS AND MAIN GIRDER

As soon as the concrete alternates were announced engineering staffs of the bar companies and patented systems and one or two independent engineers pitted their brains against one another. Each competitor probably hoped to evolve a design which would sweep the field. However, owing to the fact that the successful contractors sat as separate judges on each job, no one competitor was universally successful and more than one drew a prize.

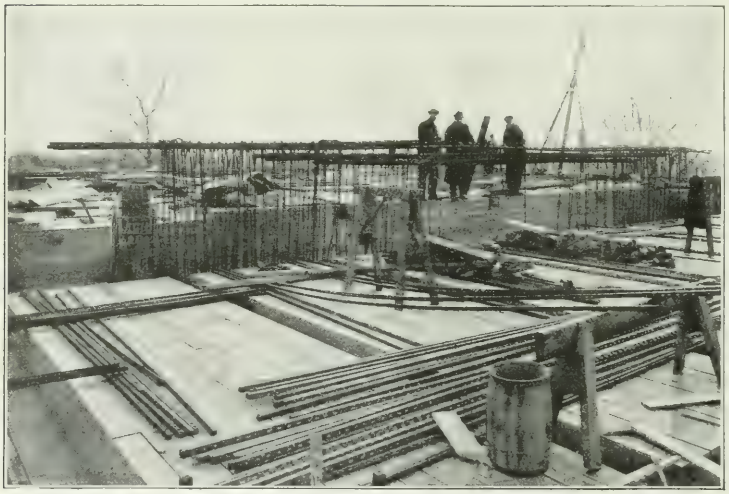


FIG. 2. VIEW OF ONE OF THE AUDITORIUM GIRDERS DURING CONSTRUCTION

Unfortunately for the independent engineers, the question of bar delivery was very critical and they did not receive all the consideration which their designs merited according to cold figures, owing to the fact that they had no steel to deliver. But this disadvantage was partly offset because they had nothing but engineering service to sell and therefore were unbiased in their preliminary design.

A preliminary design and estimate had to be prepared for each job as an assistance to the general contractor in making up his bids, if an engineer was to stand a chance with the successful bidder. All the contractors were "from Missouri." This preliminary estimate was an expensive operation. The framing was very irregular and the jobs fairly large.

The writer went at the problem as follows: All different possible methods of design, such as combinations of clay tile, metal tile, beam and girder, flat slabs, etc., were considered, together with variations of column spacing, arrangement of framing, effect on architectural features, and wall types. Tentative designs reduced to cost, pointed to a simple beam and girder construction with bearing walls. Construction costs were built up from unit costs, somewhat as follows:

Having selected the proper design, the whole structure was designed and quantities taken off and a complete and reliable estimate of the quantities of concrete, steel and framework made up. The completed estimate was arranged as below:

Concrete—1.2.4	2,000 cu.yd.
Concrete—1 1½ 3 (columns)	250 cu.yd.
Concrete—1 3 6 (foundations and walls)	500 cu.yd.
Reinforcing steel (above base size)	300 tons
Reinforcing steel (⅝ in. diam.)	50 tons
Cold drawn wire mesh	30 tons
Flat-slab forms	100,000 sq.ft.
Beam and girder forms per sq.ft. of contact area	60,000 sq.ft.
Column forms, contact area	5,000 sq.ft.
Wall forms, contact area	10,000 sq.ft.

This simple form of summary is furnished more in detail for contractors who keep more detailed cost systems.

The next step was purely business. It consisted in interviewing the bidder and convincing him of several facts, namely: (1) That your figures were reliable. (2) That you had the knowledge, ability, and organization to turn out your plans on time and get them approved on time. (3) That the steel could be bought more economically on a pound price, based on a bar list, than on a lump sum. (4) That your design was inherently the most economical. (5) That your details would require the least amount of labor, bending, placing and formwork.

The contract for Public School No. 50 was awarded to the Putnam Construction Co. Its president, Mr. O'Rourke, a man familiar with both public schools and reinforced concrete, was an able engineer as well as a practical contractor. Mr. O'Rourke was convinced of the soundness of the writer's plans and, being desirous of incorporating many practical ideas of his own, decided to employ the writer and have him prepare a reinforced-concrete design and working drawings for the above structure.

An administrative problem now presented itself. The contract for the drawings called for their completion and approval on specified dates. In other words, this meant the simultaneous approval of the Board of Education and the Building Department at an early date after the completion of the plans.

The design was placed in the hands of an experienced designing engineer and the detailing in charge of a capable detailer. The detailing engineer kept in constant touch with the Board of Education and supplied it with the preliminary prints as the plans progressed. In this way, the early approval of the board was obtained. It was due to faithful compliance to the building laws and sound engineering practice, that the early approval of the Building Department was secured. It is worth while noting that the architectural requirements are exacting to a high degree in this type of work.

A very important feature in the economy effected in this structure consisted in detailing it with the straight loose bars graded as to length without laps, hooks or bends. This method is shown in Fig. 1. The bars were carefully graded as to length for moment and bond considered at the free or non-continuous end, all shear reinforcement being provided by stirrups. It is an indisputable fact that bends and hooks and extra length for anchorages would provide a greater shearing strength, but it is the duty of the engineer to eliminate all waste due to excess material as well as to produce a design with a safety factor of four and no more. As all these items entailed a disproportionate amount of labor or material, they were consequently dispensed with and the design carried out in accordance with the American Concrete Institute committee's report of 1920. This recommends a shearing stress limit of 120 lb. for 2,000-lb. concrete, if properly anchored web reinforcement is used with steel in the top over the supports.

The selection of the type of construction was closely connected with the commercial aspects of the problem. Let us consider first the types of walls, which may be chosen; for instance, bearing, skeleton, or curtain walls. By way of explanation, it should be said that a curtain wall, under the nomenclature of the New York Building Law is applied to that wall which is built self-supporting but braced by wall columns.

After viewing the costs obtained from estimated quantities extended with unit prices, it was found that the curtain wall and the skeleton wall were the most economical types. There was, however, this to be taken into consideration. The school contractors are specialists and are experienced in one type of construction,

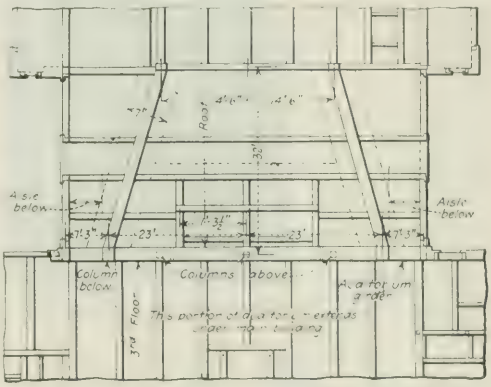


FIG. 1. LAYOUT OF BEAMS AND GIRDERS OVER AUDITORIUM

namely, a brick bearing wall school, with structural steel beams, girders and interior columns, fireproofed and arched with cinder concrete. They usually sublet the steel, floor arches and fireproof construction and lay their own brick work. Consequently they were experienced and efficient in the building of a bearing wall job, but were not organized for working a complicated reinforced-concrete job nor were there many sub-contractors so organized. They must depend for sub-contractors for the reinforced-concrete work on the more progressive of the cinder concrete arch men. Therefore, it will be readily seen that a bearing wall job, at least for a starter, presented ample opprtunity for the builder to take advantage of his own experience in brickwork and simplify the work of the reinforced-concrete sub-contractor For these reasons, a bearing wall design was adopted.

The next problem for solution was the type of reinforced-concrete construction. In general the various possible types or systems are: the beam and slab, metal core, one-way clay tile and two-way clay tile systems. Apparently the most economical of these systems is the core type of construction, but practical consideration swung the balance in favor of the beam and slab type. Since this design was made, there have been many improvements introduced in the removable metal core system which point to this system as a coming type for

all plastered ceiling or light live-load construction. The sub-contractors who were available were not familiar with the core system and therefore this system was discarded in favor of the beam and girder.

The next problem which presented itself was the designing in concrete within narrow restrictions as to size and width of certain members heavily stressed in moment and shear. This problem had already been solved in other school designs with the use of steel plate girders and triple rolled beams, but here heavily reinforced concrete girders were resorted to. The most serious case occurred where the auditorium extended under the main five-story structure and where a girder was required to span the width of the auditorium and carry three stories of walls and floors. This problem was attacked along the following lines: (1) The span was shortened. (2) The load was relieved by rearranging the framing. (3) Compression steel was introduced. (4) A raised girder of full depth between ceiling line and window sill was used. (5) A rich mix was used. The result was the girder shown in the view in Figs. 2 and 4 and in detail in Fig. 1.

FIG. 4. LOOSE BAR STIRRUPS IN GIRDER

The span was reduced by placing the column just inside the side aisles where they did not obstruct the view of any seats and only sacrificed one seat each. The load was relieved by skewing two large auditorium roof girders to come directly into the columns (Fig. 3).

The modern school building is an aggregation of class-rooms but it has warm air arteries, breathing apparatus, thousands of cabled eyes, telephone nerves and abdominal passages. All these conduits must be accorded space and the structural engineer must allow for their free passage.

This article would not be complete without mentioning an intimate subject, that of the engineer's fee. The agreement made with the contractor required that a total lump sum fee be paid in installments, the last of which came due when the third tier had been completed. The salary and overhead cost were about 50 per cent, leaving a net profit of 50 per cent, which was satisfactory when the fact that this was an entering wedge job was taken into consideration and was the more difficult because it was the first of its type.

To sum up, this job is typical of nearly all entering wedge work. The contractors' engineer must create ideas which are attractive to a contractor. He must have an efficient organization to execute the work, the head of which should be working on a profit sharing or partnership basis, and he must handle the different organizations from which he must obtain information and approval with tact and consideration.

Alterations to Queen Lane Water Filters, Philadelphia

By John S. Ely
Assistant Engineer, Bureau of Water, Philadelphia, Pa.

The Queen Lane water filter plant, Philadelphia, is being doubled in capacity by converting the preliminary filters to rapid or mechanical filters and continuing the present slow sand filters in use as such. Coagulating basins will be built for the mechanical filters. The present sedimentation reservoir will serve the slow sand filters only, thus nearly doubling the pre-sedimentation period. Other changes are noted in detail below.

The Queen Lane filter plant was built in 1909-1911, and is the latest of the five filter plants for Philadelphia. It was designed to furnish about 70 m.g.d. to districts in the North and Northwesterly section of the city. It is located in what was originally the north basin of the old Queen Lane reservoir. The south basin of the reservoir, having a capacity of 175,000,000 gal., is used as a sedimentation basin. The filter plant consisted of 22 slow sand filters of 0.75 acres each, 40 preliminary filters, each 32 x 40 ft., a 40,000,000-gal. filtered water basin, a power house, wash water tower and office building. As the plant is located in a residential section of Germantown, the area available was confined to the two city blocks on which the original basin was built and it was necessary to design the plant as compactly as possible. For this reason the slow sand filters were built above the filtered water basin, on groined arches.

This plant is nearer the center of the city than any of the others, and is advantageously located for supplying a large area by gravity. Therefore, as one of the first steps in the proposed increase of the water supply of the city, it was decided to increase the capacity of this plant. The 40 preliminary filters are in size and arrangement very similar to modern rapid sand filters, and by making changes in the interior piping and wash water systems and adding new filtering material, this portion of the plant can be readily converted into modern mechanical filters, with a capacity of about 100 m.g.d. The 22 slow sand filters will then be operated independently and should be good for at least 40 m.g.d. more, making a total of 140 m.g.d. or double the present capacity.

This arrangement, however requires the use of a coagulant in that portion of the water which is applied to the mechanical plant, necessitating the construction of additional basins and a head house for applying lime and alum.

As none of the surrounding property could be acquired except at almost prohibitive cost, the necessary space has been found for the required coagulating basins by excavating into the banks of the original reservoir. A head house has been designed to be located over the outlet end of the raw water pumping mains at the southwest corner of the plant.

This head house will be so arranged that alum and lime in proper proportions may be applied to only that portion of the supply which is to be filtered in the new mechanical plant, the untreated balance being diverted to the old sedimentation basin, and thence to the slow sand filters, or if desired the whole supply may be treated. The equipment will include dry feeding machines, solution tanks, concrete storage bins, electric hoists and hand traveling cranes for convenient

handling of the chemicals. The necessity for these is evident when it is realized that at the rate of 2 grains per gallon it would be necessary to use 1,200 lb. of alum per hour, or 14.4 tons per day.

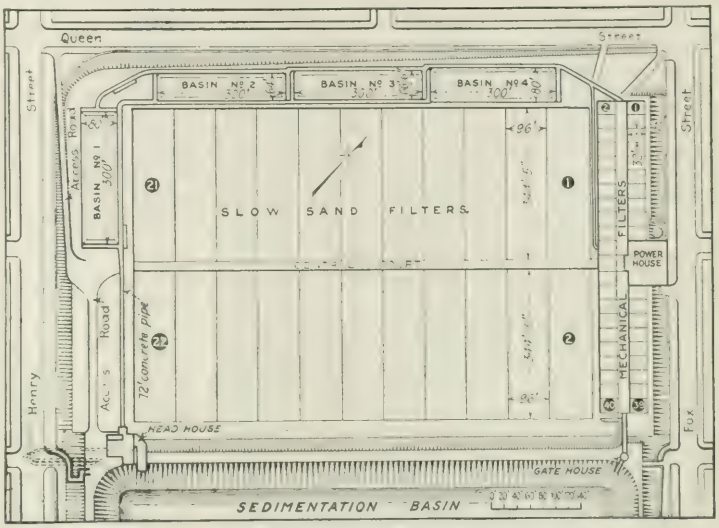
The treated water will be carried from the head house by a line of reinforced-concrete pipe 72 in. in diameter and 450 ft. long, connected at its lower end with a rectangular supply conduit running along one side of the basins. A similar conduit on the other side will carry the effluent from the basins to the mechanical filters. The basins are each 300 ft. long, but vary in width from 64 to 80 ft., according to the width of the original bank on which they are built. Their depth varies inversely as the width so that the basins have a uniform cross section of about 950 sq.ft., giving at a 100-m.g.d. rate, a mean velocity of 0.04 ft. per second and a sedimentation period of about two hours.

The basins have 9-in. concrete floors, reinforced-concrete side walls and have skimming weirs at the outlet ends. They are arranged to work in parallel, one-quarter of the supply passing through each basin, and any one may be placed out of service for cleaning by flushing through a 16-in. drain to the street sewer. The changing of the preliminary filters into a mechanical plant, while not requiring any great amount of new construction, is a somewhat slow and laborious process, especially so as it is necessary to keep as much of the plant in service as possible. During nearly ten years of hard service with Schuylkill water the sand and gravel have become quite thoroughly choked with mud and some of it has penetrated to the strainer systems and collectors, while part of the air piping is badly corroded. An entirely new strainer system has been designed which it is believed will prove more durable, and larger sizes of cast-iron piping are required to take care of the increased quantity of water to be filtered. These changes necessitate the removal of all of the old sand and gravel and some alterations to the concrete floors, roof columns and wash water gullets. The old sand cannot be used, but the gravel will be washed and replaced, and 30 in. of new filter sand placed upon it.

After the completion of the work already described, it is the intention to improve the south basin of the original reservoir, which is to be used as a sedimentation basin for the slow sand filters. This basin now has no baffles, and the inlet and the outlet are both on the same side, consequently there is a tendency for the water to run straight across the basin. A concrete inlet flume will be built along the west side of this basin and so arranged as to distribute and aerate the raw water. Baffles of A-frame or similar construction will be built across the basin and so arranged as to give a maximum period for sedimentation. It is believed that this improvement will enable the present final filters to take care of considerably more water than the 40 m.g.d. already mentioned.

In connection with the work outlined, the equipment of the Queen Lane Pumping station, which supplies raw water to the filters, is to be entirely renewed. The four old vertical triple expansion pumps are being replaced, one by one, by four turbo-centrifugal units of 40 m.g.d. capacity each. The boiler capacity is to be increased from 2,800 to 4,000 hp., and new coal bunkers and coal and ash handling machinery will be installed.

The two 48-in. force mains to the filter plant, about two miles distant, will be supplemented by a 60-in. steel pipe line.



GENERAL PLAN OF REMODELED QUEEN LANE FILTERS

The designs for the alterations outlined were made under the direction of George W. Fuller, who was retained by the city as consulting engineer. The work is being done under the direction of Carleton E. Davis, chief of the Bureau of Water. Edward Fay & Sons, Philadelphia, are the contractors for building the new basins and head house, which are now about one-half completed.

Water Jacketing Concrete Pressure Pipe

Reports from Germany state that a new method of preparing concrete pipe for high pressure resistance is being experimented with. The basic principle is to encase the pipe-line carrying the pressure in one of larger diameter, and to keep the intervening space between the two pipes under water pressure of about half the head prevailing inside the smaller pipe line. The water jacket counteracts the water pressure of the internal pipe line to an extent equal to its own pressure. In this way, according to the report, reinforced-concrete pipes can be used for carrying water under double the pressure which they are normally able to resist. The structure is made more rigid by placing webs radially between the two pipes. It is claimed that this greatly helps to resist high pressure of ground and the shocks from traffic. It is suggested that the effect obtained can be multiplied by using more than one casing.

A Plan for Meeting Water-Supply and Sewerage Costs

Distribution of First Cost and Operating Charges in Accordance with Public and Private Benefits—Capital Charges End with Life of Bonds—Application of Plan to Suburban District

By Robert B. Morse
Chief Engineer, Washington Suburban Sanitary District; Chief Engineer, Maryland State Department of Health

and Abel Wolman
Division Engineer, Maryland State Department of Health, Baltimore, Md.

THE plan for meeting both capital and operating costs of water and sewerage systems outlined in this paper is founded upon two primary principles, one that public and private benefits should be separately considered, the other that fixed and operating charges represent two classes of costs whose payments should be differentiated. By this method, the installation of both water supply and sewerage systems is paid for by a combination of property tax, annual front-foot assessment, house connection cash payment, meter service charge, and water consumption charge. The general distribution of these charges is as follows:

1. Fixed charges: (a) The general tax is used to pay only that part of the cost of water and sewerage construction which is of value to all the taxable property, such as reservoirs, pumping stations, treatment works, supply and outfall lines. (b) The front-foot assessment pays for that part of the cost of service which is of special value to properties along water and sewer lines. (c) The payment for house connections includes cost of work from water or sewer main to property line.

2. Maintenance and operating costs: (d) The meter service charge covers the "ready-to-serve" portion of the operating costs. (e) The water consumption charge provides for the fluctuating costs of maintenance and operation of both water supply and sewerage service.

This plan is now in operation in the Washington Suburban Sanitary District in Maryland. While all the elements contained therein are not new, it is believed that it represents a unique co-ordination of all of them, at any rate in a general water supply and sewerage district.

Differs From the Brockton Plan

In addition to covering water supply as well as sewerage construction and operation, the system differs from the well-known Brockton sewerage method in two major and in several minor respects. It makes (1) a fundamental distinction between capital and operating charges and, (2), provides for a flexible adjustment of relative charges in accordance with variations in systems. The Brockton plan does not emphasize either of these considerations, but, perhaps on account of legal and local restrictions, distributes inflexibly and definitely the charges between general tax, assessment, and consumption classes. Both plans employ the same sources of revenue, since these are the only possible ones, but they differ completely in the fundamental philosophy of distribution of charges between these sources.

Methods of Paying for Systems—The usual methods of paying for municipal water and sewer construction and operating costs fall into one or more of the following classes: (a) general taxation, (b) special assessments, (c) rates based upon service. The use of any single one of these methods of payment would impose an undue burden upon many properties, since no one of them is equitable in its distribution of costs.

Manifestly any plan of meeting the costs of construction, maintenance, and operation of water supply and sewerage works should be founded upon the principle that the expense entailed upon any individual, public or private, should be proportionate to the benefits which he derives. A thoroughly equitable financial plan for constructing and operating water and sewerage systems must involve a combination of all the three methods indicated above. The mere presence of waterworks or sewerage in any town is of value to all of the taxable property, remote though it may sometimes appear.

The only portion of the cost of water and sewerage service that should be allocated to the tax rate is the measure of value that such service represents to all the taxable property, unless a graded plan of taxation on the basis of geographical location is used.

That part of the cost of service which represents a special value to all properties, vacant and improved alike, along water and sewer lines may be reasonably met by special assessment. The amount of this special assessment should be as closely as possible proportionate to the expense that the mere presence of the property entails upon the system. This expense is determinable by the length that the property binds upon the public way in which the pipe line is placed. In the case of a system properly designed this assessment should be independent of the size of the pipe in the street.

Special Assessments for Portion of Cost

The third class of benefit, and the greatest, is enjoyed by the developed properties along the pipe lines, and it is the connection of such properties with the system and their use thereof which give rise to the major part of the costs of maintaining and operating the system.

An exact analysis of the benefits received by the various classes of property above discussed is difficult of accomplishment. The problem may be solved, however, with a degree of approximation which will give a reasonably fair division of costs. The solution necessarily will be governed somewhat by local prejudices, and policy frequently dictates that such prejudices should determine the absolute amounts of the several classes of charges. Local feeling, however, should not be allowed to destroy the fundamental philosophy of the plan. There should be firm adherence to the principle that capital cost be met by the tax rate and by front-foot assessment, and that expense of maintenance and operation be covered mainly, if not wholly, by charges for service rendered.

It is convenient and substantially equitable to measure the value of a system to all the property in the community (that is, the charge to the tax rate) by the capital cost of the main elements of the system, such as reservoirs, pumping stations, treatment works, supply and outfall lines, and that portion of the cost of main arteries and collectors which would represent the excess of their cost over that of equal lengths of small

distributors and laterals. The front-foot assessments should meet the cost of the pipes and appurtenances necessary for bringing water, including that for fire fighting, to, and conveying sewage from, local areas. The assessment charge, however, should not include the cost of water and sewer connections. The expense of constructing these, which from the main to the property line should be done by the municipality, should be met by a charge, preferably a uniform one, upon the properties connected. The expense of making these connections represents, to a great extent, the particular benefit that a built-up property receives. If more nearly theoretical accuracy is desired, it may include the cost of fire hydrants and their connections. If so, the assessment charge is relieved of this cost.

Universal Metering Accepted Desideratum

On the maintenance and operating side the principle of universal metering is here assumed as an accepted desideratum. The cost of water delivery and pipe upkeep should be met by a "ready-to-serve" and a consumption charge. If the meter is furnished by, and remains the property of, the municipality, as is desirable, the "ready-to-serve" or so-called "service" charge should include an element to cover the fixed charges on the cost of the meter, unless its cost is included in that of the house connection. Whenever there is an antipathy towards sewer rentals as such, it is in a measure equitable to cover the cost of maintenance and operation of the sewerage system by an increased charge for water.

The question may naturally arise as to the manner of raising sufficient construction funds where capital costs are not wholly met by the tax rate, whether with or without the issue of bonds. To the writers it does not appear practicable or desirable to start upon a new improvement of any magnitude without the issuance of bonds. It is not necessary, however, granted proper legislative authority, that more than that proportion of the fixed charges which has been above specified as correct be borne by the tax rate. The remainder should be met by the front-foot assessments and the connection charges. Barring local legislative prohibition, the former may be made payable upon the commencement of construction in that area in which the assessments apply. If the assessment and connection costs are made payable in one or a few installments, a revolving fund will be created which will reduce the amount of future bond issues. However, this arrangement often results in a heavy burden upon many property owners. It is entirely feasible to impose an assessment charge on the basis of a few cents per front foot a year and to cover the house connection charge by a very small annual payment, both continuing during the life of the bonds. These need be sufficient in amount to cover only that part of the annual fixed charge on the bonds that is not to be met by direct taxation. If this is done the assessment becomes nothing but a small annual expense, which is practically the same as a slight increase in taxation for those along the pipe lines, and the payment for connections an additional service charge.

In the application of the plan here under discussion to particular localities it may be found advisable in many cases, for the purpose of front-foot assessment, to classify properties in a community in accordance with the uses to which they are put, imposing different unit rates upon each class. This is done to avoid burdens or prohibitive charges against properties with long frontages. This method is rational and equitable for the reason that some kinds of property, business and industrial, for instance, enjoy relatively greater advantages from the presence of adequate water supply and fire protection systems, and perhaps of sewerage systems, than do residential properties. Likewise, small residential or subdivision properties are more dependent upon water and sewerage service than is acreage or agricultural land. The more intensive the development, in general, the greater the benefit and the greater the capability of bearing the burden.

For the purpose of further decreasing the charges on long frontages it has been found necessary in some instances to establish a sliding scale of front-foot rates for a given class of property, decreasing the unit with an increase of frontage. In this case, if the property is later subdivided, or its character changes, its unit assessment would be modified to suit the new condition.

The advisability or necessity of classifying properties or of applying a sliding scale of assessment naturally depends upon the municipality or locality under consideration. Local conditions must govern, but the equities are such that departure from fundamental theory is not important.

Application of Plan in Washington Suburban Sanitary District—The Washington Suburban Sanitary District is an area of 95 sq.mi., with a population of approximately 35,000, comprising parts of two counties in Maryland adjoining the District of Columbia. Numerous small incorporated communities and unincorporated villages closely adjoin each other in many parts and are scattered at greater intervals in other sections. Much of the territory is distinctly suburban, but there are still extensive rural areas.

Water supply and sewerage facilities were inadequate, and in some instances entirely absent. General sanitary conditions were bad and were becoming worse with the failure to provide for the future. In order to remedy these conditions by the installation of adequate and comprehensive water and sewerage systems, the Sanitary District was established by the Maryland Legislature of 1918. The area was chartered as a municipal corporation for the above purpose. It was given the power to issue its own bonds, lay its own front-foot assessments, and to fix the amount of additional tax to be levied within the district by the two boards of county commissioners. A commission of three residents, William T. S. Curtis, T. Howard Duckett and Emory H. Bogley, constitutes the administrative body.

Four Land Classifications

Construction and operation of the general systems are being carried on under the financial plan described in this paper. Land is classified as industrial or business, subdivision, small acreage, and agricultural. Subdivision property is defined as land platted into lots, blocks or squares. All property not so platted, where the total area does not exceed 15 acres, is classed as small acreage, unless it is used exclusively for agricultural purposes and is not within an incorporated town. All other land is designated as agricultural.

Front-foot assessments are uniform within prescribed areas where construction work is to be undertaken. They begin to be payable at the time a project in any section is started. While established on the basis of an annual charge per front foot during the life of the

bonds, any assessment may be paid, within one year after levy, in one prescribed sum sufficient to cover the proportionate share of the cost of the construction work. Assessments on business or subdivision property may be extinguished, at any time, by the payment of a sum which if put at interest at 3½ per cent, compounded annually, would yield an annuity equivalent to the annual assessment for the period during which the bonds have still to run.

With the exception of lots of irregular shape, relative to which the commission is empowered to use its judgment, all subdivision properties are assessed for their full frontage even though the water or sewer line does not extend along its entire length. Corner lots in this classification are assessed on only one side, as these obtain no greater benefit than do the interior lots of the block.

High Prices Taken Into Account

As the construction work in the district was commenced during an era of extremely high prices, in order not to penalize too greatly the property owners of those sections in which the first work has been undertaken, the assessment rates in such areas have been fixed at figures slightly below those necessary to carry the bonds so far issued, but sufficiently high, it is believed, to provide for the fixed charges on all the district bonds that will have been issued after a period of years, if the same charges are levied for construction that will be completed at considerably lower prices. This will penalize to some extent those sections in which construction work is delayed. Under the enabling act, front-foot assessments once laid on a property cannot be increased, although they may be diminished, should conditions so warrant. If there is disappointment in not attaining much lower costs of construction, front-foot rates on properties later brought under assessment will have to be raised somewhat, or deficiencies may be wiped cut by a comparatively small increase in the general tax. At this date the situation is being materially aided by investment of the sinking fund in liberty bonds, through increased interest rates, and it will be greatly helped in the future when the accumulated yield of these bonds becomes available.

In order to cover periods of changing costs, where the installation of improvements must continue over a considerable number of years and be done by the periodic issuance of bonds, it appears to the writers that the best plan would be to change annually the rates for front-foot assessments uniformly throughout the jurisdiction, to suit the needs of the ensuing year, just as is done in the levy of taxes.

The tax, front-foot assessments, house-connection charges, service and water rates (including sewerage service) in the district are at present as follows:

General tax, 4c per $100 of assessed valuation

Front-foot assessment (annual per foot)	Water	Sewerage
Business or industrial property, first 200 ft	14c	8c.
All excess	7	4
Subdivision property, first 150 ft	9	6
All excess	3	2
Small acreage property, first 150 ft	9	6
2d 150 ft	3	2
All excess	1	1
Agricultural property	9	6

(No assessment unless connected, and length assessed limited to 150 ft.)

Water connection $25, sewer connection $25, amounts payable in one sum or in four annual installments, the deferred payments bearing interest at 6 per cent.

Meter service charge, $4 annually for ¾-in. meter, increased amounts for larger-sized meters.

Water consumption charge (includes sewerage service) for all water registered.

15c. per 1,000 gal., up to 25,000 gal. semi-annually.

14c. per 1,000 gal., next 25,000 gal. semi-annually.

13c. per 1,000 gal., excess over 50,000 gal. semi-annually.

No rate fixed for very large consumers as none has yet been connected.

It may be of value to give an example of how the annual cost of water and sewerage service, exclusive of initial payment for house connections, works out in actual practice for a residential property.

Description	Tax	Assessment	Service Charge	Consumption Charge	Total
Property assessed at $5,000 Frontage 60 ft	$2 00	$9 00	$4 00	$6 00	$21 00
Annual consumption 40,000 gal					

General Application of Plan—The plan which has been described for financing the construction and operation of water supply and sewerage improvements is applicable not only to the installation of new systems in cities, towns, unincorporated county areas and joint districts consisting of a number of municipalities, or of municipalities and unincorporated territory, but with proper adjustment for taking care of past obligations and existing methods of individual payments it may be more or less readily applied to extension projects. The essential for maximum effectiveness is a central organization for ownership and control, with power to issue its own certificates of indebtedness, to proceed with all new work as its judgment may dictate, to purchase, condemn or otherwise to incorporate previously installed systems, and to readjust prior financing, both with respect to the bondholders and the citizens. In the case of a district formed from minor political subdivisions, opposition to the transfer of ownership of municipal and private systems may be encountered. However, in many cases, as in that of the Washington Suburban Sanitary District, the receipt of full remuneration for perhaps a broken-down or obsolete system, followed by a reduction of the local tax rate or the elimination of responsibility for giving service, or both, will be welcomed by municipalities, private companies and realtors.

Plan Applicable to Extensions

Particular stress may be laid upon the ease with which the plan lends itself to the construction of extensions wherever they are needed, either for convenience, the protection of the public health, or for the stimulation of development. Each extension is self-supporting from the beginning, there is no need of deposits being paid into the public's treasury before the construction work will be started, and there is no cause for the installation of extensions or of isolated systems on the part of those developing land.

The construction of adequate water and sewerage works in small villages is just as feasible under this plan as in the larger towns or in cities. Perhaps the most important engineering activity of the Maryland State Department of Health is the encouragement of movements for the installation of proper water and sewerage systems in the various towns of the State. Until a year or so ago the fight was an up-hill one. Excessive increase of tax rates was the obstacle. Beginning only a few months prior to the legislative session of 1920, at the peak of construction costs, an exposition of the plan described in this paper as it would relate to individual towns resulted in the passage of several acts for the construction of water and sewerage systems, embodying the methods of payment used in the Washington Suburban Sanitary District. One act provided for the issuance of bonds to the amount of $60,000 for a public water supply in a town of 600 inhabitants. Another village with a population of less than 400 was allowed a bond issue of $55,000 for complete water and sewerage systems. Since then the Department of Health

has been prosecuting a systematic campaign in a large number of municipalities. Rough layouts and preliminary estimates of cost are made, the approximate length of assessable frontage is ascertained, and a practicable scheme for local financing is worked out. The total expense to similar properties is found to be practically independent of the size of the town.

When it is discovered that, even under present conditions, the total annual expense to the small property-holder for adequate water supply, fire protection and sewerage service will vary from perhaps $15 to $30, and the blighting effect of a high tax rate is avoided, local interest is invariably immediately aroused.

The efforts of the State Department of Health are not being confined to individual towns, but are being extended to encouraging the establishment of water and sewerage districts consisting of favorably located communities or of the larger towns and their unincorporated suburbs. In the latter case the extension of municipal systems into sections which have not been able to obtain improvements under county government is rendered feasible. Progress is now being made towards the formation of a water and sewerage district in the Georges Creek region where within a comparatively small area there are communities with an aggregate population of over 30,000 which now have inadequate facilities.

Porous Filter Walls and Dams Spall Under Frost Action

APPARENT failure of the concrete in the filter plant and at two mountain dams of the Cheyenne municipal water-works has finally been diagnosed as due to freezing of the seepage through porous concrete. J. A. Whiting, city engineer, gives the following results of the investigations.

At the filter plant he states that conditions are as follows:

(1) The concrete disintegrates and falls off of all outside walls where water is in contact with the walls on the inside, except below the ground level where the concrete seems to be as good on the outside as it is on the inside.

SPALLED FILTER WALL [illegible]

(2) The concrete disintegrates on the outside of the walls for 18 in. above the high water line wherever water has been standing continuously.

(3) The beams supporting the roof over filter beds, 3 ft. above water, show some disintegration.

(4) The inside of all outside walls below the water line are in perfect condition.

(5) All outside walls below the ground level, having water on the inside, appear to be in perfect condition.

(6) All concrete baffle walls inside of the filter plant appear to be in excellent condition.

(7) All walls either inside or outside that do not come in contact with the water are in splendid condition. An examination of samples sent to Prof. D. A. Abrams, Structural Materials Institute Research Laboratory, Lewis Institute, Chicago, indicated no increase in the magnesia or sulphuric anhydride as one would expect if the concrete were disintegrated by the action of alkali waters. There was no indication that the use of alum in the water had any influence on the behavior of the concrete. Analyses of the city water show an alkalinity of 81 p.p.m.; $CaCO_3$, 67.4; $MgCO_3$, 2.8; $MgSO_4$, 14.6; $NaSO_4$, 9.6; NaCl, 6.3 p.p.m., indicating a comparatively soft water.

DETAIL OF SPALLED PILASTER

In the fall of 1920 when Mr. Whiting visited the two concrete dams in the mountains he found water seeping through them in small streams and freezing in large masses. Apparent failure of the concrete similar to that at the filter plant was observed.

The settling basin walls and other parts of the filter plant, the outside portions of which have shown signs of disintegration, have been covered with two coats of waterproofing paint made up of 16 parts of refined coal tar pitch, 4 parts of portland cement and 1 part of kerosene. The cement and kerosene mixture was stirred into the hot tar but the mixture was applied cold. So far the waterproofing has prevented percolation. If it continues to be successful the dams will be treated similarly during the summer.

Concrete Paving Record Broken

A record of 1,105 ft. of 18-ft. concrete pavement, averaging 7¾ in. thick, was recently made in 9 hours on Federal Aid Road No. 43, being constructed for the Michigan Highway Department in Muskegon County. The contractor was Carl Scharl, Muskegon, Mich., operating the outfit described in *Engineering News-Record* Oct. 2, 1919, p. 658. Previous high records are reported in *Engineering News-Record* Feb. 3, 1921, p. 222.

Reservoir Capacity Curves Without Topographic Survey

By C. C. Jacob
Hydraulic Engineer, Salt Lake City; Federal Court Water Commissioner for Uintah Basin, Utah

A NUMBER of storage reservoirs are in operation, particularly in the West, for which accurate capacity curves have not been determined, usually through lack of topographical data. Where natural lakes have been developed as storage reservoirs by raising their water surface, it is frequently impracticable to secure a topographical map of the lake bed. The following method was developed to determine the capacity curve of such reservoirs, and also as a check on capacity curves determined in the usual way from topographical maps. It is based on the method previously published by the writer for determining rating curves on rough mountain streams impossible of direct measurement. (See "Indirect Method for Determining Station Rating Curves," *Engineering News-Record*, Sept. 30, 1920, p. 666.) The theory in both cases is precisely the same.

To apply the method, it must be possible accurately to measure the inflow and outflow at different stages of the reservoir for short periods of time. It is not necessary, however, to secure continuous records of flow for an extended period. The time interval is made as short as practicable to eliminate seepage and evaporation losses from the problem.

Consider any reservoir whose capacity curve is unknown. At any stage H (H being the elevation of the water surface above the outlet gate) the inflow Q', and outflow Q'' are measured as accurately as possible, the gates being adjusted so as to make ΔQ (the quantity of water stored or released) as large as possible for the period, which ordinarily should extend only for a few hours. The change in the water surface elevation during the period, ΔH, is also measured. Similar determinations are made at different stages of the reservoir, up to the maximum stage, if practicable.

The observations need not be made consecutively or even the same year. If the gates cannot be manipulated for the determinations, actual records of inflow and outflow and reservoir stage incidental to the regular reservoir operation can be used, but as many values as possible should be secured to insure that errors in the record are compensated.

A curve (Fig. 1) is plotted from the data secured as follows: ΔQ is the water stored or released during the interval, corresponding to a change of reservoir stage, ΔH. Values of $\Delta Q_1/\Delta H_1$, $\Delta Q_2/\Delta H_2$, $\Delta Q_3/\Delta H_3$, etc., are plotted as absissae and the corresponding average stage of the reservoir H_1, H_2 H_3, etc., as ordinates and a smooth mean curve drawn through the points. Then at any point on this curve ($\Delta Q/\Delta H$, H) the area between the curve and the H axis is equal to the capacity of the reservoir at that particular stage. That this is true is easily seen from the fact that the elemental area under the curve $\Delta A = \Delta Q/\Delta H \times \Delta H = \Delta Q$. Hence $A = Q$, the capacity of the reservoir, up to that point.

INDIRECT DETERMINATION OF CAPACITY CURVE, PIUTE RESERVOIR, NEAR MARYSVALE, UTAH

Records for 1914

Date	Mean Gage H.	Acreage Inflow	Feet of Outflow	Difference ΔQ	ΔH	$\frac{\Delta Q}{\Delta H}$	H
Aug 13	56.56	1,016	2,024	1,008	0.56	1,800	56.29
Aug. 15	56.01						
Aug. 28	51.14	1,208	2,468	1,260	0.74	1,710	50.77
Aug. 30	50.40						
Aug 16	55.68	928	2,112	1,184	0.72	1,645	55.32
Aug 18	54.96						
Sept. 7	47.64	1,040	2,412	1,372	0.81	1,695	47.24
Sept 9	46.83						
Sept 14	43.38	1,044	2,992	1,948	1.27	1,530	42.74
Sept. 16	42.11						
Sept. 18	40.80	1,048	2,852	1,788	1.30	1,375	40.15
Sept. 20	39.50						
Sept. 28	35.43	604	1,540	936	1.02	920	34.92
Sept. 30	34.41						
Sept. 25	36.49	376	1,576	1,200	1.06	1,130	35.96
Sept. 28	35.43						

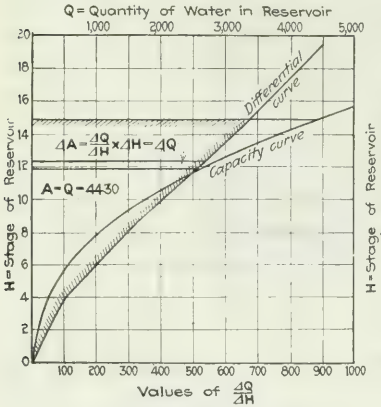


FIG. 1. ILLUSTRATING METHOD OF PLOTTING RESERVOIR CAPACITY CURVE
Based on inflow, outflow and steam heights.

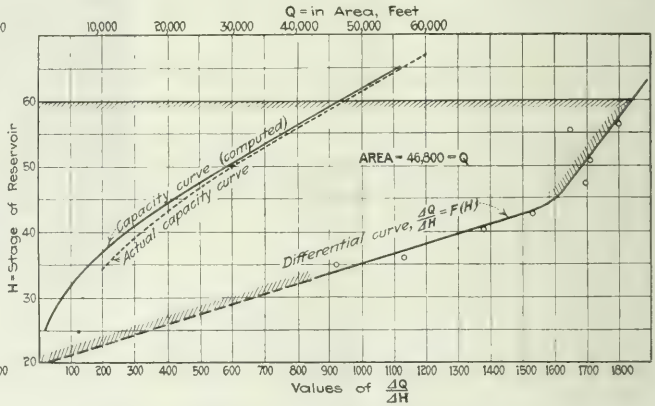


FIG. 2. COMPARISON OF COMPUTED CAPACITY CURVE WITH CURVE DERIVED FROM TOPOGRAPHIC SURVEY, PIUTE RESERVOIR

The accuracy of the determination will of course depend upon the accuracy of the observed quantities ΔQ and ΔH. With reasonable care, where conditions can be controlled, it should be possible to determine the capacity curve with a high degree of accuracy, comparable with the results secured from accurate topographical surveys, and with comparatively slight expense.

As an actual test of the method, it was applied (Fig. 2) to a reservoir where the capacity curve had been previously determined by topographical survey, and fairly accurate records of inflow and outflow were available—the Piute Reservoir on Sevier River in Utah. The resulting curves illustrate the method and show the

comparative results obtained. The data used were from the actual operation records for 1914, furnished by the U. S. Geological Survey. The length of interval used was two days. The resulting capacity curve is seen to agree very closely with the curve developed from actual survey for the middle and upper sections. The divergence of the lower part of the curve from the actual curve is accounted for by lack of data covering the lower stages. More satisfactory data could be secured by making field observations for the specific purpose of determining the capacity curve.

Cleaning a Railway Water Main

Abstract of paper by F. D. Yeaton, assistant engineer, C., M. & St. P. Ry., appended to report of committee on Water Supply, American Railway Engineering Association.

HIGH cost of cast-iron pipe and of pipe laying should make the subject of cleaning water mains unusually attractive. Municipalities have done considerable pipe cleaning, but railroads have done comparatively little. At Belle Plaine, Ia., a 6-in. pipe line, 8,000 ft. long, delivering water to an engine terminal, had its carrying capacity reduced about 10 per cent due to a rough hard scale, $\frac{3}{16}$-in. thick.

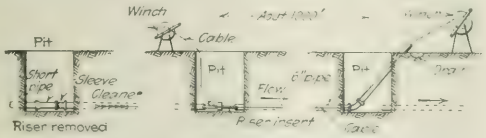


FIG. 1. METHOD OF CLEANING A WATER MAIN

This pipe line was cleaned in 1,000-ft. sections, two places 1,000 ft. apart being uncovered, the water shut off and a 3-ft. section of pipe removed at each place. A cable carrier and special riser pipe were inserted at the opening nearest to the pump and a 45-deg. elbow and short length of pipe were connected to the other opening, as shown in Fig. 1. Water was then turned on and forced the carrier, to which was attached a $\frac{3}{16}$-in. steel cable, through the pipe, as in Fig. 2. A $\frac{3}{8}$-in. cable was then attached to the $\frac{3}{16}$-in. cable and pulled through by a hand winch. The water being shut off and the riser removed, the scraper or cleaner was attached to the $\frac{3}{8}$-in. cable and inserted into the main, which was then closed by a short piece of pipe, as shown at the left in Fig. 1. The water was again turned on and the

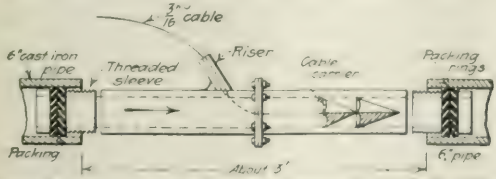


FIG. 2. CARRIER FOR LEADING CABLE THROUGH PIPE

cleaner was pulled through by the $\frac{3}{8}$-in. cable and a hand winch operated by four men.

The supervisor was furnished by the contractor and the necessary force by the railroad company, the force consisting of a foreman, a calker, a carpenter (to sheet and brace the pits) and eight laborers to dig the pits and operate the winches. A rough estimate of the cost, including transportation, labor, superintendence and equipment was $200 per day. The length of straight pipe cleaned per day was 1,000 ft., or an average cost of 20c. per linear foot. The cleaner will operate through a 45-deg. elbow and is reported to have passed a long 90-deg. bend. It requires about 30 lb pressure to force the cable carrier through the pipe at a speed of 5 to 10 ft. per min. The rate at which the cleaning can be done depends upon the thickness and hardness of the scale as well as upon local conditions.

Improvements Required in Road Building Plant

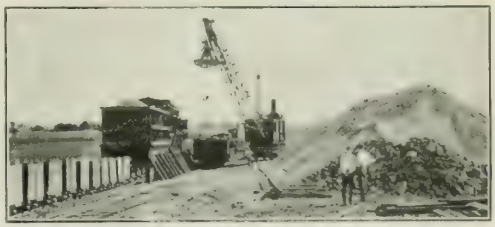
Small Units Excel Large Units—Central Mixing Plants Require Standardizing—Paving Mixers Too Heavy

By B. H. Piepmeier
Engineer of Construction, Illinois Division of Highways, Springfield, Ill.

Condensed from a paper read before the Materials Handling Section of the American Society of Mechanical Engineers at the Chicago Meeting of May 23-26, 1921.

IN GENERAL, the building of a system of roads requires the installation of a number of small plants in preference to a few large plants. In the past this has been particularly true, first, because of inability to secure experienced and capable superintendent for large plants; second, because the railroads have failed to deliver sufficient materials to keep large plants working efficiently; and third, because of the frequent breaking down of machinery. With large plants the breakdown of one machine delays the entire operation, although the small construction unit necessitates many operations by hand at somewhat greater expense than if performed by machinery. When the final analysis is made the small unit will show high efficiency on account of the possibility of often operating it independently of any particular machine that may be out of service on account of a breakdown.

On account of the conditions that have existed during the past few years it has not been possible for the contractor with the large plant to show a fair profit. These conditions have been inadequacy of railway transportation,



CENTRAL MATERIALS YARD WITH LOCOMOTIVE CRANE

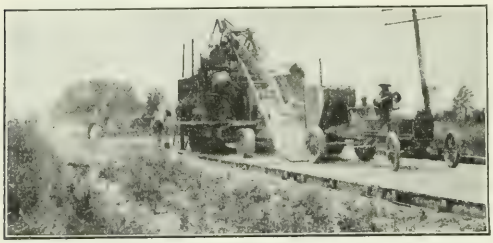
uncertainty of labor conditions in the manufacture of both road machinery and materials, and inefficiency of the men on the work.

Many breakdowns have been caused by the inefficiency of the labor used in the manufacture of the machine and in its operation on the job. Constant breaking has not only put an individual machine out of service but also other equipment which depended upon it. Contractors need to give more thought to the design of road plant so that its successful operation may not depend upon one machine. Many already realize that it is economy to duplicate machines. Some contractors have installed a duplicate pumping system for the supply of water. The additional cost of the duplicate unit is small compared to the advantage of being able to operate the plant without a delay. In many instances contractors have duplicated concrete mixers. The average road job may not always justify complete duplication of the mechanical units, but where there is a large season's work a careful investigation is required of the advantage of duplicate units.

As most specifications now prohibit materials from being stored upon the subgrade, the contractor is compelled to provide transportation, either by industrial railway or motor trucks. The industrial railway, under normal conditions, will insure a more uniform delivery of materials, regardless of weather conditions, than any other method.

The chief objection to it, however, is that it is limited to road construction having grades ordinarily less than 4 per cent and where there are few railroad crossings. Then, too, its high initial cost demands that a large mileage of roads be built each year in order to absorb the interest on the investment and the depreciation.

Truck delivery has superseded team delivery as it is much more rapid and will carry material to a paving mixer or from a mixer direct to the road with less disturbance to the roadbed. Truck transportation is very flexible and is therefore better suited to various sections of work than



TRUCK HAULAGE OF DRY BATCH TO PAVING MIXER

perhaps any other method. It is especially suited to the delivery of mixed concrete from a central plant to the road being improved and to the delivery of proportioned batches direct to the paving mixer or to a point where the batch boxes may be transferred to a short line industrial railway which in turn delivers them to the paving mixer.

The delivery of mixed concrete from a central mixing plant direct to the job has been attracting considerable attention. This method is worth a careful study as it permits centralization of the contractor's operations and enables him in many instances to economize in his plant and operating expenses. Central mixing plants should be simple in operation and reasonably uniform in design. A study of central plants shows that no two have been very similar in design. It would seem possible that the operation of unloading aggregate and cement from railroad cars and then mixing the materials to the desired proportions and consistency could be standardized to such an extent that central plants could be simplified and made more economical in operation. The mechanical engineer and the equipment designer should lend their assistance.

Central mixing plants may be fairly uniform in design, but the delivery of the concrete from the plant to the road will vary considerably to fit the existing local conditions. Mixed concrete may be delivered by industrial equipment provided there are reasonably short hauls and the equipment is designed for small loads with considerable speed in the transportation. The small truck will usually prove to be the most efficient machine for the delivery of mixed concrete as it will take the full batch direct from the mixer to the road in the least possible time.

Delivery Trucks

Pneumatic-tired trucks are essential where speed is an important factor in delivery and where it is necessary to do considerable hauling over the subgrade. Pneumatic tires will usually reduce the load on the subgrade to less than 125 lb. per square inch. This pressure, though frequently applied, does not seriously injure or displace a prepared subgrade having average soil conditions. It is practically impossible to deliver materials over earth roads with trucks when the roads are muddy or during rainy periods. However, the road may be materially improved, permitting the truck to be used practically the entire construction season, if it is constantly maintained by the use of the road drag and given an application of ½ gal. of oil per square yard of surface early in the construction season.

The light pneumatic-tired truck may also be used for the delivery of proportioned batches of aggregate direct to the paving mixer on the road being improved. There are now on the market many types of batch boxes and dump bodies that permit the batches to be dumped directly into the skip of the paving mixer.

Transportation is one of the most important factors in the economical construction of roads. This part of plant operation, therefore, should be given much study. The transportation cost should be estimated per ton-mile and should take into consideration the effect on the cost of operation of the remainder of the construction plant. Hauling costs vary from 20 to 40 cents per ton-mile. A saving, therefore, of a few cents per ton-mile may in a season's work amount to several thousand dollars. The actual hauling costs may be exceedingly low, yet if the delivery affects the maximum output of the remainder of the plant, the inefficiency of the plant should naturally be charged against the transportation cost.

Plant Costs and Improvements

The plant investment of the road contractor of today is entirely too great for the work that is accomplished during a single construction season or for the work done from one particular installation. It is not uncommon to see from $60,000 to $100,000 worth of equipment to build less than ten miles of highway. It is evident that this will show from $2,500 to $3,000 which must be charged off for equipment against every mile of road built. It is doubtful whether there is any other construction in which there is so much depreciation and interest on plant investment to be charged off on so small an amount of work. It would seem desirable, therefore, that the mechanical engineer, equipment designer and contractor should spend more time in the design

TRUCK HAULAGE OF WET BATCH FROM CENTRAL MIXING PLANT

of road construction plant in order to insure a greater output with less initial investment.

Many of our road-building machines are being made larger, more cumbersome and more expensive each year. The fact that road building machinery is subjected to more severe use than perhaps any other machinery used in construction has induced the manufacturer to add weight to his equipment each year to insure more rigid construction. The writer believes that the concrete paving mixer can be completely redesigned and a machine produced that will be much smaller in size, will mix more concrete and be less cumbersome. Mixer manufacturers have continued to improve the design of their paving mixers by following the same principles of mixing that have been in use for many years. It seems absurd that we must have a concrete paver costing $8,000 to $12,000 and weighing from 10 to 15 tons that will lay less than 2 miles of 18-ft. concrete road in 30 days. It seems absurd also that we should still be using a mixer that requires 60 sec. of time for mixing when it should be possible that the same amount of mixing by some mechanical means can be done in less than 15 sec. If such a machine could be produced, a one-bag paver would turn out as much concrete as our present four-bag paver. The present paver is also designed so that the mixing is concealed from the view of the operator; this absolutely prevents a uniform consistency which is essential in securing a good concrete.

If the mixer designer can produce a smaller machine having a greater output per hour of operation and have it so designed that the consistency of the concrete produced can be controlled by the operator instead of by some un-

satisfactory mechanical means, the results will be a wonderful aid to the road-building industry.

It also seems possible that a very material improvement can be made in railroad equipment. Practically all road contractors now unload aggregates from open-top cars by means of clam-shells. This method is not always the most economical but the contractor is forced to use it as he cannot secure hopper bottom cars. On account of the large volume of road materials that must be delivered by railroad cars, it seems possible that some type of car could be designed that would permit of more rapid unloading by more economical methods. If this is not done, it is hoped at least that open-top car manufacturers will improve the design of their cars and make them so that they can be more easily unloaded with clam-shell equipment. Not only would improvement in the design of open-top cars aid the individual unloading the car but the railroad company would add to the life of the equipment.

Deficiencies of Existing Cars

Many open-top cars are now designed with projecting angles, rivets, bolts, braces, timbers, etc., that serve chiefly to interfere with the efficient operation of the clam shell. It is difficult to understand why railroad cars could not be designed so that the interior of the car would be perfectly smooth. In fact the writer believes that it would be practicable and economical for all open-top cars to be built with a fillet having a radius of about 18 in. in the bottom angle at the ends of the car. The curved bottom angles would permit the cars to be emptied more rapidly and economically either with hand shovels or by clam shells.

Further investigation should also be made of the use of open-top removable batch boxes for railroad transportation of materials. While the substitution of standardized batch boxes for open-top cars would be a radical departure from present equipment, it is evident that the average construction plant could be designed to handle the transfer of boxes with considerable more economy than it now handles the loose materials.

Prevention of Water Hammer in Long Railway Force Main

By J. L. Campbell
Chief Engineer, El Paso & Southwestern System, El Paso, Texas

ONE operating district of the El Paso & Southwestern R.R. is supplied with water by a pipe line 140 miles long. On one section of this line the water is lifted through a distance of 37 miles to an elevation of 821 ft. by two pumping stations, one at the foot and the other half way up the hill. The pumps are Nordberg double-acting piston pumps.

Water hammer on the pumping main was prevented by a steel cylinder mounted in a horizontal position over and connected to the main outside the pump house. The cylinders are 5 ft. in diameter and 15 ft. long, designed for 300-lb. pressure, with glass gages on the cylinders and a pressure gage mounted on the pumping main immediately beyond the tee connection to the main. The pumps have a normal capacity of 1,000,000 gal. per day at 50 r.p.m. and a maximum pressure of 300 lb.

The upper half of the cylinders is kept full of air under the pumping pressure by automatic air-charging devices attached to the water end of the pumps and actuated by the working of the pumps. The vertical fluctuation of the water in the glass gages usually lies within ½ in. and the pressure gages indicate a variation of pressure less than 2 lb. Considering the length of the water column in the main and the high pressure the prevention of water hammer by this method is very complete.

Water-Closet Flush Tanks and the Water-Waste Problem

By Albert O. True
Hydraulic and Sanitary Engineer, Rensselaer, N. Y.

WHAT is the safe minimum amount of water discharge from the common house flush tank? The writer estimates the sanitary flushing water of our larger cities as 12 to 20 per cent of the total water consumption.

Many are familiar with the accomplishments of the Construction Division, U. S. Army, in successfully limiting the per capita water consumption in the cantonments to 55 gal. per day. George W. Fuller, in discussing the admirable paper by Col. Dabney H. Maury, describing the water supply of the camps and cantonments, called attention to the expedient of bending down the floats in flush tanks for restricting the charge of flushing water (*Proceedings*, Am. Soc. C. E., Vol. XLV, No. 6). The writer, during his service as utilities officer in several cantonments, observed the effectiveness of this simple method. The discharge valves in some makes of tanks are designed to permit of regulation of the amount of flushing water.

Effect of Design on Volume of Water

A few years ago it was the writer's practice, as sanitary engineer, New York State Department of Architecture, in specifying water-closet flush tanks, to require a discharge of not less than 5 gal. of water per flush, and for flushing valves not less than 4 gal. At that time these details were largely a matter of custom, the important feature being to insure a copious flush. A few gallons more or less on the safe side did not seem a serious matter at the cost of water then prevailing.

My observations of flushing requirements for sanitary fixtures at the army cantonments indicate that an appreciable saving of water can be effected by reducing the volume of flush without danger of producing unsanitary conditions in the plumbing fixtures or in the sewerage system if the latter is well designed. The amount of reduction of flushing water which can be safely made will depend in each case on the type of water closet and arrangement of flush tank, and should be determined beyond any reasonable doubt by competent observation.

The writer has made experiments with the wash-down siphon closet bowl. This fixture was almost universally installed in the army cantonments. It is the common house closet very largely used in civil communities having modern plumbing. The bowl is cleared by plain siphonic action of the flush. Its external characteristics are a circular water surface in the bowl and a "hump" protruding from the front of the bowl due to the outlet leg of the trap. These closets were operated for a period of observation of two months, using as little as 2½ gal. per flush. Flush tanks were of the "low-down" type, discharging directly into the closet through a short length of 2-in. flush pipe. "High up" tanks can be used with all types of water closets and require no more water than low-down tanks. Probably they can be operated with less water, as the flush is delivered under a head about 5.5 ft. greater than is the case in low-down tanks.

The writer roughly estimates that in the more modern houses of average communities 75 per cent of the

water closets are of the wash-down siphon type mentioned above. Most of the remaining 25 per cent will probably be of the siphon jet type—found in large and expensive residences, hotels, hospitals and institutional and governmental buildings. It can be recognized by its smooth "vase like" front, large oval water surface in bowl of about 90 sq.in. and bulbous, wavy curved back resulting from the tortuous outlet leg of the trap. The bowl is cleared by siphonic action, which is accelerated by a water jet impinging into the inlet leg of the trap. The tortuous passage of the outlet leg of the trap tends to fill the bore of the outlet, thus lending additional strength to the siphon action.

The writer has no experimental data on the minimum flush for the siphon jet closet or any closet using the water jet (some makers have a wash-down siphon bowl with water jet). It is known that they will operate safely with 4 gal. of water. Owing to the larger water content of the trap passages and bowl of the siphon-jet fixture, and its more powerful siphon action, it is likely it cannot be operated with less than 3½ gal. of flushing charge without endangering the water seal, unless the tank is provided with a generous "afterfill" attachment.

The latter device is simply a small pipe which discharges a part of the water (about 2 or 3 quarts) from the ball-cock valve into the closet bowl after the action in the bowl trap has ceased. It is commonly integral with the ball-cock equipment and discharges into the overflow standpipe.

Old Style Systems

All types of water closets other than those mentioned above will be found principally in old buildings having old-style plumbing systems. Some special types will b found in prisons and institutions. Most all the old-style fixtures are of the following four types: the wash-down, washout, down-flush and hopper closets. All are variations in the adaption of a bowl to an "S" trap either integral with or separate from the fixture. They are flushed almost always by high-up tanks, by displacement of the contents of the bowl and trap. It is probable that their water consumption could be cut in half with safety.

Data are not available on which to base positive figures as to possible saving in flushing water. The following illustration will therefore be considered a "desk estimate" awaiting revision or rejection: It is estimated that flush tanks average 20 flushes per fixture per day. Allowing an average of one water closet per family of five, flushing water at 5 gal. per flush, the daily water consumption in closets alone is 100 gal. per day per family.

In a city of 100,000 the flushing water from these fixtures would approximate 2,000,000 gal. per day. A saving of 40 gal. per water closet per day seems conservative at this time. This gives a total estimated saving for the above-named community of 800,000 gal. per day. At 7c. per 1,000 gal. this would result in a gross saving of $56 per day or $20,400 a year. Allowing $10,000 for expenses the first year and $6,000 for each succeeding year to effect and maintain this saving, there would result an annual net saving of about $9,000 per annum, assuming that there were always 25 per cent of the fixtures which needed attention, as would probably be shown by an inspection.

Sliding Car Stop for Yard Tracks

As a substitute for usual fixed bumping posts at ends of yard tracks and industry tracks, some railways are using a sliding stop which is expected to check cars efficiently but without causing damage to the car or its contents. This device, shown in the accompanying views, consists of a pair of steel castings which rest on the rails, being held in place by flanges and secured by clamps fitting around the rail heads.

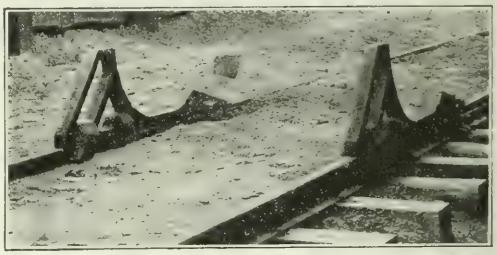


FIG. 1. CAR STOP ON YARD TRACK—SHOES IN PLACE

In ordinary practice the shoes are set 10 to 30 ft. from the rail end, but where longer travel is desired special splice bars are used to enable the clamps to pass the rail joints. Although the track is shortened normally by 10 to 30 ft., its full length can be utilized when necessary by pushing the car and shoes to the end blocks. When a car engages the stop, it is checked by the incline which carries the wheels into the shoes, along which they travel before striking the rear portions of the shoes, which are shaped to fit the wheels, as shown.

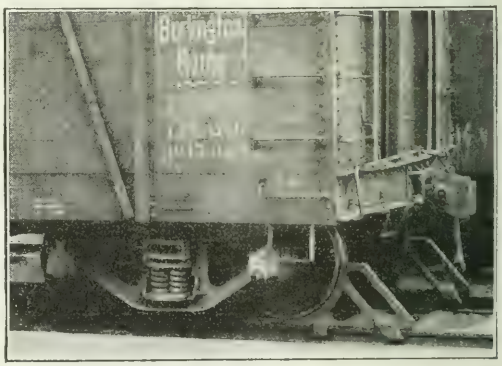


FIG. 2. CAR TRUCK IN SLIDING STOP—HALTED BY SHOES

In the design illustrated, only the two end wheels are engaged, but for tracks in continual service or having a down grade to the stub end the shoes are made longer, so that when the outer wheels reach the end of the shoe the inner wheels are resting on the incline.

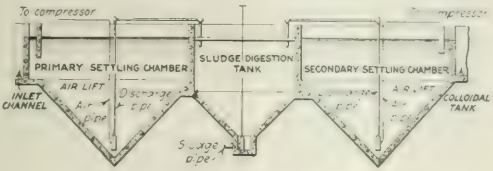
When a car is pulled off the stop, the small front projections cause the shoes to move with it until they reach their normal position, where they are stopped by striking the splice bars, the wheels then riding over the projections and returning to the rails. In tests, two 50-ft. loaded coal cars run against the stop at 8 m.p.h. moved it 30 ft. Another car at 5 m.p.h. moved it only 4 ft. further. This device is manufactured by the Friction Car Stop Co., Cleveland, Ohio.

Air-Lift Removal of Sludge from Sewage Tanks

By W. G. Kirchoffer
Madison, Wis.

EXPERIMENTS on the removal of sludge by air-lift pumps, made by the writer in connection with an investigation of the sewage works of Madison, Wis., showed advantages for this method as compared with the ordinary gravity method.

This Madison plant consisted of settling tanks with separate sludge digestion, followed by colloidal tanks, contact dosing chambers and sprinkling filters. The tank portion is divided into five units, each consisting of a primary and secondary settling tank, sludge digestion tank and a colloidal tank (see *Engineering News-Record*, Sept. 11, 1919, p. 510). Unit No. 3 was divided into two half-units. Usually 2, 2½ or 3 units are in service at a



AIR LIFTS IN SEWAGE TANKS

time, depending upon the season of the year or the ideas of the superintendent. The air-lift tests were applied to unit No. 3-B.

The air pumps were made of 1½ and 2-in. pipes with foot pieces of 4-in. and nozzle of ¾-in. pipe. Some trouble was experienced with clogging due to threads, strings and waste which accumulated in the bottoms of the tanks in large balls. Had the pumps been made of larger pipe with larger flaring foot pieces and no nozzles, this trouble would have been largely avoided. The arrangement is shown in the accompanying drawing. Efficiency in air consumption and power required were matters left for future consideration. The plant consisted of a 4 x 6-in. vertical air compressor and a 4-hp. gasoline engine. Better results might have been expected with the plant operated by an electric motor or automatically from a large air storage tank.

Chemical Analysis—In the raw sewage or primary settling tank the average of several determinations for relative stability by the methylene blue test showed no stability by either the air-lift or the old gravity process. In the secondary and colloidal tanks, the air-lift showed 11 and 30 per cent respectively, the gravity process showing zero and 21 per cent. The average results were 7 and 14 for the two processes respectively.

Tests for oxygen consumed were consistently in favor of the air lift for all the tanks and filters. The very few tests for free and abluminoid ammonia, nitrites and nitrates showed as good results for the air-lift as for the old process. The results on total, dissolved and suspended solids were more or less erratic due to fluctuations in the character of the sewage and disturbances in the inlet channel. Tests showed no percentage of removal in the primary settling tank and only 2.7 per cent in the secondary by the old process, but 15.4 per cent in the secondary tanks by the air-lift.

The best results for removal of suspended solids at the colloidal tanks were 66⅔ per cent by the old process and 93½ per cent by the air-lift. The contact filters showed no reduction in suspended solids by either process. The average removal of suspended solids by the entire plant was 48 per cent for the old process and 53.5 per cent for the air-lift, the maximum results being 82 and 100 per cent respectively.

Sedimentation Tests

The beneficial results of the air-lift removal of sludge are illustrated by the records of sedimentation tests made by James Mackin, superintendent of the plant. A 1-gal. sample was collected at 7 a.m., 1 p.m. and 4 p.m. each day of raw sewage from the inlet channel and tank effluent from the collection channel at the end of the colloidal tanks. These samples were placed in conical galvanized-iron receptacles with glass graduates attached to the small ends. After standing for three hours the deposits were recorded in cubic centimeters, as indicated on the glass graduate. When clean tanks were first put into operation, the old or gravity process of removal would show results as good as the air-lift process, but as the tanks began to foul up with septic sludge the effluent would begin to show an increase in the settleable solids until such times as the tanks would be put out of commission, and clean tanks put in use in their stead.

After my investigation Mr. Mackin continued to operate the plant, but pumping the sludge once daily. He also continued to take samples of effluent for sedimentation tests. On Nov. 1 units No. 1, 2, 3-A and 3-B were in operation. The sediment in 1-gal. samples was 1 c.c. for No. 1 and No. 2. Samples from 3-B (air-lift test) showed no sediment. By the end of the month both No. 1 and 2 showed 4 c.c. per gallon sample. The effluent from 3-B was 0 to 0.5 until the middle of the month and from 0.5 to 1.0 c.c. to the end of the month.

On Dec. 3 units Nos. 4 and 5 were put in operation, 3-B with air-lift sludge removal being continued. Clogging of the air-lift pumps was experienced from Dec. 10 to 28, when the tanks were emptied and large balls of rags, lint and strings were found at the entrance to the foot piece. After this cleaning the tests showed not to exceed 1 c.c. During this period the colloidal tank of unit 3-B was not cleaned out and it is evident that septic action was taking place, as it was noted in all of the colloidal tanks that septic action began 20 to 40 days after starting a unit. These tanks had flat bottoms and were not easily cleaned without dumping. In a plant where such tanks could have septic sludge removed readily or where no such tanks were used it is probable that the sediment in gallon samples could be held to zero or nearly so.

From experience covering a period of several months it was concluded that the use of air-lift pumps is an effective method of sludge removal where tanks for separate sludge digestion are provided.

Providence Resumes Chemical Precipitation

Treatment of the sewage of Providence, R. I., by chemical precipitation with lime was resumed the latter part of April. The practice was discontinued in September, 1919, because it was impossible to obtain lime or towage to convey the sludge to sea for dumping. All sewage reaching the precipitation plant was disinfected with hypochlorite during this period, but through a large part of 1920 most of the Providence sewage was discharged directly into the river through storm overflows without disinfection, owing to a break in the intercepting sewer.

Motor Truck Transport of Freight by European Railroads

RAILWAYS in France and England operate a store-door delivery service for parcels (or express) and freight, for which service motor transport systems are used extensively and special means have been introduced for increasing the economic efficiency of such systems by reducing time lost in loading and unloading.

Eight-Wheel Tractor-Trailer Unit—Motor vehicles are superseding horse-drawn vehicles in the service of the Paris & Orleans Ry., at Paris, France, according to a paper in the *Revue Generale des Chemins de Fer* by Mr. de Laland, superintendent of commercial service of this railway. Horse wagons are still used for districts near the station but light 1- and 1½-ton motor trucks are used for the long trips, in order to utilize the speed capacity which is their great advantage.

For regularity of the station work it is necessary to clear the freight platforms rapidly and it has been the practice to place horse wagons at the platform in the evening and leave them to be loaded at night. This arrangement prevented placing the motor trucks early in the morning for prompt loading, and the trucks could not be left all night as it was necessary to take them to the garage for the regular overhauling. A test with demountable decks or floors for the trucks did not prove

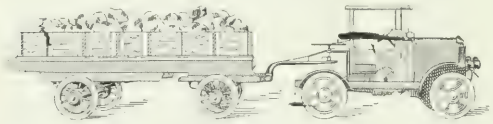


FIG. 1. TRACTOR-TRAILER UNIT OF PARIS & ORLEANS RY. (FRANCE)

satisfactory, as they could not be removed from the station platform when loaded and it was difficult to shift them to the truck frames.

A tractor-trailer system, Fig. 1, proved to be a satisfactory solution of the difficulty, using a 1½-ton four-wheel tractor having a 15-hp. four-cylinder engine and pneumatic tires. The trailer has a flat floor with removable stakes and side boards, and its wheels have solid rubber tires. It is designed for 5 tons but can carry 8 tons. To the swiveling frame of the front axle is attached the pole or draw bar, with automatic coupler engaging a nut on a vertical screw at the rear of the tractor. The driver can operate this nut from his seat, raising or lowering it in order to vary the load carried by the rear or driving wheels and thus vary the adhesion of the tractor.

This tractor-trailer unit or train can turn easily in a 16-ft. street. A switching tractor at the station places the empty trailers at the freight platforms as required and removes the loaded trailers to a yard where the regular tractors couple up to them. The service requires about three trainers to each tractor, the equipment at the Ivry freight station at Paris being 20 tractors with 50 trailers.

Six-Wheel Tractor-Trailer Unit—The Great Western Ry., England, has introduced a system in which a four-wheel tractor supports the front end of a two-wheel trailer, the unit being capable of hauling a 7-ton load at the legal speed limit of 20 m.p.h., according to a paper read by Mr. Conradi before the British Institution of Mechanical Engineers. The trailers are parked in the station yard, the forward end of the trailer being supported by a pair of hinged legs, but with this arrangement the trailer cannot be moved to and from the platform without attaching it to a tractor. Mr. Conradi suggested that by fitting wheels to the supporting legs the trailers could be moved by a team, and it may be

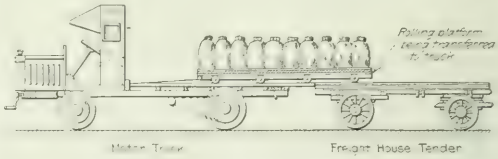


FIG. 2. MOTOR TRUCK WITH ROLLING DEMOUNTABLE FLOOR; MIDLAND RY. (ENGLAND)

noted that such a wheeled support is used for a tractor-trailer system now in operation at St. Louis, Mo.

Motor Truck with Demountable Floor—For the Midland Ry., England, a system of portable rolling floors for motor trucks was devised by Mr. Conradi, thus avoiding the necessity of installing overhead cranes to handle these floors, as at the freight stations of the Lancashire & Yorkshire Ry. The system on the latter road is somewhat similar to that employed for l.c.l. freight transfer at Cincinnati, O. (see *Engineering News-Record*, March 11, 1920, p. 508), except that closed bodies as containers instead of movable floors are used at Cincinnati. For the Midland Ry. service a number of old horse-drawn wagons were converted into station "tenders" by having the floors fitted with rails for the small wheels or rollers of the portable floors. Tenders with portable floors mounted on them are placed at the freight house for loading and are then removed to the station yard by horses. An empty motor truck backs up to the tender, and the portable floor with its load is rolled onto the truck frame and secured, as shown in Fig. 2.

A suggested modification is to erect fixed platforms with rails, on which the loaded portable floors can be placed if no trucks are ready, thus enabling the tender to be moved to the station for another load. At warehouses or industries tenders or fixed platforms may be provided for prompt transfer of loads to and from the motor trucks.

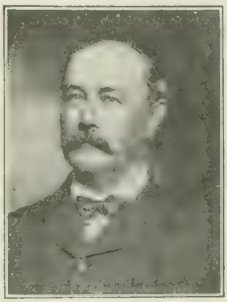
Preventing Mortar Stains on Masonry

Brown stains on limestone masonry arising (presumably) from action of the mortar are being studied at the Bureau of Standards in Washington, where two methods of preventing this staining are under investigation. The first is the use of a colorless waterproofing material on the limestone at the contact face of the mortar, the action of which is to prevent the passage of water through the mortar and into the stone in such a way as to carry the staining material with it. Preliminary tests indicate that most of the staining is prevented by this means. The second method consists of applying a removable porous coating on the exposed face of the limestone wall. The stains then come through the coating, form on its outer surface and later on are removed when the coating is removed, while when forming directly on the stone surface they are difficult to remove because the staining material is insoluble. The method is expected to be of some value as most of the stains form during the erection of the masonry.

Completes Forty-Eight Years' Service As City Engineer

Charles E. Bolling, Who Entered Engineering Department of Richmond, Va., in 1873, Becomes Consultant to City

IN FEBRUARY, 1921, Charles E. Bolling became consulting engineer for the Department of Public Service of the city of Richmond, Va., after forty-eight years' continuous service in the city engineering department, the last thirteen of which were as city engineer. Practically the whole municipal development is included in these years. In 1873 Richmond was a discouraged, fire-torn city of 54,000, hardly yet recovered from the ravages of war and the inertia of reconstruction. Today it is a prosperous civic community of 175,000, well built and admirably equipped with every engineering and sanitary necessity. Mr. Bolling has had no small part in this growth. While like most engineers he has not reaped great pecuniary reward, in his own words, he has now "the satisfaction that work, hard work, and fidelity to trust may bring an engineer so long a public servant."



CHARLES E. BOLLING

Mr. Bolling entered the service of the city of Richmond Feb. 15, 1873, as assistant to the city engineer, Capt. Charles H. Dimmock, who died only the next month to be succeeded by Col. W. E. Cutshaw, the city engineer for the next thirty-four years. The city engineer at that time had charge of all street and sewer construction, maintenance and repairs, grounds and parks, bridges and the James River harbor improvement. He was further required to make all surveys for the other municipal departments and supervise plans and specifications for all public buildings of every kind. The city was only slowly recovering from the destruction and loss occasioned by the Civil War and the almost total destruction by fire in April, 1865, of its manufacturing and mercantile districts. During the reconstruction period from 1865 to '70 no municipal improvements of any kind had been made. There were no plans for future development. Many of the records had been destroyed, the city's finances were little or nothing, and its credit was practically nil. The field for the future was a broad one.

Colonel Cutshaw with only three assistant engineers devoted the following three decades to the task of making Richmond a city, and in this work he was ably assited by Mr. Bolling. From February, 1873, to July, 1885, Mr. Bolling was on surveys, plans, street paving, sewer construction, public parks, reservoir plans, and public plans. From 1874 to 1876 he was assistant engineer in charge of the building of a reservoir near the city for additional water-supply and the laying of all supply mains and other appurtenances connected therewith. After completion of this reservoir he was put in charge of all city construction work on streets and sewers and on surveys for additional water-power pumps at a new location above the city on the James River.

In July, 1885, he was elected by the city council to be superintendent of the city water-works, which included also the duties of engineer of the water department, formerly performed by the city engineer. In this capacity he worked for twenty-three years, during which time there were designed and constructed large sedimentation and coagulating basins, located between the canal and river, one mile above the pump works, and the enlargement of the distribution system with installation of practically 100 per cent metering was carried to successful completion.

After the death of Colonel Cutshaw in November, 1907, Mr. Bolling was elected by the city council as city engineer and entered upon the discharge of these duties in January, 1908. From that date to January, 1919, for each term of two years he was re-elected city engineer. In 1919 by reason of a charter change in the city he was elected director of public works, embracing the position of city engineer. In February, 1921, he was succeeded as director of public works by Allen J. Saville, nominated by the mayor for this office and elected by the council. Mr. Saville appointed Mr. Bolling consulting engineer for the department of public works, which position he now holds.

Boston Sliding Scale Gas Rate Standard Raised by Commission

In granting an increase in gas rates to the Boston Consolidated Gas Co. the Massachusetts Department of Public Utilities reviewed in some detail what has become known as the Boston sliding gas scale. Provision for this scale, with a standard or base price of 90c. per 1,000 cu.ft. and a standard dividend of 7 per cent, was made by the Massachusetts Legislature in 1906. Before passing to the commission's summary of its decision, it may be noted that the increase in gas rates allowed by the commission up to $1.40 per 1,000 cu.ft. near the end of the year was preceded by temporary increases of the standard price to $1.10 on Mar. 5, 1920, and to $1.35 on July 23. This action was taken under a clause in the act of 1906 that provided for jurisdiction by the commission provided that there should be no deviation from the standard price of 90c. for ten years and none thereafter unless a change become necessary to correct inequities arising from substantial changes in the costs of making and distributing gas. The syllabus in this opinion, as given in *Public Utilities Reports*, March 17, 1921 (Rochester, N. Y.), follows:

1. The Massachusetts "sliding scale" act expressly suspended the jurisdiction of the commission over the price of gas to be charged to the consumer, reductions in price depending solely on the desire of the stockholders for greater dividends.

2. The principle of the Massachusetts "sliding scale" act that decreased costs and increased profits due to skillful and wise management shall be shared by the stockholders and the public rather than wholly taken by either, is essentially sound, but conversion of the theory into a fixed rule, expressed by the interrelation of a standard price and standard dividend, is necessarily artificial, and conditions must be stable and a considerable period elapse to make it an effective regulator of the selling price.

3. In the midst of unstable and unprecedented operating costs, a standard cost of gas does not exist, and a standard price is an anomaly, and, therefore, the standard required by law to be fixed should be a temporary rather than a permanent one.

4. The standard price of gas to be fixed by the Boston Consolidated Gas Co. under the Massachusetts "sliding scale" act was placed at $1.40 a thousand cubic feet.

Remote-Control Electric Haulage in Quarry Service

Two Layouts for Overburden and Rock—Economy Over Steam Service—Man in Tower Controls Car Motors and Brakes

ELECTRIC traction by a remote control system, in which car movements are governed by an operator in an elevated tower, is the method adopted by the Bessemer Limestone & Cement Co., Youngstown, Ohio, in removing the overburden from a new quarry. Shale and top soil, having a thickness of 35 to 55 ft., are excavated by a steam shovel having a 3½-yd. dipper and giving a daily output of 1,000 to 1,500 cu.yd. A similar system for handling the quarry rock has been in service for over two years, and the accompanying plan shows the two layouts for stripping the site and for handling quarry stone.

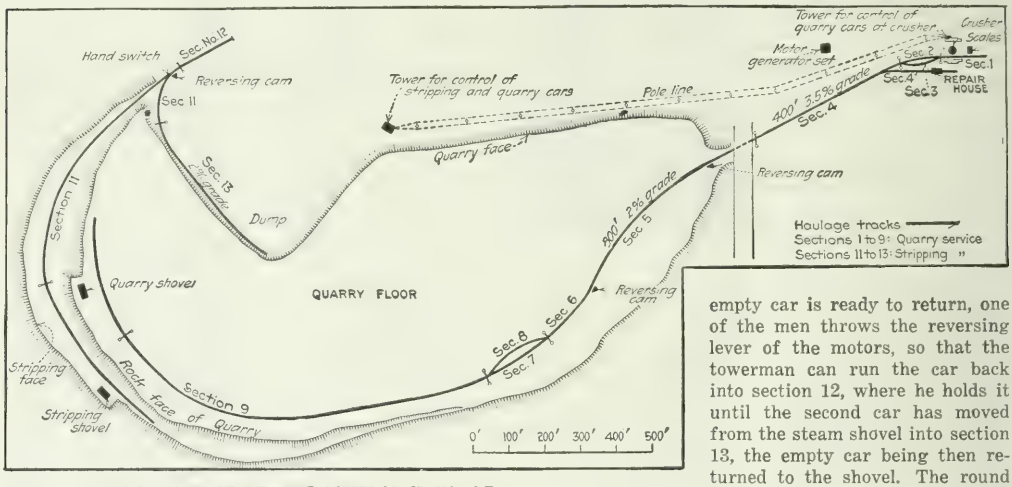


FIG. 1 TRACK LAYOUT OF REMOTE-CONTROL HAULAGE SYSTEMS AT QUARRY

All tracks are of standard gage, with 60-lb. rails having bonded joints and cross bonds at 200-ft. intervals. Insulated joints divide the track of the stripping layout into four sections, with separate electric supply to each. A 45-lb. third rail is carried by supports on the middle of the ties. The three sections marked 11, 12 and 13 are under the control of the towerman. The end section, at the stripping face, is controlled by the steam shovel operator. This section is short and is shifted as the shovel advances.

Handling Overburden.—Two 20-yd. side-dump cars are used for the stripping work and are operated on the shuttle system. The cars have a 30-hp. motor on each truck and are fitted with solenoid electric brakes. Current of 220 to 240 volts is used for the motors, but for the brakes 110-volt current is applied to the solenoids through electric switches. When the car at the shovel is loaded, the shovel operator throws a control switch and admits current to the track section, causing the car to move into section 11, where it is under control of the tower man. The car continues into the switchback section 12, where a cam at the side of the track operates a lever on the car, reversing the motors. The switchman opens the switch admitting the car into section 13, where the towerman stops it at any desired point by shutting off the current and applying the brakes. For the more permanent layout of the quarry service the switches and reversing cams are under the control of the towerman.

In section 13 the track is on the edge of a spoil bank 40 ft. high and is shifted as the dumping progresses. When a man on the dump releases a latch the weight of the load tilts the car body, the empty body returing to position by gravity and being latched automatically. About six men are employed at the dump to level the material and shift the track. At times they have to dump the car by hand or with jacks. There is no automatic reversing cam on the dump track, but when the empty car is ready to return, one of the men throws the reversing lever of the motors, so that the towerman can run the car back into section 12, where he holds it until the second car has moved from the steam shovel into section 13, the empty car being then returned to the shovel. The round trip averages 8 to 10 minutes, with a running speed of 15 m.p.h.

With two cars, a towerman and a switchman, about 1,000 to 1,500 cu.yd. are handled daily, as compared with 800 cu.yd. with the former equipment of two steam locomotives operating trains of six 4-yd. cars on tracks of 38-in. gage. Two enginemen and two brakemen were required, while the electric haulage system requires only two men. There is also less time lost at the shovel, and as track has to be kept in better condition for the large cars the car repair work is proportionately less. The number of men used on the dump depends on the handling of track and varies with the amount of dumping space available. Ordinarily the shifting of the dump track occupies one day each week.

Handling Quarry Stone.—In quarry service, for removing the rock to the crusher plant, three cars of 10-cu.yd. capacity are in operation. No switchback is included in the quarry layout, but there are two passing sidings, the cars being operated on the shuttle system. This part of the track layout comprises nine sections under the control of the same towerman who controls the stripping movements, these sections including the two sidings and a repair track. A second towerman at the crusher house spots and dumps the cars. The end section in the quarry, which is generally short, is under control of the shovel operator, as in the stripping work. Grades of 2 and 3½ per cent lead from the quarry floor to the crusher plant.

A loaded car started by the shovel operator moves into section 9, where its control is in the hands of the towerman, who stops it usually at the first siding (on sections 8 or 7) to allow an empty car to pass. The car is held by applying the brakes through the solenoid and electric switch and then cutting off current from the section in which the car stands. The empty car proceeds through section 9 to the short section at the steam shovel, at which point it comes under the control of the shovel operator; meanwhile the loaded car is run through three sections to the second siding, where it passes an empty car just coming from the crusher. Finally the loaded car is run into the crusher house, where it is spotted by the towerman by means of the brakes and is dumped by means of a remote-control hoist also operated by the towerman. A reversing cam at the crusher automatically throws the reversing control on the car as it arrives at the dumping hopper, so that the empty car can be started back to the quarry.

Both the stripping and the quarrying work are in full view of the main towerman, only hand signals being required from the switchman and dump foreman of the stripping layout. If the towerman should fail to see the car start from the shovel it would simply drift into the next section and come to a stop. No trouble is experienced in dark or foggy weather and at night the work is illuminated by flood lights. Electric current is supplied by a local power company.

Electric and Steam Operation.—In 2½ years' experience with quarry haulage this remote control system has been found satisfactory both as to service and cost, as compared with light locomotives and cars. It is considered by the quarry company that there is some saving in power, but that the main saving lies in the fact that the movements of the cars are all under control of one man, stationed in a sheltered position. This results in fewer delays and more regular operation, with consequent greater output or material handled. Shuttle operation is used for both the stripping service and the quarry service, but continuous loop operation on a similar haulage system, with spur tracks at the shovels, has been used at another large quarry, as described in *Engineering News* Oct. 21, 1909, p. 421.

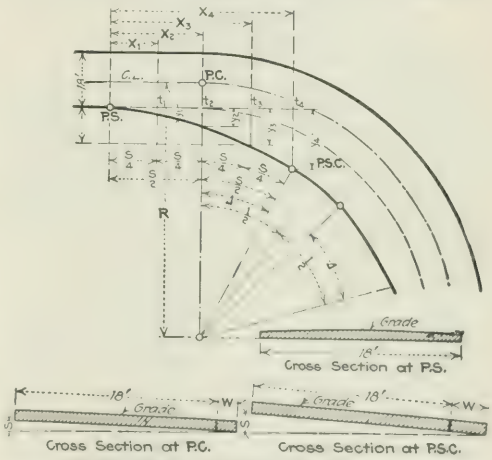
The electric haulage system is that of the Woodford Engineering Co., Chicago, which supplied and installed the electrical equipment. The introduction of this system was decided upon by F. R. Kanengeiser, vice-president and general manager of the Bessemer Limestone & Cement Co., and the operation is under the direction of J. A. Johnson, superintendent of the company.

During the last three months of 1920, when the electric haulage system for the stripping had come into full operation and was working on an economical basis, the cost per cubic yard of material excavated and dumped was 40 per cent that of the former cost of steam operation.

Pennsylvania Practice in Widening Highway Curves

HIGHWAY curves are widened and superelevated, in the standard practice of the Pennsylvania Highway Department, by the use of the transition spiral and one-slope roadway, as indicated by the accompanying diagram and tabulation of offsets and superelevations.

In applying the table, the engineer selects such a central angle delta as will give at least an arc of widened roadway one-third in length. For example: Given I = 84°; R = 200 ft., and delta = ½ I = 28°. Interpolating from the table: One-half length of spiral equals 70 ft., and the offset from tangent T at PS equals 0 ft.; at T (35 ft. beyond PS) equals 0.2 ft.; at T_2 (or $P.C.$ of circular curve) equals 1.5 ft.; at T_3 (from tangent projected) equals 6 ft.; and at T_4 equals 16 ft.



CURVE DIAGRAM, PENNSYLVANIA HIGHWAYS

OFFSETS AND SUPERELEVATIONS FOR WIDENING HIGHWAY CURVES

Radius of Cl. of Roadway	Total Offset	Half Length of Spiral for Various Angles from 0 to 15°	Half Length of Spiral for Various Angles of 15° and Over	Point X_1	Point T_1 Y_1	Point T_2 X_2	Point T_2 Y_2	Point T_3 X_3	Point T_3 Y_3	Point T_4 X_4	Point T_4 Y_4	Super-Elevation of P. C. S. and P. S. C.
50'	6 5'		15'	7 4'	0 0'	14 7'	3 3'	21 5'	6 2'	28 3'	9 4'	12¼"
60	6 0		20	10 0	0 4	19 6	3 0	28 9	6 7	38 2	10 5	12
80	5 0		20	10 0	0 3	19 8	2 5	29 4	5 2	39 0	7 8	11½
100	4 5		30	15 0	0 3	29 9	2 3	44 5	5 3	58 9	9 6	11½
120	4 0		40	20 0	0 3	39 9	2 0	59 6	5 5	78 7	11 6	11
140	4 0		40	20 0	0 3	39 9	2 0	59 6	5 5	79 0	10 4	11
160	3 5	.	40	20 0	0 2	39 9	1 8	59 9	4 7	79 3	9 2	10½
180	3 5		50	25 0	0 2	50 0	1 8	74 7	5 0	99 0	11 0	10½
200	3 0	35		17 5	0 2	34 9	1 5	52 3	3 5	69 6	6 3	10½
200	3 0		70	35 0	0 2	70 0	1 5	104 7	6 0	138 2	16 0	10½
220	3 0	35		17 5	0 2	34 9	1 5	52 3	3 4	69 6	5 9	10½
220	3 0		70	35 0	0 2	70 0	1 5	104 7	5 6	138 5	4 6	10½
240	2 5	40		20 0	0 2	40 0	1 3	59 9	3 3	79 6	6 2	10½
240	2 5		80	40 0	0 2	80 0	1 3	119 7	6 0	158 2	16 7	10½
260	2 5	45		22 5	0 2	45 0	1 3	67 4	3 3	89 6	6 6	10½
260	2 5	.	90	45 0	0 2	90 0	1 3	134 7	6 4	177 9	19 0	10½
280	2 5	50		25 0	0 2	50 0	1 3	75 0	3 3	99 7	7 2	10½
280	2 5	..	100	50 0	0 2	100 0	1 3	149 7	6 8	197 6	21 0	10.
300	2 0	50		25 0	0 1	50 0	1.0	74 9	3 0	99 4	8 0	10
300	2.0	..	100	50 0	0.1	100 0	1.0	149 7	6 5	196 5	24.0	10

In superelevating, start is made at *PS* with the standard crown. From this point the crown is gradually changed into a one-slope section until at the *PC*, one-half the superelevation, as shown in column five of the table, is obtained. The superelevation is then gradually increased until the maximum superelevation as shown in column five is reached at the *PSC*, this superelevation being held until the *PSC* is reached. Beyond the *PSC* the superelevation is diminished by one-half at the *PC*, from which point the one-slope section is gradually changed to the crown section.

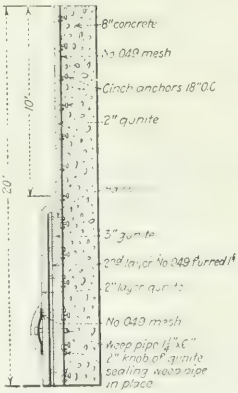
It is the practice to make the thickness of the one-slope slab uniform and equal to the average thickness of the standard 18-ft., crowned section.

Reservoir Waterproofed by Gunite Interlining

Seepage Through Porous and Cracked Walls Entirely Stopped—Construction Methods Described in Detail

By Barclay A. Greene
Pratt-Thompson Construction Co., Kansas City, Mo.

A CEMENT gun method of waterproofing, which is possible of frequent use, was successfully employed last season to stop ground water seepage into a small reservoir of the Mount Vernon, Iowa, water supply. Porous spots and cracks had developed generally in the reservoir side walls until, under an unbalanced head, the inflow was 100,000 gal. in 24 hours. This inflow was completely stopped by a 1:3 mortar lining constructed as shown by the accompanying sketch.



GUNITE INTERLINING FOR CIRCULAR RESERVOIR

Leakage had developed gradually. The reservoir, a circular tank 40 ft. in diameter and 20 ft. high, was underground, with a 6-ft. covering. The bottom 5 ft. was in solid rock, but the shell was 8 in. thick from bottom to top and the floor and roof were also 8 in. thick of 1:2:4 concrete. At the time of construction, eight years ago, the concrete was a little porous and the leakage small—just a moderate seepage through reasonably sound material. The seepage, however, increased with the age of the reservoir until the walls had become porous and cracked and the inflow had reached the volume stated. This inflow was through the shell and largely within a zone from 1 ft. to 10 ft. from the floor. The maximum head was 17.85 ft.

From a light scaffolding over the entire interior of the tank, the walls were sounded and all loose material removed with picks. Then, starting at the top, a layer of American Steel & Wire Co.'s triangular mesh, No. 049, was placed and anchored securely by means of ¾-in. two-stage cinch-anchors, and ½-in. x 3-in. bolts. Each layer of mesh had a side lap of 4 in. and an end lap of 8 in., and all laps were securely wired with No. 14 black annealed wire; the ties were 8 in. apart on the seams.

After the mesh was placed, the cement gun was used as a sand-blast machine and the concrete was thoroughly sand-blasted, leaving a clean unaffected surface, and cleaning all rust from the mesh. Starting at the top and working down, the 1:3 mixture of sand and cement was then applied 2 in. thick, without any waterproofing compound whatever.

As the work neared the bottom 10 ft., where the seepage was greatest, a 3-in. layer was applied. Within the bottom 6 ft., 26 weep pipes were installed, varying from ¾ to 1½ in. in diameter and held temporarily in place by a small amount of oakum around the pipe, placed well back from the surface of the concrete. To seal the weep pipes in place, a mixture of one part cement, two parts sand, and two parts gypsum was used and deposited with the gun. This was the only place where any mixture other than 1:3 sand and cement was used. At this bottom section of 6 ft. it was also necessary to place an additional 2 in. of lining, with another layer of mesh, making a total of 5 in.

The second layer of mesh was anchored to the first layer by hair-pin ties; a tie was made of No. 14 wire in the shape of a hair-pin 6 in. long, and was twisted around the first layer of mesh and allowed to protrude 3 in. through the first 3-in. layer of mortar. After this 3 in. had set, the second layer of mesh was placed, and anchored to the No. 14 wires, securely twisted and drawn taut, but furred 1 in. away from the first layer by means of pre-cast concrete blocks. The lining was brought down to the bottom with no fastening to the bottom.

There was no seepage whatever through the floor and the floor concrete was in good condition so the bottom was not touched. This method concentrated the seepage entirely to the flow from the 26 weep pipes. These were capped alternately, and gunite, with a layer of mesh, was applied until the weep pipes were entirely covered by a knob of mortar. The mesh placed over these knobs was anchored in the same manner as the second layer of mesh, by means of hair-pin ties.

The work was performed by the Pratt-Thompson Construction Co., Kansas City, Mo.

Traffic in 1920 Through the Sault Canals

An increase of 16 per cent in freight traffic and 20 per cent in passenger traffic for the season of 1920, as compared with the season of 1919, passing through the American and Canadian canals at the Sault Ste. Marie, Michigan and Ontario, is indicated in the statistical report on 1920 operations, prepared under the direction of Lt.-Col. E. M. Markham, Corps of Engineers, U. S. Army. The total freight traffic of both canals was 798,282,496 tons during 1920, showing an increase of 11,046,954 tons over 1919. The total number of passengers was 68,451, or an increase of 11,459. The traffic through the American canal was 97 per cent of the total freight and 37 per cent of the total number of passengers carried. Compared with the season of 1919 there was an increase of 20 per cent in freight and 58 per cent in passenger traffic. Traffic through the Canadian canal was 3 per cent of the total freight and 63 per cent of total passengers carried. Compared with the previous season there was a decrease in freight traffic of 40 per cent and an increase in passenger traffic of 6 per cent. The American canal was opened April 19 and closed Dec. 26, 1920, and the Canadian canal was opened April 23 and closed Dec. 23, 1920.

The Engineer in Foreign Trade

Technical and Business Qualifications Demanded of Federal Representatives for Special Investigators

By R. S. Mac Elwee
Director, U. S. Bureau of Foreign and Domestic Commerce, Washington, D. C.

THERE is undoubtedly a great field for the properly trained engineer in the foreign-trade service of the United States. In private business and in Government activity there is a constant demand for engineers who possess, in addition, commercial qualifications. The marketing of highly technical products abroad requires engineering training as a background, with the proper commercial and language study superimposed upon the engineering foundation.

In selling harvesting machinery, gas engines, and tractors, for example, this lack of a technical training has been keenly felt by many of the men who have not had it, and some of them have tried to familiarize themselves as much as possible with some of the fundamental engineering principles through reading, courses with correspondence schools, and the like. The sales manager for an elevator company, selling, putting up, and registering elevators abroad, realized so keenly the basic necessity for a sound electro-engineering training that a rule was adopted making this a prerequisite in the employment of salesmen. This work, of course, is only typical of many lines of engineering —civil, mechanical, electrical, chemical, and industrial.

Technically Trained Men Desired

As to the requirements of the Government, there may, of course, be other branches of the federal service that need engineers who have, also, a training in foreign affairs and languages, but in the present discussion I wish to speak especially of the Bureau of Foreign and Domestic Commerce. This bureau has had and now has attachés and trade commissioners who are professional engineers. The new policy has been to assign an engineering trade commissioner as assistant to the commercial attaché at those posts where engineering matters are of prime importance. At present, Major Brady, mechanical engineer, is assigned to assist the commercial attaché at Buenos Aires. Following the armistice, he was assigned to the commercial attaché in France. We have Frank Rhea, railroad engineer, assigned to the commercial attaché at Peking. If we are to have thoroughgoing reports of value on technical subjects, the men who write them must be technical men and must have had not only proper technical education, but also considerable professional experience. The Bureau of Foreign and Domestic Commerce sends abroad traveling trade commissioners to make extended investigations in special lines, and in specific surveys of this character it has, for example, employed mining engineers.

Effective Work by Engineers

The peculiar availability of such men for certain of the trade-commissioner positions is illustrated by several investigations that have been made in the past or are now in process. Particularly conspicuous has been the work of Paul Page Whitham, who spent three years in China and tropical Asia studying transportation matters and has written numerous confidential and other reports. Two large reports, "The Port of Shanghai" and "The Port of Manila," the bureau hopes to publish this year if it has sufficient funds. Usually, such able men who serve the bureau for a time enter private employment sooner or later at salaries very much larger than those the bureau is able to pay. Mr. Whitham has returned to China in a private capacity.

Although the number of engineers of various types that enter the service of the Department of Commerce abroad is necessarily limited, the number going into foreign trade is large enough to offer our universities a problem in engineering education.

The foreign commerce of the United States is particularly in need of those men who are competent engineers and who have, at the same time, the personality and business training in foreign affairs to enable them to go abroad and compete with British, German, French, Belgian, and other nations for large and lucrative contracts that are being let by foreign firms, cities, and central governments. This is a problem deserving the closest consideration by the engineering profession.

Reinforcing a Bridge Corroded by Locomotive Gases

BROADWAY in Cleveland crosses the tracks of the New York, Chicago & St. Louis Ry. (Nickel Plate) on a steel deck-plate-girder bridge built in 1888. On account of extensive corrosion of the floor system of this structure in recent years, especially over two drill tracks, the bridge was slated for early replacement. Corrosion had attacked especially the top flanges of the 38-in. plate-girder floor beams, which were found to be greatly reduced in area, and some holes had developed even in the web below the top flanges. The corrosion was almost as bad in the sidewalk brackets outside the girders as in the floor beams between the girders, although the girders themselves showed little injury. Financial conditions, however, delayed the renewal of the bridge, and it became necessary to reinforce the structure in order to maintain it in service.

New stringers had been put in some years ago, and as the main girders, 66 in. deep, were not seriously affected, the floor beams and sidewalk brackets were the principal items to be dealt with, and this only in the three panels over the drill tracks. It was decided that the floor beams were not so much weakened but that they could be left in place and counted upon for partial duty if supplementary floor beams were put in to take part of the load and be available for full service in case of failure of the old beams. This scheme was carried out, using 20-in. I-beams taken out of another structure. An I-beam was placed transversely midway between the old floor beams, being riveted to the main girders after bringing it up to bearing against the stringers. The cantilevered sidewalk brackets were dealt with in the same way. Additional stiffeners and kneebraces were placed on the main girders at the connections of the new floorbeams.

According to George H. Tinker, bridge engineer of the Nickel Plate, who carried out this reinforcement, two cast-iron sewer and water pipes suspended five to ten feet below the bridge floor do not appear to have been injured by the locomotive gases. The iron hanger rods supporting these pipes are attacked, however, and must be replaced from time to time.

Letters to the Editor

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Turbine Specific Speeds

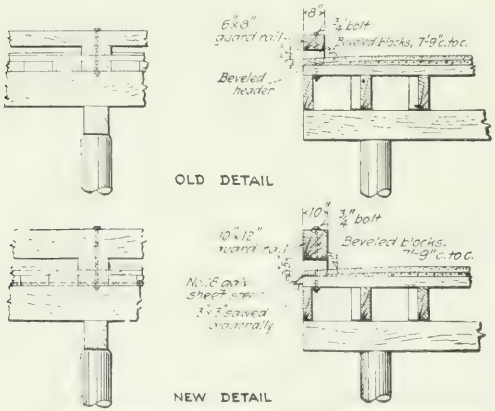
Sir—In connection with the article by E. A. VanDeusen in *Engineering News-Record*, May 12, 1921, p. 806, on specific speeds of turbines, progress in turbine design may be noted. The specific speed of a Francis runner varies between 10 and 100 and, in the usual stock turbines, between about 25 and 85. It is reported, however, that a Bohemian engineer, Viktor Kaplan, has designed one to run at 360, and to develop high efficiency. If tests substantiate this claim the utilization of low heads will be greatly simplified; it may even lead to the development of tidal power, a problem that has received the attention of so many British engineers.

LYNN PERRY.

Easton, Pa., May 20.

Edge Waterproofing for Asphalted Bridge Floors

Sir—Your issue of Dec. 3, 1920, contains on p. 1279 an article describing the Wisconsin Highway Commission's method of covering plank decks on highway bridges with bituminous wearing surfaces. Local experience with timber trestles which have been paved with sheet asphalt extends over a period of about twelve years. The shortcomings of the early designs have developed during this time and have also suggested several improvements. In view of our experience, I feel it desirable to call the attention of your readers to a point wherein the Wisconsin method requires additional features to give good results if untreated planking is used for decking.



NEW AND OLD EDGE DETAILS FOR ASPHALT-PAVED TRESTLE—SEATTLE

We find that where water from the pavement is permitted to crawl back under the planking, assisted by winds, capillary attraction or slope, dry rot sets in. The first indication of this is a break in the pavement, at first in only a few places, but always near the edge of the roadway. By degrees the damage becomes more general. Where heavy loads have broken through the pavement, the repair gangs find the planking badly decayed.

To prevent similar destruction, later structures have been provided with a metal drip, as shown, which conducts the harmful water away In order further to protect the deck in case water should find a way between the header and paving, we paint the planking when laid with two coats of creosote oil. This painting is confined to a strip 4 ft wide along both margins of the roadway. With this added protection, we feel that the life of our structures will be lengthened considerably.

W. H. TIEDEMAN,
Seattle, Wash., April 14. Assistant City Engineer.

Hudson Vehicle Tunnel Ventilation

Sir—In your issue of March 31, p. 562, there is an article under the caption "Hudson River Vehicle Tunnel Contracts To Be Ready May 15," and in the following issue of April 7, p. 602, there appears a statement of the maximum amount of free air per minute required to give adequate ventilation when the tunnel is being operated at full capacity, with motor vehicles only.

The cross-sectional design of the tunnel, as shown on the plans of the commission, gives a pressure duct area of about 61 sq.ft., with an exhaust duct area of about 75 sq.ft. With these data at hand it is possible to make an approximate estimate of horsepower required to operate the ventilating system that has been outlined in the various reports on the subject, but as yet no such estimate has appeared in print. The results of such an investigation are herewith appended, which the writer believes are of public interest, as the act of the New York Legislature creating this enterprise specified that the tolls and rentals shall pay the estimated cost of administration, maintenance and operation, and in addition will pay within 20 years the amortized cost of construction.

The distance between pier-head ventilating shafts center to center of the river section appears on published plans to be 3,800 ft., with the distance between New Jersey shafts 2,000 ft., and between New York shafts 1,100 ft. The amount of air required per tube from each pier-head shaft toward the river is 378,843 cu.ft. per minute, giving an initial intake-duct velocity of 6.210 ft. per minute. In the north tube, downgrade, there are two stretches, each 1,100 ft. in length, each stretch requiring 133,037 cu.ft. per minute, initial duct velocity 2,181 ft. per minute. Upgrade, two stretches 1,000 ft. long, each requiring 324,058 cu.ft. per minute, initial duct velocity 5,312 ft. per minute, and one stretch 500 ft. long, to portal, requiring 162,029 cu.ft. per minute, duct velocity 2,656 ft. per minute. In the south tube, downgrade, one stretch from portal to shaft, 500 ft. long, requiring 64,655 cu.ft. per minute, duct velocity 1,060 ft. per minute, and two stretches 1,000 ft. long each requiring 129,310 cu.ft. per minute, initial velocity 2,120 ft. per minute. Upgrade, if pier-head shaft is used in both directions, two stretches, each 550 ft. long, each requiring 175,434 cu.ft. per minute, duct velocity 2,876 ft. per minute, and one stretch 1,100 ft. long to exit portal, requiring 350,868 cu.ft. per minute, duct velocity 5,752 ft. per minute.

In determining the static pressure caused by duct friction allowance must be made for the flattened form of duct. The intake or pressure duct has a frictional resistance due to its form, equivalent to a circular duct 75 in. in diameter, through which air is passng at the same velocity.

As data on duct friction is principally founded on galvanized iron walls some modification might have to be made in the case of concrete enclosures, but if necessary some other lining could be introduced within the concrete. It is proposed to throttle the discharges into the tunnel so as to give equal distribution of air along each duct line. This arrangement, while giving equal ventilation along the line, increases the static pressure. Some allowance must be made for the formation of eddies and air pockets by which a certain amount of pure air will bypass to the exhaust duct, without performing its full duty of dilution.

This adopted system of ventilation requires practically double the horsepower of those in ordinary practice on account of the exhaust. While exhaust duct has a larger area it may be assumed that the power to operate it will be about the same as to operate the intake. In order to make the system flexible and to proportion it to traffic conditions, a battery of say four fan units will be required on each duct line, as only about 50 per cent reduction is the standard practice on a motor-driven fan unit. Such an

arrangement of multiple units, of course, increases the horsepower.

A rough calculation on the above basis gives a total of 8,000 hp. for the river section, 1,881 hp. for the New Jersey section, and 1,446 hp. for the New York section, or a total of 11,327 hp. Assuming that a rate of 2c. per hp. could be obtained, the power cost of operating at maximum capacity would be $226.54 per hour, $5,436.96 per day and $1,984,-490.40 per year.

In order to arrive at some estimate of what proportion of this maximum ventilation will be required per annum, in operating the tunnel, four different years have been considered—the year of opening, five years after opening, ten years after opening, and fifteen years after opening.

In a forecast of tunnel traffic given on p. 41 of the 1920 report of the commission, the maximum hourly traffic is given as 1,350, or 675 for each tunnel, or one-third of the tunnel capacity, at time of opening. In five years, 1,050 for each tunnel, or one-half capacity. In ten years, 1,550, or four-fifths capacity, and in fifteen years, full capacity at maximum.

No study, however, is presented as to the estimated traffic distribution during the twenty-hour hours. From a comparison of the Hudson ferry traffic charts the following traffic distribution has been deduced, covering a 24-hr. period:

6 hours 15% of maximum traffic	6 hours 60% of maximum traffic
6 hours 30% of maximum traffic	6 hours 100% of maximum traffic

As it would be impracticable to follow all the traffic fluctuations with ventilation adjustment, the above is assumed to be the rate of plant operation during the different periods.

At the opening of the tunnel, with a maximum of one-third tunnel capacity, we arrive at a ventilating cost of $25,000 per annum for normal traffic conditions. Five years after opening, with a maximum of one-half tunnel capacity, we get a cost of $85,000 per annum. Ten years after opening, with a maximum of four-fifths tunnel capacity, we get a cost of $330,000 per annum. Fifteen years after opening, with maximum of tunnel capacity, we get a cost of $725,000 per annum.

In the above annual costs no allowance is made for possible blocks in the tunnel, as no data are at hand as to probable frequency of their occurrence and the average duration of the resulting traffic jam. Both these factors of frequency and duration will greatly increase as the amount of maximum traffic approaches tunnel capacity and will add greatly to ventilation costs.

Some data for forecasting these costs might be obtained from a study of traffic operations over the East River bridges, and deducing therefrom some percentage of frequency of traffic blocks as maximum traffic approaches bridge capacity. The duration of resulting traffic jams, however, will be much greater in the tunnel than on the bridges, since the trouble point will be on the upgrade. With the bridges this is on the approach, and traffic may be diverted; while in the tunnel this is at the outlet, and the whole length of tunnel behind becomes congested. To the above costs per annum, therefore, a sum must be added to cover the expense of traffic blocks, and the amount so added will increase very rapidly with each year of increased traffic.

On p. 71 of the commission's 1920 report, a financial statement is given showing how the tunnel cost is to be amortized, but on p. 69 the estimated cost of power for lighting, pumping and ventilation is given at $31,000 per annum at time of opening, and $301,000 per annum when tunnel is operated at full capacity. It would appear, therefore, that those figures should be amended to conform to these lately published ventilation requirements.

As the horsepower varies inversely as the cube of the duct area it would seem advisable to considerably increase their capacity, especially in the river section. The same object could be accomplished on the approaches by adding another ventilating shaft on the upgrade land portions. An alternative would be to provide for future duct enlargement, as the ventilating costs will mount very rapidly toward the maximum after the forty-year period is past. Still another alternative would be to limit the traffic to a lower maximum than tunnel capacity, if this can be done without interfering with the requirements of the New York act.

WALTON I. AIMS,
Civil Engineer.

New York City, May 7.

[Proof of the foregoing communication from Mr. Aims was submitted to Clifford M. Holland, chief engineer of the New York-New Jersey tunnel commissions, whose reply follows.—Editor].

Sir—Referring to the communication from Walton I. Aims proof of which has been submitted to me for consideration, it appears that the main point raised by him is that from an approximate estimate of the horse-power required to operate the ventilating system, he concludes that the amortization figures published in the commissions' 1920 report should be amended.

Mr. Aims' analysis appears to be correct in principle, but his calculations are based upon incorrect data, as determined from the recent experiments performed on the large scale model of the tunnel duct at the University of Illinois under the direction of Prof. Arthur C. Willard. This work has been done under an agreement between the tunnel commissions, the U. S. Bureau of Mines, and the university to obtain the coefficient of friction for the flow of air in concrete ducts and the horsepower required to ventilate the tunnel. The results of these exhaustive experiments show that the horsepower differs less than 10 per cent from the horsepower forming the basis of the figures published in the commissions' 1920 report. It is expected that this data will be published shortly in a bulletin by the engineering experiment station of the University of Illinois.

CLIFFORD M. HOLLAND.

New York, May 20.

Notes on the Suez Canal and on Indian Public Works

Sir—On my way East I have recently passed through the Suez Canal and learned there from the resident engineer some facts regarding its maintenance that may interest your readers.

The Suez Canal is 160 km. long. During and since the war the work of deepening and enlarging has gone on steadily, and the depth of 12 m. at present aimed at has been completed for a distance of 130 km., leaving 30 km. which is 10.5 km. deep. This portion of least depth is toward the Suez end, where there is a tide of 1 to 1.8 m. so that it may be said that the full depth exists throughout at certain stages of the tide. There is practically no tide at the Mediterranean end.

The minimum width at bottom is 45 m. The ordinary width of 60 to 75 m. is increased to 100 to 110 m. at curves and special places. Much of the canal banks are now lined with stone wall to prevent washing, and this wall is set back at full standard width, leaving in places some dredging still to be done to complete the enlargement. The breakwater at Port Said has been extended so as to obviate much of the silting up of the entrance which formerly occurred. Generally the canal is in a forward and efficient state and there is practically 40 ft. of water available now.

The traffic before the war was about 20 million tons annually. It fell during the war to 13 to 14 millions and is now about 17 millions.

There is much public work being done in India and building operations are active. Many new projects are, however, delayed because of financial stringency and also awaiting the clearing of the political atmosphere, the prospects for the improvement of which seem better than they were. The British government has introduced far-reaching reforms giving the native people much more scope and control than they had before. A few native agitators are very noisy, but the mass of the people knew nothing of democratic government and were quite content to have their affairs looked after and the country developed by the British, who on the whole did it honestly and well. The tales of the miserable of a downtrodden people are pure fabrication. It remains to be seen how the new regime will work out.

A. W. ROBINSON.

Singapore, April 10.

HINTS FOR THE CONTRACTOR

Gravity Plant With Drop Chute Pours Steel Building Floors

CONCRETE floors and concrete embedding the framework of a steel factory at Cleveland, O., was successfully placed with a boom-type gravity plant by hanging a vertical chute to a counterweight chute elevated to swing clear of the steel framework. In steel buildings, ordinarily, it is impracticable to chute by gravity plant directly into the forms because the steel frame interferes with swinging the inclined chutes. Therefore the common practice is to chute to a floor hopper and wheel the concrete from this hopper to the forms. In constructing an 80 x 300 ft. steel frame factory for the Cleveland Rubber Co., the gravity plant tower was built high enough to permit the boom and counterweight chutes to clear the steelwork and the concrete was dropped directly into place by a vertical chute extending down through the steel frame. This procedure is stated to have been economical compared with wheeling. The contractors are the United States Engineering Construction Co., of Cleveland, Ohio, with K. D. Cowan as superintendent in charge.

Bucket and Trolley Form Simple Means for Shaft Sinking

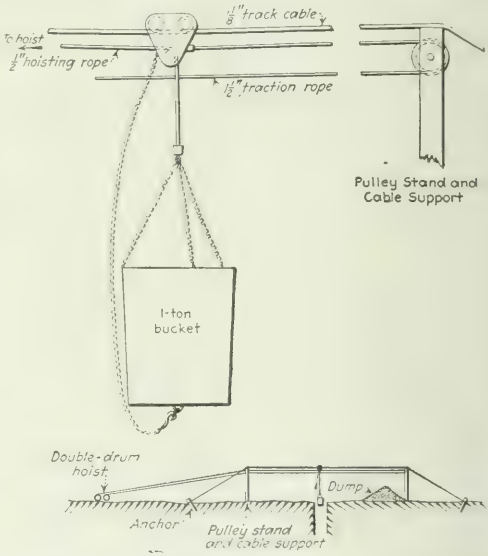
By B. G. Best
Civil and Mining Engineer, Ironwood, Michigan

THE arrangement shown in the accompanying sketch may be used in sinking a prospect or ventilation shaft when it is desired to minimize the expense of temporary equipment such as headframes, trestles, cars, etc., or when surface operating costs must be kept as low as possible.

As used in sinking a small shaft for a Michigan iron mine the equipment consisted of a 1⅛-in. wire-rope track cable, passing over the mouth of the shaft and securely anchored at both ends; two timber supports for the track cable, which also serve as pulley stands; ½-in. wire hoisting rope and traction rope; three pulleys for ½-in. rope, two placed one above the other on the pulley stand nearest the hoist and the third in the farther stand; a trolley; a short length of chain attached to the trolley and having a hook at the lower end; a sinking bucket; and a double drum hoist.

The supports for the track cable were placed on a line passing through the center of the mouth of the shaft and the center line of the drum, at approximately equal distances on each side of the shaft, and far enough apart to provide sufficient room for the waste dump. The bucket was supported by three chains instead of the customary bail to reduce the danger of overturning while in motion and to allow the bucket to right itself after dumping. The hoisting rope ran from the drum over the upper pulley on the first support, through the trolley to the bucket. The traction rope ran from the drum over the lower pulley on the first support, around the pulley on the second stand, and back to the trolley where it was made fast.

In operation the bucket was hoisted high enough to allow the lander to fasten the hook of the trolley chain in a ring in the bottom of the bucket. The bucket was then pulled out to the dump by the traction rope, the hoisting rope being kept sufficiently taut to hold the bucket in an upright position. To dump the bucket the hoisting rope was paid out at a greater speed than that at which the traction rope was taken in. Taking in the hoisting rope while the traction rope was held fast righted the bucket, and when the traction rope was paid out the bucket was pulled back to the shaft. The



GENERAL ARRANGEMENT AND DETAILS OF BUCKET AND TROLLEY

brake on the traction rope drum was then set and the bucket lowered.

When the track cable may be inclined, with the lower end at the dump, stops may be placed on the track cable and the traction rope done away with.

The disadvantage of such an arrangement is the additional delay caused the shaft miners while the bucket is being drawn out to the dump and back to the shaft, but this slight disadvantage is more than compensated for by the reduced equipment and operating costs.

Taking the Curl Out of Large Drawings

By Ralph R. Randell
Federal Power Commission, Washington, D. C.

THE handling and working with tracings and other large sheets which have been rolled, is often rendered difficult by their tendency to curl. The curl is ordinarily lessened or eliminated by re-rolling tightly in the reverse direction. An easier method of removing is found by alternately heating and cooling the roll, the heating and cooling being done conveniently by placing the roll on a radiator or in the sun, and in a cool draft in the shade.

NEWS OF THE WEEK

New York, June 2, 1921

MacDonald Testifies Before Townsend Committee

Chief of Bureau of Public Roads States Principles Favored for Federal Aid Legislation

(Washington Correspondence)

While good arguments have been made for and against the Townsend bill in the hearings being conducted by the Senate committee on postoffices and post roads, it seems to be the general sentiment that the advocates of the Townsend measure have scored most convincingly. It may be stated, however, that no organized effort has been made by friends of the Dowell bill to impress the Townsend committee. It is evident, nevertheless, that Senator Townsend is interested in having all views on highway legislation made a part of the record which is being built up before his committee.

Gen. Pershing appeared before the committee and while he emphasized the importance of local roads, his testimony, taken as a whole, can not be regarded as a particularly strong endorsement of either of the plans now before Congress. It was clear that Gen. Pershing was not familiar with either of the bills and his observations were of the most general character.

Townsend Bill Opposed

Thomas H. MacDonald, chief of the U. S. Bureau of Roads, was the most important recent witness to oppose the Townsend measure. He said, in part:

"A policy of self-determination is the policy which has been adopted by the Government in a large way. This to me is the big important question in this whole matter—that the efforts of the Federal Government should assist in developing matters primarily of local interest but which, in the aggregate, have a tremendous influence upon the national life. The form of the legislation has recognized the necessity of reconciling the conflicting claims of the advocates of state rights and of those in favor of centralization in matters which affect, first of all, the local and afterward the Nation as a whole.

"These are principles which I feel should be incorporated in new federal legislation:

"1. Adequate provision should be made for securing and retaining the services of men best qualified in highway engineering and administration. To do this it will be necessary to increase by a considerable margin the salaries now paid in the Federal organization. The salaries now paid are below the scale paid in some of the states.

(Continued on p. 966)

Vehicle Tunnel Wrangle Continues

At their joint meeting May 24 the New York and the New Jersey commissions charged with the administration of the Hudson River vehicular tunnel project failed to reach any agreement as to whether or not the board of consulting engineers, "dismissed" by the Jersey commission, is still legally in existence. No move was made to break the deadlock on the Jersey City street widening controversy, although "satisfactory progress" on the settlement negotiations was reported by Commissioner Shay. Three of the New Jersey commissioners, Messrs. Noyes, Barlow and Boettger, refused to join in the majority vote of the Jersey body approving salary vouchers for the members of New Jersey's "board of technical advisers," appointed to take the place of the board of consulting engineers which the Jersey commission claims to have abolished and which the New York commission insists is still in existence. At this writing the attorney-general of New York has rendered no opinion in the case and the delay in starting construction work at the New Jersey end of the tubes continues.

Licensing Controversy Referred to Am. Soc. C. E. Committee

At its meeting April 25 the board of direction of the American Society of Civil Engineers appointed a committee of five (R. L. Humphrey, chairman, Willard Beahan, Baxter L. Brown, Anson Marston and Francis Lee Stuart) to consider and report upon the matter of the practice of engineering by corporations and unrestricted partnerships.

The subject was introduced by a communication to the board by Col. W. J. Wilgus. After discussion the following resolution was offered by C. W. Hudson and seconded by George H. Pegram;

"Resolved: That it is the sense of the board of direction of the American Society of Civil Engineers that the granting of licenses to practise engineering and surveying should be limited to qualified professional engineers and surveyors and associations composed solely of qualified professional engineers [illegible]

"Further Resolved: That a copy of this resolution be forwarded by the secretary to the Hon. Nathan L. Miller, Governor of the State of New York."

[illegible] tion, offered by I. W. McConnell, referring the whole matter to a committee of five to be appointed by the chair [illegible] carried by a vote of 9 to 7.

Conference Discusses Highway Traffic Regulation

Trend Toward Automatic Control Evident—Two-Lane Widths Sufficient Says Johnson

Highway traffic regulation from the point of view of state and city authorities and the public was the subject of a one-day conference, May 23, held under the auspices of Yale University at New Haven, Conn. The meeting, organized by Prof. Charles J. Tilden, who is on leave of absence from the university in order to serve as director of the federal committee on highway and highway transport education at Washington, D. C., included addresses by William P. Eno, traffic specialist, of Washington, D. C.; Commissioner Charles J. Bennett of the Connecticut Highway Department, Dean A. N. Johnson, University of Maryland; Harriet E. Beard, of the Detroit Department of Education, and Police Commissioner James W. Inches of Detroit. One of the main objects of the conference was to stimulate public interest in the regulation of highway traffic in order to secure more rational and effective legislation, a higher degree of public safety and a wise expenditure of road building funds.

Central Bureau Needed

The conference brought out, among other things, the need for a centralized bureau of information on highway transport and traffic regulation, the administration of traffic control by specialists instead of aldermen, police commissioners and other unqualified city officials, a more intimate knowledge of the subject by the public, and traffic census statistics which may be used as a basis for the economic planning of state highway systems. In the city traffic problem the scientific control of vehicular movement and the education of the public are the important factors, while the state problem, as set forth by Commissioner Bennett and Dean Johnson, involves the proper location and width of highways, restrictions as to the weight, size and speed of motor vehicles, and schedules of registration fees based on service rendered. The dominant note sounded at the conference was the need for a new kind of thinking by state and municipal officials charged with the administration of highways and streets. It was frequently emphasized that today's demand is for an intensive study of the economics of highway transport rather than the details of highway construction and design.

In stating the basic principles which

should govern the regulation of traffic on city streets, Mr. Eno stressed the need for codes drafted by experts. Education of the public, beginning with the children in school, was insisted upon as a necessary feature of successful traffic regulation. The trend of development, according to Mr. Eno, is toward the automatic regulation of traffic by means of signs, semaphores, signal towers, and lines painted upon the pavement. He quoted figures showing that more than 50,000 deaths from traffic accidents during 1920 exceeded the total number of men in the American army killed in action during the war.

New York and Detroit Traffic

Digressing from his prepared paper, Mr. Eno maintained that a vast improvement in handling traffic on Fifth Ave., New York City, could be effected by inaugurating a scheme of rotary traffic at all street intersections. He characterized as a failure the present scheme of controlling traffic on Fifth Ave. by signal towers, which, he said, were improperly located and had the effect of driving off the avenue all vehicles except the Fifth Ave. buses and the automobiles of shoppers. The present Fifth Ave. scheme, he stated, is uneconomical in that in the 1¼ miles between 34th and 57th Sts. as many as 120 policemen have been assigned to traffic duty. Mr. Eno's paper will be published in an early issue.

In describing the control of traffic at Detroit, Commissioner Inches endorsed the principle of automatic control by means of signs and signaling devices at frequent intervals. One of the most pressing problems of the present relates to the parking of vehicles on city streets. Eventually, Commissioner Inches believes, cities must embark on extensive programs of street widening or else must construct municipal garages, if the parking problem is to be solved. Detroit's traffic regulation system involves an extensive use of signs, towers, and other signaling devices, which Commissioner Inches explained in detail. He was followed by Miss Beard, who described how the public schools of Detroit are instructing the children in the elements of traffic control and public safety.

Basis of Vehicle Fees

Commissioner Bennett, of Connecticut, whose paper is published in full on page 935 of this issue, asserted that traffic has become the most important factor in the administration of public funds for the development of highway systems. Making certain assumptions regarding the operating costs of motor trucks on dirt and on paved highways, he presented an argument for an increase in motor vehicle fees, based on the extra cost of service rendered to this agency of highway transport. Mr. Bennett made a strong plea for a centralized bureau of information on transportation and traffic subjects and for a bureau of research in this field.

The traffic census and its significance, by Dean Johnson, was the concluding paper of the conference. Using figures covering the total number of motor vehicles in the United States, the total road mileage, and making assumptions as to the percentages of the highway mileage carrying motor traffic and the range of operation of these vehicles, Dean Johnson reached a conclusion that 500 vehicles per mile per day represents the average traffic on state highway systems. As a result of observations on certain Maryland roads, curves were plotted showing the number of vehicles passing a given point at various speeds and spacings. The clearance between moving vehicles was found to vary as the square of the velocity. At a 15-mile per hour speed and a clearance between vehicles of 15 ft., the discharge of a single traffic lane is 2,640 vehicles per hour. Upon the assumptions made it was shown that at certain higher rates of speed fewer vehicles per hour passed a given point, due to lengthening the clearance distance between vehicles. Dean Johnson concluded that except in certain special cases state highway systems will not be called upon to carry, on the average, more than 500 vehicles per day throughout the year and that a highway paved for a width sufficient to accommodate two lanes of traffic will suffice for many years to come. Highway plans contemplating an extended system constructed for a greater width than required by two lanes of traffic are, in Dean Johnson's opinion, extravagant and without economic justification. Dean Johnson's paper and traffic diagrams will be published in an early issue.

New Basis for Motor Vehicle Fees in Minnesota

Under the terms of a constitutional amendment adopted at the general election last November, the Legislature of Minnesota has passed regulations for the levying and expenditure of automobile license funds. In lieu of all other taxes motor vehicles will be taxed yearly as follows: Two per cent of the list price at the factory, for the first three years of the life of a car; during the fourth and fifth years on 75 per cent, and thereafter on 50 per cent of the list price. The following minimums have been established: $12 for cars weighing less than 2,000 lb. and $15 for cars weighing more; for trucks, $15 under 2 tons capacity, $30 between 2 and 4 tons, $50 for over 4 tons.

All license funds will be expended for the construction and repair of a system of trunk highways under the direction of a one-man commission. Governor Preus has appointed C. M. Babcock to be commissioner. Mr. Babcock has appointed J. H. Mullen to be deputy commissioner and chief engineer. Both men held like positions under the old system and were largely responsible for bringing about the change in levying and expending motor-car taxes.

Federal Engineering Bureaus Get Deficiency Appropriations

Quite contrary to the usual practice, the committee on appropriations of the House of Representatives has acceded to the request of the Secretary of Commerce and has allowed the full $250,000 requested for export industries. This fund is to be used principally in an effort to assist the twelve chief export industries—cotton and cotton goods, paper and paper products, leather and leather products, chemicals (including dyestuffs), heavy machinery and machine tools, electrical goods, automobiles and accessories, lumber and lumber products, metal products, vegetable oils, hardware, and jewelry and silver ware.

In addition, the committee approved the full amounts which Secretary Hoover asked for the Bureau of Standards, as follows: Testing structural materials, $50,000; industrial research, including elimination of waste, $100,000; standardization of equipment, $100,000.

May Resume Store-Door Delivery

Railroad representatives at a conference recently held in Baltimore under the auspices of the Federal Highway Council's transportation committee agreed to the fullest co-operation in re-establishing store-door delivery in that city. After store-door delivery of less-than-carload freight had been in effect for forty-seven years in Baltimore and Washington, it was abolished by order of the Interstate Commerce Commission in 1913 on the ground that it constituted discrimination.

At the Baltimore meeting, the Pennsylvania R.R., the Baltimore & Ohio R.R., and the Western Maryland Ry., and shippers of Baltimore were represented. A. E. Beck, traffic manager, Merchants and Manufacturers Association of Baltimore, was appointed chairman of the local committee to work out the details of the service.

To Hold Conference on Resources of Interior Waters

A conservation conference to consider river and lakes as means of food production has been called by Herbert Hoover, Secretary of Commerce, and will be held at Fairport, Iowa, on June 8 to 10. His announcement points out that there is a certain community of interest between small groups, such as fishermen and sanitary engineers, but that there has been no concert of effort to serve the public welfare. Four broad subjects compose the program: (1) Depletion of aquatic resources, with causes and remedies; (2) utilization of swamp and shore areas as fish and game preserves; (3) opportunities and need of research station; (4) plans for conserving the resources of interior waters. Local arrangements are in the hands of R. L. Barney, Director of Fisheries Biological Station, Fairport, Iowa, and J. E. Krouse, Davenport Pearl Button Co., Davenport, Iowa.

International Railway Body Acts on Pre-War Basis

Under the name of the International Railway Association, the International Railway Congress has been reorganized and has resumed its pre-war functions of exchange of questionnaires and reports between railroad managements in various nations, with headquarters at Brussels, Belgium. Since the beginning of the world war the activities of the association have been suspended, and following the armistice the assets were sequestered by the Belgian Government since they included funds of Central European States. The last session of the association, meeting then as the International Railway Congress, was held in Berne, Switzerland, in 1910. The next meeting will be held at Rome in April, 1922. The 1915 session was scheduled to take place in Berlin.

Following the first International Railway Congress held at Brussels in 1885, a permanent association was formed, the articles of which were agreed upon at the Milan Congress in 1887, and from that time the association held meetings regularly, at first every two, then every three, and latterly every five years. Various railroad subjects were assigned for study to "reporters" and the results submitted at the meetings and in the Bulletin of the association. The Bulletin also has contained original articles on technical railroad matters, including those of organization, and reprints of other articles appearing in various countries, as well as detailed accounts of actual work accomplished and in progress.

Association Sequestered

After the return of the Belgian Government to Brussels, the association was "sequestered" and its dissolution and liquidation ordered, following which the administrations of the railways and the members representing the association, from thirty-five countries, transferred their equities to a new organization to be known as the International Railway Association, to function along the same lines as the old International Railway Congress. Germany is not represented among the thirty-five countries participating, including those of Europe, North and South America, Asia, and the new states comprising the old Empire of Austria-Hungary. Russia is not at present represented in the association, and the shares of the administrations of the old Russian railways have been deposited with a bank "until such a time as the events which are now developing in that country terminate." The governments of all the countries to which the association extends have now maintained their adherence.

It is stated that the International Railway Association is now in a position of resuming its work of rendering the same services as before the war, including the issuance of the Bulletin and the international studies of "reporters."

Announcement of the present status of the association is contained in a statement by Mr. Colson, vice-president of the permanent commission of the association, issued May 10, 1921. L Weissenbruch, 11 Rue de Louvain, Brussels, Belgium, is secretary of the association.

Caribou Plant of Great Western Power Co. Put in Service

The Caribou hydro-electric plant of the Great Western Power Co., located on the Feather River in California, was put in service May 6 in the presence of a large group of company officials and guests who went to the plant by special train. The plant is connected to the high tension network serving San Francisco and is notable for the size of the two impulse units constituting the initial installation, which have a capacity of 30,000 hp. each, and for the high tension of the transmission line, which is 165,000 volts. The plant is about 185 mi. from San Francisco.

Diehl Is A. A. A.'s New President

George C. Diehl, consulting engineer, of Buffalo, N. Y., and engineer of Erie County, was last week elected president of the American Automobile Association at the annual meeting of the board of directors in Washington, D. C. Mr. Diehl had served for years as chairman of the association's good roads board. He is a member of the American Society of Civil Engineers.

In his final report as chairman of the good roads board Mr. Diehl said:

"We are convinced that road building benefits all classes of citizens and all kinds of property and that all who share in these benefits should also share in the burdens. We believe that motorists should insist that construction expenses of State highway systems, or the fund needed to retire State highway bonds, should be paid for from general taxation, city property and country property alike, and that the motor vehicle revenues should be reserved principally for the maintenance of the main highways."

City Manager Appointed for Sacramento, Cal.

The City Commission of Sacramento, Cal., acting under the recently adopted new commission-manager charter, has appointed Clyde L. Seavey city manager at a salary of $10,000 a year, for an indefinite period. Mr. Seavey, who will take office on June 30, when the commission plan goes into full effect, has been a member of the California Board of Control since its creation in 1911, except that for the period of [illegible] he was released to serve as [illegible] of the State Tax Commission. Earlier Mr. Seavey had been connected with the State Board of Examiners and also earlier he had been managing editor of the Pasadena *News*. Sacramento had a population of about 65,000 by the census of 1920.

Owens Leaves Lakewood Company

Roy G. Owens, vice-president in charge of sales of the Lakewood Engineering Co., of Cleveland, has tendered his resignation. He has been prominent in the affairs of the company since the consolidation of the Milwaukee Concrete Mixer Co. with it in 1917 and has represented the Lakewood organization in numerous important conferences touching the welfare of the construction industry. Mr. Owens has been a factor in the formation of many of the progressive policies for which the Lakewood company has been noted in the contractors' and power plant equipment fields.

ROY G. OWENS

Mr. Owens has been in the construction industry all his life, his first business experience being in general and builders' hardware lines. In 1910 he joined the sales force of the Texas Portland Cement Co. and, after a year with that organization, went with the Wiley Chute Co. of which he later became proprietor. This company manufactured concrete distributing apparatus and Mr. Owens' connection with it continued from 1912 to 1917. In 1916 he became general sales manager of the Milwaukee Concrete Mixer Co., at the same time directing the interests of his own organization. In 1917 came the consolidation of the Milwaukee company with the Lakewood Engineering Co., with Mr. Owens in charge of sales.

His chief work has been the building up of the Lakewood sales organization. One of the departures for which he was largely responsible was the establishment of a policy of selling its equipment through its own branch houses, instead of through agents, wherever the volume of business seemed to justify that method of distribution.

In addition to the work normally falling to a director of sales, Mr. Owens has taken a broad interest in all movements for progress in the construction industry. He was the originator of the "Buy Now" campaign which was conducted on a national scope during the slack period immediately following the war. He has worked with the United States Chamber of Commerce on various matters relating to construction activities, and has personally directed several extensive circular campaigns carried on by the Lakewood Engineering Co. in order to induce highway engineers to let their contracts early and highway contractors to ship materials in the late winter, when a plentiful supply of equipment was available.

Mr. Owens' resignation will take effect shortly, but plans for his new connection have not matured to a point where they can be announced.

New York Port Authority Appoints Consulting Board

Announcement was made at a luncheon of the Merchants' Association of New York City, May 27, by E. H. Outerbridge, chairman of the Port of New York Authority of the appointment by that body, of a technical advisory board of three members to assist in formulating the final comprehensive plan for the Port of New York, which must be presented to the legislatures of the two states, under the terms of the port compact, before Jan. 1, 1922. The members of the new board are: Francis Lee Stuart, previously vice-president and chief engineer, Baltimore & Ohio R.R., Morris Sherrerd, consulting engineer, Newark, N. J., and Nelson P. Lewis, consulting engineer, New York City, for many years chief engineer of the Board of Estimate. At the same time announcement was made of appointment to the engineering staff of the commission of Major Elihu C. Church, transportation engineer, who served on the General Staff of the A. E. F. in France and has more recently been connected with the New York Chamber of Commerce, and H. C. Bixler, superintendent, Manhattan division, Pennsylvania R.R.

Mr. Outerbridge also announced that the Port Authority is organizing an advisory council to be drawn from about 100 commercial and civic organizations in the Port District, who will be invited to name representatives and alternates to confer with the commissioners from time to time on all important questions involved in the work, and who will be expected to report back to their respective organizations.

Townsend Bill Hearings

(Continued from p. 963)

"2. Provision should be made for the classification of federal-aid roads in each state under systems of like or equal importance. The states should retain the initiative in the selection of these roads but federal authority should be given to review the selection and require modifications based on certain principles to be incorporated in the law.

"3. Federal funds for construction should be met by state funds, proper time being allowed for the states to secure the necessary legislation and constitutional changes.

"4. Maintenance of roads built partially with federal aid should be provided for.

"5. The federal administration should be given authority to train men for the organization in a manner similar to that now followed in France. It should not be the object to give men the preliminary engineering and economic training, but to take graduates from the established institutions providing specialized courses. The whole matter of highway organization and administration is a matter of trained personnel."

Senator Townsend asked Mr. MacDonald if a commission of five men devoting all their time and study to this subject could administer the road work more efficiently than the present Bureau of Public Roads. To this Mr. MacDonald answered: "I think the question is entirely a matter of the men who are put in. I think a commission might be set up that would do better work. I also think a commission might be chosen that would do much poorer work. I really do not believe anyone can answer that question. Road selection is a matter of common honesty. If the road commissioners of a county will specify honestly the most important road within that county it will undoubtedly become a part of an interstate system of roads. I believe we ought to accept and build on the foundation already established in the states, but give the Federal authority the right to review and modify, but not give it original jurisdiction."

Chapin Favors Commission

Roy D. Chapin, president of the Hudson Motor Car Co., made one of the best witnesses who have appeared for the Townsend bill. Among other things, he said:

"I favor a commission because in our form of government it seems the most feasible and business-like form of administration. A commission properly set up would have power to handle the subject properly. It would be a clearing house for the states in all their operations. It would be able to conduct research work on a very large and broad scale. It would have a continuity of policy which is of very great importance. It would work for the greatest good of the Nation, partly because it would be more directly responsible to the people of the Nation than is a bureau or department. A commission must stand upon its own bottom. Everything it does goes directly to the people. A commission would bring to the problem an aggregation of brains representing different types of minds. You have engineering minds, business minds and scientific minds. I condemn the existing federal-aid law emphatically."

Senator Oddie, of Nevada, asked Gen. Pershing whether he considered the quick completion of coast to coast highways, which would serve military as well as civic purposes, a very important step in our military progress. To this Gen. Pershing replied: "That would, of course, be valuable but you have four or five railroad trunk lines running across the continent. That would serve for transcontinental purposes. If the military operations were conducted in any particular locality those coast to coast roads would be available and useful for military purposes."

C. R. Berry, assistant general freight agent of the Chicago, Great Western railroad, made the following observation in the course of his testimony: "In our section the railroads are not opposing the hard surfaced roads. They are encouraging them. We feel that it will build up the value of the land and improve the counties and the territory which the railroads serve."

G. S. Hoag, field secretary, Lincoln Highway Association, declared that he would favor taking all Federal aid money and applying it on interstate roads and withdrawing aid to counties and states for inter-county roads.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

Personal Notes

Yu Chi Ma, formerly with the division of sanitary engineering, New York State Department of Health, has resigned to accept a position as operator and chemist with the new water purification plant at West Palm Beach, Fla.

I. B. Lanphier, formerly assistant highway engineer, Illinois Highway Department, is now with the division of timber mechanics of the U. S. Forest Products Laboratory, Madison, Wis.

A. R. McGinnes, engineer with the U. S. Reclamation Service, has been appointed project manager of the Huntley Project, with headquarters at Ballantine, Mont.

Fred A. Rhodes has been reelected manager of operations, city engineer, and street superintendent of San Diego, Cal.

Major Mott Sawyer, builder of the Government spruce railroad in the Olympic Peninsula near Port Townsend, Wash., has been appointed superintendent of the Olympia division of the Chicago, Milwaukee & St. Paul Ry., with headquarters at Port Angeles.

Lawrence Lyons, of Brook, Ind., has been appointed director of the Indiana State Highway Department.

M. J. Stinchfield, Jr., formerly construction engineer with the Koppers Co., Pittsburgh, Pa., manufacturers of coke and gas ovens, has been appointed assistant state engineer

of Indiana to be connected with the drainage, stream pollution and water power problems of the state.

THOMAS C. ATWOOD has been selected by the trustees building committee of the University of North Carolina as its executive agent in carrying out the building program authorized by the legislature recently. He has made a specialty of management-engineering for some years past and has been connected with the construction of the Yale Bowl, the Squantum destroyer plant for the Navy Department, the Sparrows Point and other shipyards for the Emergency Fleet Corporation and a large mill and housing project for the Durham Hosiery Mills.

LAFAYETTE HIGGINS, state sanitary engineer, Iowa State Board of Health, since 1908, has resigned to open a consulting office with his son, Lafayette Higgins, Jr. Mr. Higgins served the Board of Health on part time until 1913. From 1890 to 1896 he was professor of civil engineering at Drake University and for the two succeeding years was city engineer of Des Moines, Ia. He maintained a consulting office up to 1913. His son spent a year with the Chicago, Rock Island & Pacific Railway Co. and for the past year has been an assistant engineer in the Iowa State Board of Health.

JOHN CHAMBERS, city engineer, Louisville, Ky., has been appointed chief engineer and superintendent, Louisville Water Co.

R. G. TYLER has resigned as city engineer of Paris, Tex., to become dean of engineering at the University of Oklahoma, Stillwater, Okla.

NEIL M. CAMPBELL, city engineer of Lake Forest, Ill., will open an office in Lake Forest to engage in private engineering and surveying practice, in addition to his duties as city engineer.

L. B. EVENSEN, former city engineer of Great Falls, Mont., has entered consulting mechanical and municipal engineering practice in that city.

L. E. RAYMOND, formerly superintendent of construction with the Turner Construction Co., is now with W. L. Stoddart, architect, in the same capacity.

R. G. MANLEY has been appointed city engineer and superintendent of streets of Upland, Cal.

FRANK MALONEY, from 1911 to 1915 adjutant general of Tennessee, and recently in engineering practice in Knoxville, has been appointed state highway engineer of Arkansas, succeeding V. P. Knott.

L. A. WILSON has resigned as assistant engineer division of highways, State of Illinois, to become a partner of the firm of the Clinton Engineering Co., Clinton, Iowa.

THE LA SALLE ENGINEERING CO. has been reorganized by A. B. Boyer and I. A. Baum, under the name of Boyer, Baum & Co., to practice consulting engineering in connection with structural steel, reinforced concrete and timber structures.

J. A. GLOMINSKI, formerly resident engineer New York Central R.R., Buffalo district, is now highway engineer, U. S. Bureau of Public Roads at St. Paul, Minn.

IVAN S. SIEGRIST, designing engineer with Black & Veatch, consulting engineers, Kansas City, Mo., for 5½ years, has resigned his position to take up the business of his father, the Siegrist Engraving Co.

P. G. LANG, JR., formerly assistant engineer of bridges with the Baltimore & Ohio R.R., has been appointed engineer of bridges, with headquarters at Baltimore, Md.

D. M. LAMDIN, division engineer, Atlantic Coast Line R.R., with headquarters at Waycross, Ga., has been appointed engineer of construction.

W. S. HANLEY, since 1912 chief engineer, New Orleans Great Northern R.R., with headquarters at Bogalusa, La., has been appointed chief engineer of the St. Louis Southwestern Ry., with headquarters at Tyler, Tex.

PERRY T. NAYLOR, formerly assistant city engineer, has been appointed city engineer of Hastings, Neb.

THE MARKHART THAYER ENGINEERING CO., Pittsburgh, Pa., has been organized by Prof. H. R. Thayer and C. O. Markhart to take over the business of Brown, Egerman & Markhart, civil engineers and architects.

OBITUARY

CHARLES M. JARVIS died in Atlantic City, N. J., May 21. He was born in Binghamton, N. Y., in 1856 and was graduated from the Sheffield Scientific School, Yale University, in 1877. In 1878 he became draftsman for the Corrugated Metal Co. at East Berlin, Conn. In 1882 the firm name was changed to the Berlin Iron Bridge Co., with Mr. Jarvis as vice-president and chief engineer. Later, he became president and acted in this capacity until the company was merged into the American Bridge Co. Specialties of the Berlin Iron Bridge Co. were the parabolic truss bridge, of which more than 500 were built in New England and New York State, and steel mill building construction. He served one year as vice-president in charge of operation of the American Bridge Co. Later, he became vice-president of P. & F. Corbin, New Britain, Conn., hardware manufacturers. He was instrumental in the formation of the American Hardware Corp., of which he was president. A few years ago he retired owing to ill-health.

COL. THOMAS C. CLARKE, consulting engineer in the coal and coke industry, died May 25 in New York. He was born in Philadelphia, Pa., in 1873 and was graduated from the Massachusetts Institute of Technology in 1893. From 1893 to 1897 he was general inspector and assistant on bridge construction work in Philadelphia and was also associated with John F. O'Rourke in consulting work. In 1902 he became treasurer of the Imboden Coke & Embree Iron Co. and in 1903 treasurer and assistant general manager of the Astoria Steel Co. Later he became general superintendent of the Lackawanna Iron & Steel Co., Lebanon, Pa., in charge of the entire work of five blast furnaces, byproduct coke oven plant, stone quarries, etc. During the World War he attended one of the early Plattsburg camps, from which he was graduated an engineer officer. He went to France as lieutenant-colonel. In France he was promoted to colonel and commanded his regiment in the Argonne Forest. As a result of his participation in a raid which broke through the German lines, Colonel Clarke was decorated with the Croix de Guerre and was cited in American First Army orders. Since the termination of the war he has been vice-president of the International Coal Products Co.

EDMUND T. PERKINS, consulting and supervising engineer and president of the Edmund T. Perkins Engineering Co., Chicago, Ill., died in Chicago, May 21. He was born in Scottsville, Va., in 1864, and was graduated from Union College with the degrees of C.E. and B.A. in 1885 and M.A. in 1888. From 1885 to 1902 he was connected with the U. S. Geological Survey as assistant topographer. In 1888 he did topographical work in Missouri, Kansas and Oregon. From 1889 to 1895 he was in Idaho and, among other work there, ran the reconnaisance lines for wagon roads through mountains and inaccessible regions. From 1902 to 1910 he was with the U. S. Reclamation Service as engineer in charge of Colorado River investigations, preliminary surveys and plans on the Yuma Project, Yuma, Ariz., and later in charge of the Chicago transportation and contracting office. In 1910 he entered private practice as consulting and supervising engineer in Chicago and established the Edmund T. Perkins Engineering Co., which has been successful in developing a number of large drainage districts in Illinois, Iowa and Missouri. He was a member of the Everglades Engineering Commission of the State of Florida with the late Isham Randolph and with M. O. Leighton. He was one of the organizers and the third president of the American Association of Engineers and was for many years president of the National Drainage Congress. He also served as chairman of the engineering committee of the Chicago Chamber of Commerce which has been active in civic matters.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Value of Organized Collection of Business Information

That it will be the task of the Federal Government to co-operate with the press by perfecting its agencies for the collection, organization and dissemination of economic data was one of the points stressed by Herbert Hoover, Secretary of Commerce, in his address before the nation's representative business men at the Hotel Commodore, New York City, last week, the occasion being the 125th anniversary of the founding of the *New York Commercial.*

Referring to trade conditions at the time the *New York Commercial* was established, Secretary Hoover asserted that the inspiration back of the foundation of the paper lay "in the primary necessity for all except the most primitive commerce, to know accurately and promptly the course of the market, the movements of transport, the opportunities of trade, the record of production, and the stocks in hand from day to day." Mr. Hoover asserted that the risk and, therefore, the volume of business depended largely on the accuracy and completeness of commercial intelligence and, therefore, the preparation and dissemination of this information was almost as complex as commerce itself. Though the press had gone far in the collection and distribution of information vital to the safe conduct of business, Mr. Hoover asserted that no one individual or institution could be expected to collect, co-ordinate and disseminate all needed commercial data. He emphasized the need for the extension by the government of agencies for the accumulation of these commercial data and, in co-operation with the daily press, its distribution among men who so vitally need it.

"If the government had maintained an efficient and full service of information of economic trend relating to production, to the stocks of commodities, to their distribution, both at home and abroad, we could greatly have mitigated the height of the last boom and the depth of the present slump," declared Mr. Hoover.

"There is perhaps no complete cure for these booms and slumps, but we can say that they would be infinitely more violent if it were not for the services of information that are at the disposal of the commercial public today through the press, and for such services as the government does perform."

Mr. Hoover said that he was convinced that if the increasing volume of consumption that has steadily grown during the last few weeks throughout the country "could be promptly illuminated to the public, the whole of our commercial community would take courage and would carry us forward with even greater strides than those with which we will now proceed."

Open price associations, he said, in so far as he had investigated them, had originated from a "rightful desire" to secure accurate and complete information of the volume of production on stocks, on consumption and on price.

Road Contracts for May, 1921, Exceed Those of May, 1920

The value of street and road contracts let during the month of May, 1921, exceeded the contracts let during the corresponding month of 1920 by approximately $5,000,000, analyses of contracts let as reported in *Engineering News-Record* indicate. The total value of contracts for street and road improvements during May of this year totaled $35,064,031 whereas during May, 1920, this total was $30,257,872. The value of all contracts let during May, 1921, was approximately 65 per cent of the value of all contracts let during May, 1920, the respective figures being approximately $109,000,000 and $166,000,000.

Street and road improvement was not the only class of construction which set a higher contract figure this year than last, for the contracts awarded during the past month in water-works improvements, excavation and dredging work, and in Federal government work exceeded those let during May, 1920.

VALUE OF CONTRACTS LET IN MAY 1921 AND 1920

Classification	May 1920	May 1921
Waterworks	$1,381,655	$4,943,562
Sewers	2,314,874	2,162,460
Bridges	5,363,709	1,642,894
Streets and roads	30,257,872	35,064,031
Excavation—dredging	403,705	2,031,799
Industrial	39,661,869	7,799,584
Buildings	70,946,738	48,442,471
Federal government	1,167,045	1,809,588
Miscellaneous	14,373,321	4,408,142
Totals	$165,870,788	$108,904,531

In miscellaneous building construction during May of this year the total contract value amounted to in excess of $48,000,000, whereas during the corresponding period of 1920 the contract value was $70,946,000. However, this latter figure includes the construction of a single $25,000,000 project. A comparison of the value of contracts let for the two corresponding months of 1920 and 1921 is given above.

These are direct comparisons of money involved and do not take into consideration a decrease in the cost of construction work within the year.

Wyoming Votes Road Bonds

On May 10 every county in the State of Wyoming voted to authorize the state to issue bonds in the amount of $1,800,000 for state highway construction work.

Eight Cardinal Principles in Building

Building trades employers, prominent contracting firms, and building trades employees are frequently using the daily newspaper as a means of advertising their particular views of this and that question in connection with wage discussions and business conditions. The Wells Bros. Construction Co. of Chicago and Springfield, Ill., recently carried a double-page advertisement in a Springfield paper in which it was stated that the square deal in building could be found in the eight cardinal principles adopted by the building trades and the construction employers of Chicago twenty years ago.

These eight cardinal principles are as follows: (1) There shall be no limitations as to the amount of work a man shall perform during his working day; (2) there shall be no restriction of the use of machinery or tools; (3) there shall be no restriction of the use of manufactured material, except prison made; (4) no person shall have the right to interfere with workmen during working hours; (5) the use of apprentices shall not be prohibited; (6) the foreman shall be the agent of the employer; (7) workmen are at liberty to work for whomsoever they see fit, that they shall demand and receive the wages agreed upon by the joint board in this trade under all circumstances, and (8) employers are at liberty to employ and discharge whomsoever they see fit.

Brindell's Lieutenant Guilty of Extortion

Peter Stadtmuller, a former lieutenant of Robert P. Brindell, convicted New York labor leader, was found guilty of extortion by a jury in the New York criminal court, May 25. The specific evidence upon which he was convicted was that he had been given money, in return for which construction was allowed to proceed on certain buildings in Maiden Lane, New York City. The penalty for extortion is a maximum of fifteen years' imprisonment, though first offenders may be given indeterminate periods ranging from seven and a half to fifteen years.

Pennsylvania Highway Department Lets Large Contract

The Pennsylvania Highway Department during the past week let contracts for the construction of modern-type highways worth $8,472,465. The money is to be expended in building thirty-five projects. The most expensive job is located in Bucks County and will cost $935,917. Pennsylvania now has more than 700 miles of highways under construction, a large part of which are uncompleted contracts from 1920.

Will Let Contracts for Pacific Coast Logging Railroad

Announcement is made by the California & Oregon Lumber Co., of Brookings, Ore., that contracts will be ready to let not later than June 15 for the whole or part of 14 miles of railroad from the mills of the company in Oregon to the Redwood holdings in northern California. James H. Owen, president of the company, is now completing the cross-sectioning for the line. Construction will include the erection of a deck Howe truss bridge of three 162-ft. spans, several minor bridges, approximately 6,500 lin-ft. of trestle, and the necessary grading.

Price Restrictions Removed from German Semi-Finished Steel

(Berlin Correspondence)

The Iron Control Board, formed in Germany in the first part of 1919 to rectify the tremendous rise in prices, has recently issued new inland prices for pig iron and railway material, and has cancelled existing prices of semi-finished material without making new stipulations. Thus, the Board has renounced its most important function, constituting itself little more than an advisory body. The reservation made with regard to railway material is of small consequence as the only large purchaser is the administration of the state railroads.

Bids to Be Received Soon on Construction of Two Bridges

Bids are being asked for the construction of two large bridges, one a highway bridge and viaduct across the Lehigh River at Bethlehem, Pa., and the other a concrete bridge with a steel swing span over Lake Worth from West Palm Beach to Palm Beach, Fla. Bids on the former will be received June 23 and on the latter June 17. The bridge at Palm Beach will be 1,885 ft. in length of concrete arch type with a swing span of 174 ft.

Work Begins on Memphis Auditorium

Work has started on Memphis' $1,000,000 municipal auditorium and city market, the contract having been let recently for the foundation and basement work. The foundation is to be finished by Nov. 21, 1921. The structure is to be 335 ft. square with arcades on all four sides. Light-colored brick and Bedford stone are to figure in the exterior and Tennessee marble in the interior work. The auditorium is to have a seating capacity of about 12,000 persons.

Building and Loan Associations

According to a report of the secretary of the United States League of Local Building and Loan Associations, there are in the United States 8,633 building and loan associations with assets aggregating $2,519,914,971, an increase of $393,294,581, or 18.5 per cent, during the past year. The total membership is 4,962,919, an increase of 673,593 for the year, or 15.77 per cent. The average amount due each member is $507.75 as against $495.80, the amount shown last year.

Probe of Building Combines by Lockwood Committee Ends

With the imposition of fines instead of prison terms upon building material dealers and others in the building industry convicted of violations of the state anti-trust laws as the chief cause, Samuel Untermyer announced May 25 that he would discontinue all investigations of alleged illegal combinations in the building industry in New York City. Mr. Untermyer, who with agents of the Department of Justice, has requested justices of the State supreme court that heavy prison terms be given those convicted of violations of the state anti-trust laws, made his sudden announcement that the investigations would cease upon learning that Justice Davis of the New York Supreme Court, had imposed fines upon individuals and corporations, members of the Association of Dealers in Masons Building Materails. Ten individuals were fined from $300 to $450 each, and nine corporations from $500 to $4,000. All the defend-

Labor Rates and Conditions Throughout the Country

VERY few changes are recorded since last month. Probably the most optimistic report is from Los Angeles, where few men are idle in the various crafts. In Detroit building construction is quiet, with no strikes, and rates unchanged. Montreal forecasts a possible general reduction of 10 per cent, "to stimulate construction." In Pittsburgh it is expected that contractors will declare open shop if unions do not accept wage cuts of 20 to 30 per cent. New Orleans agreements expire this month, and it is anticipated that the workers will consent to a reduction of the wage scale, in view of the decreased cost of living. Atlanta reports active building of residences and small apartments. Boston bricklayers are still on strike. Until Kansas City joint committee acts, old scale continues.

S means scarce, E, enough, P, plentiful. Higher rates indicated by +, decreases by

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.00P	$0.70P	$1.00P	$0.30P		$1.00P	$0.25P
Baltimore	1.25P	.80P	.87½P	.54P	$0.74P	1.00P	.35P
Birmingham	1.00	.87½		.25@ .40	..	1.00	.20@ .25
Boston	.90	.80P	.90P	.60P	.90P	.90P	.55P
Cincinnati	1.25P	1.00P	.70E	.85P	1.00E	1.25P	.35@ .40
Chicago	1.[illegible]	[illegible]				1.25	1.00
Cleveland	1.00P	[illegible]P	1.25P	.87½P	1.10P	1.25P	.87½P
Dallas	1.00P	1.00P	1.00E	.60E	1.00E	1.00E	.50@ .75P
Denver	1.[illegible]	1.00	1.00	.75@ .81¼	1.00	1.00	.37½@ .50
Detroit	1.00P	.80P	.80@ .90P	.50@ .60P	1.00P	.60@ .80P	.50P
Kansas City	1.[illegible]	1.00	1.00	.90	1.10	1.10	.75
Los Angeles	1.00P	1.00P	1.00P	1.12½P	1.00P	1.00P	.75P
Minneapolis	1.00P	.80P	.80P	.65P		.80P	.50P
Montreal	.90P	.65P	.65P	.55P		.65P	.30P
New Orleans	1.00P	1.00P	1.00P	.65P	1.00P	1.00P	.50P
New York	[illegible]	1.12½	1.[illegible]	.87½	1.12½	1.12½	.75@ .80
Pittsburgh	1.00P	1.[illegible]P	1.12½P	1.00P	1.00P	12.5P	.80P
St. Louis	1.[illegible]P	1.[illegible]P	1.25P	.88P	1.25P	1.25P	.67½P
San Francisco	1.[illegible]P	1.12½P	1.12½P	1.00P	1.12½	1.12½P	.81¼P

ants had pleaded guilty to violations of the Donnelly anti-trust laws, their cases growing out of investigations made by the Lockwood joint legislative committee on housing.

In announcing his decision, Mr. Untermyer summed up the achievements of the Lockwood committee and outlined some of the constructive measures it is hoped to have enacted. In the first place, Congress probably will be asked to amend the Federal statutes so as to compel presiding judges to impose prison sentences on violators of anti-trust laws.

Though the investigation of alleged illegal combinations in the building industry is to be discontinued, Mr. Untermyer will take up, as chief counsel for the committee, the operation of financial influences in the building industry.

Northwest Lumber Production 28 Per Cent Below Normal

Lumber production in the Pacific Northwest region for the week ending May 21 approximated 57,000,000 ft.b.m., according to a bulletin issued by the West Coast Lumbermen's Association. This figure represents approximately 72 per cent of normal production. Shipments for the week were about 64,000,000 ft.b.m., and new business totaled in excess of 67,000,000 ft.b.m.

Australian Contract Awarded Here

According to recent press dispatches the International General Electric Co., a subsidiary of the General Electric Co., has been awarded a $1,875,000 contract for transformers, switch gear, and other equipment, let by the Victorian Electricity Commission for development of coal mining near the city of Melbourne, Australia.

Coal and Ore Movement Increase Car Loadings

An increase of 32,133 in the number of cars loaded with revenue freight during the week which ended on May 14, compared with the previous week, was shown by reports just received by the car service division of the American Railway Association from the railroads of the country. The increase was largely due to increased loading of coal and ore principally for lake movement.

The total for the week was 750,158 cars, which was, however, 92,987 below that for the corresponding week in 1920, but 10,213 more than that for the corresponding week in 1919. Increases during the week were reported in the loading of all commodities except grain and grain products and livestock, compared with the previous week.

During the week 161,782 cars were loaded with coal, which was an increase of 18,459 over the previous week. It was, however, 1,800 cars below the total for the corresponding week last year and 4,100 under that for the corresponding week in 1919. There were also 22,806 cars loaded with ore, or an increase of 9,700 over the week before.

New Hand Drill Developed To Break Pavement

For use in making street openings for gas and water mains, electric cables, street railway tracks and other purposes the Ingersoll-Rand Co., of New York, has placed on the market a paving breaker operated by compressed air from a small portable plant. The device is similar in design to the non-rotating type of hand hammer rock drill. The company makes the following statement regarding the performance of the machine, based on data furnished by a large public service company:

"A good crew of 8 men using hand methods will cut about 80 lin.ft. of 18 to 24-in. width asphalt and concrete in an 8-hr. day. The asphalt averages 3 to 6 in. in thickness and the concrete about 6 in. That means 10 ft. per man per day, or 50c. per linear foot at a $5 wage. Three men with a compressor and two paving breakers cut an average of 300 lin.ft. per day. This costs about 16c. per linear foot when wages, operating cost, interest, depreciation, etc., are all taken into consideration."

Builders in Lockout Against San Francisco Unions

Four counties in central California, in which are included San Francisco, Oakland and the neighboring cities, are now involved in a controversy between the San Francisco Builders' Exchange and the San Francisco Building Trades Council. The "building war" entered its third week on May 23 and had then reached a stage where building operations in the coast metropolis were said to be "paralyzed." The situation grew out of the refusal of the unions to accept a 7½ per cent wage reduction which a board of arbitration decided was fair for seventeen of the fifty-eight building trades craft. Both the builders and the unions had previously approved the personnel of the board and agreed to abide by its findings.

Supply firms closed their places of business for the duration of the tie-up and on May 26 it was estimated that $100,000,000 worth of residence, office and commercial building work had been stopped and that 11,000 men of the building trades were idle. On May 25 the San Francisco real estate board endorsed the stand taken by the builders in insisting that the unions be not allowed to repudiate their agreements.

Monthly Prices of Construction Materials

Ups and Downs of the Mark t

In the absence of reports from our representative in Seattle, we are quoting the same prices here as last month.

Railway Supplies—Rails, ties, spikes and bolts the same as last month.

Pipe—Cast-iron pipe down $5 in New York. Chicago reports no changes at present, but resale prices $3 below standard quotations, and a reduction looked for at an early date. Steel discounts and prices of sewer and drain tile unchanged.

Road Materials—The decline in road oils continues, although business is reported fair. Oils are down ½c. per gal. in New York. Asphalt in bulk is down $1, to $16 per ton in New York. Other revisions in Los Angeles, Atlanta, Cincinnati and Detroit. Wood blocks down in Detroit. Paving blocks down in Cincinnati and Detroit.

Sand, Gravel and Stone—Sand down in Montreal and Cincinnati, up in Los Angeles. Gravel down in Cincinnati and Los Angeles. Crushed stone down in Los Angeles, up in Cincinnati. In Dallas, crushed stone is $2.80 per cu.yd. f.o.b. cars, and $5 delivered. Stone is down 25c. in both Chicago and San Francisco, while gravel is down 50c. in Chicago and 25c. in San Francisco. Slag prices revised for Easton, Pa., and Buffalo. Crushed slag quotations added for Erie and Emporium, Pa.

Lime—Hydrated down $1 per ton in New York, $2 in Boston, and down in Montreal and New Orleans. Lump down in Boston, Minneapolis and New Orleans.

Cement—Is $2.80 net delivered in New York, $2.40 alongside dock, and $2 at the mills supplying this district. No changes elsewhere.

Common Brick—Down in Boston, Minneapolis, Cincinnati, Detroit, New Orleans, Dallas and Kansas City.

Hollow Tile—Prices are again quoted for New York and the Perth Amboy, N. J., factory. Down in Boston, Minneapolis and New Orleans.

Steel—No changes on structurals or reinforcing. Mill orders light, as is warehouse business also. Black and galvanized sheets a little lower in New York, unchanged elsewhere. Steel interests in Chicago refuse to supply quotations on triangle mesh.

Lumber—Despite a further decline in New York a temporary bottom appears to have been reached in the lumber market in general. Increases in Cincinnati, and revisions in both directions in Minneapolis, down in Baltimore.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$28.75	$45.60
Northern Basic	26.52	42.80
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	27.82	46.80
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*34.26*	49.70
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	24.00	42.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*26.26**	46.00*
Virginia No. 2 (silicon 2.25 @ 2.75)	*27.00**	45.00*
Basic	*25.00*†	44.50†
Grey Forge	*25.00**	43.50*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*23.00*	43.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*29.67*	47.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*26.46*	45.65
Basic	*24.46*	44.40
Bessemer	*26.96*	44.90

*F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$45.00	$45.00		$45.00
Standard openhearth rails	47.00	47.00	$47.50	47.00
Light rails, 8 to 10 lb.	2.50*	3.75*		2.45@3.00*
Light rails, 12 to 14 lb.	2.25*	3.75*	2.20*	2.40@2.95*
Light rails, 25 to 45 lb.	2.20*	3.75*	2.20*	2.32@2.85*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8 Ft. 6 In.
Chicago, White Oak	$1.45@$1.55	$1.55@$1.65
Chicago, Hardwood and Red Oak	*1.50@1.40*	*1.50@1.55*
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco Green Douglas Fir	.80	1.12
San Francisco, Empty Cell Creosoted, Douglas Fir	1.76	2.48

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Sap Cypress
Grade 3	$1.35	$1.20	$1.10
Grade 2	1.25	1.10	1.00
Grade 1	1.15	1.00	.90

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$3.30	$4.00	$3.40	[illegible]	[illegible]
Track bolts	4.35	6.00	4.60	[illegible]	[illegible]
Standard section angle bars	2.50	3.50	2.75	[illegible]	4.50

PIPE

WROUGHT PIPE—The following discounts are to dealers for carload lots on the Pittsburgh basing point of April 15, 1921:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62½	50	1 to 3	43½	18½
			1 to 1½	35½	20½

LAP WELD

2	54	38½	2	42½	
2½ to 6	58	46	2½ to 6	46	16½
7 to 12	54	41	7 to 12	33	20½
13 and 14	45		7 to 12	29	16½

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60½	49	1 to 1½	35½	21½
2 to 3	61½	50			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	52½	41	2	31½	18½
2½ to 4	56½	45	2½ to 4	34½	22½
4½ to 6	55½	44	4½ to 6	33½	21½
7 to 8	50½	37	7 to 8	24½	12½
9 to 12	45½	32	9 to 12	19½	7½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	54%	62½%	50½%
3½ to 6 in. lap welded	49%	58½%	46½%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	40%	50%	36½%
3½ to 6 in lap welded	39%	46%	32½%

Malleable fittings, Class B and C, from New York stock sell at *net* list prices. Cast iron, standard sizes, 20—5% off

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	$68.30	$79.30	$60.00	$69.10	$60.00	$90.90
6 in. and over	*58.30*	76.30	55.00	64.10	55.00	85.90

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$50.00	$35.00	$60.00	$50.00	.....	$55.00
4	60.00	51.00	60.00	60.00	$90.00	65.00
5	90.00	65.00	85.00	80.00	115.00	84.00
6	115.00	90.00	*85.00*	100.00	150.00	110.00
8	185.00	130.00	*100.00*	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.22	$0.132		0.13	$0.135	$0.13	
4	.22	.132	$0.11	.13	.135	.1625	$0.18
5	.34	.198		.182	.2025	.195	.165
6	.34	.198	0.165	.182	.2025	.2275	.25
8	.52	.308	.275	.26	.315	.325	.35
10	.78	.462	.355	.364	.4725	.455	
12	1.00	.594	.4675	.468	.6075	.585	.80
15	1.50	.792	.6875	.81	.81	.975	
18	2.18	1.10	.935	1.134	1.125	1.365	
20	2.60	1.32	1.2375	1.512	1.35		
22	3.50	1.98			1.80		
24	3.90		1.7875	1.944	2.025	2.34	2.40
27	.....			2.80	3.75	3.25	
30	.....		4.00	3.55	4.75	3.90	
33	.....			4.35	5.50		
36	.....			4.75	6.00		
	3	5	8		12	24	36
Boston	$0.138	$0.207	$0.322		$0.625	$2.08	$5.45
Minneapolis	.....		.42		.77	2.45	5.60
Denver	.....	.15	.30		.50	1.95	
Seattle	.....		.40		.80	2.88	
Los Angeles	.11*	.165*	.27		.49	1.65	
New Orleans	.....		.26		.476	1.82	
Cincinnati	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Memphis	.11*	.165*	.27		.4675	1.7875	
Montreal, *delivered*	.30*	.45*	.85		1.35	4.50	6.30
Detroit	.175	[illegible]	[illegible]		.6345	2.25	$6.375
Dallas	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Baltimore, *delivered*		.28	.44		.86	2.84	

*4-in., 6-in., 9-in., 30-in. respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—The following are prices per gallon in tank cars (8,000 gal. minimum) f.o.b. places named:

	Current	One Year Ago
Texas, 40-50% asphalt, f.o.b. terminals	$[illegible]	$0.13
Texas, 60-65% asphalt, f.o.b. terminals	[illegible]	.13
Texas, Heavy, f.o.b. terminals	[illegible]	.13
Texas, [illegible] f.o.b. terminals	[illegible]	.14
New York, [illegible] asphalt, f.o.b. terminals	.08	.10
St. Louis, 40-50% asphalt, f.o.b. [illegible]	[illegible]	[illegible]
Chicago, 40-50% asphalt	.06	.08
Chicago, 60-65% asphalt	.06	.08
Chicago, 40-50% asphalt	.10	.07
Chicago, [illegible] asphalt	.13	.08
Chicago, [illegible] asphalt	.15	.10
San Francisco, [illegible]	15.00	2.25

* [illegible] $21.75 [illegible]

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums, and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$28.00	$16.00
Boston	No quotations	
Chicago	28.50	21.00
San Francisco	21.50	15.00
Dallas	35.00	27.00
Seattle	27.50	....
Denver	....	50@70
Minneapolis	....	25.93
St. Louis	sold out for 1921	
Baltimore	40.00	....
Los Angeles, *at factory*	22.15	15.00
Montreal	28.00	21.00
Atlanta	33.00	....
Detroit (petroleum asphalt)	24.50	20.00
Cincinnati	37.50	31.00
Maurer, N. J. (asphalt)	27@38	....
Maurer, N. J. (asphalt cement)	29@36	25@31

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite	No quotations
Chicago	About 4x8x4 dressed	$3.35 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	65.00 per M
Boston	5-in. granite	4.20 sq.yd.
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107.00 per M
Baltimore	Granite	2.25 sq.yd.
Montreal	Granite	130.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	4.50 sq.yd.
St. Louis	4x8x4 dressed	3.40 sq.yd.
	4x84x common	3.00 sq.yd.
Kansas City	No. 1 Granite	2.90@2.95 sq.yd.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	26	sq.ft.
	Queens, 5 ft.	26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.70	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 70c. for 5x16 in., 80c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.51
New York	3½	16	2.78
Boston	3	16	3.45
Chicago	4	16	3.75@4.00
Chicago	3½	16	3.25@3.50
St. Louis	3½	16	3.05
St. Louis	4	16	3.50
Seattle	4	16	Off market
Minneapolis	3½	16	2.36
Atlanta	3½	16	2.30
New Orleans	3	16	2.99
New Orleans	3½	16	3.42
New Orleans	4	16	3.85
Dallas	4	18	3.90
Baltimore	3½	16	3.75
Montreal *delivered*	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	3.30
Kansas City	4	16	2.40

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.50	$3.00	$2.50	$2.50	$1.25	$1.50
Denver	2.00	1.80	1.80	1.80	1.60	1.40
Chicago	2.25	2.15	2.25	2.15	2.25	2.15
St. Louis	1.55	1.78	1.60	1.82	1.60*	1.68
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas, *delivered*	3.50	2.50	4.00	2.50	3.00	2.00
Minneapolis, *at pit*	2.00	1.50	....	1.35	1.00	.75
Cincinnati	2.36	....	2.36	1.55	1.86	1.50
San Francisco	2.25	1.50	2.25	1.50	1.50	1.50
Boston, per ton	2.65	3.00	2.65	3.00	2.00	3.00
New Orleans	2.85	3.00	....	....	1.65	1.40
Los Angeles, per ton	1.45†	1.25	1.45†	1.25	1.33†	1.15
Atlanta, per ton	2.80	2.25	....	2.25	1.62½	1.15
Detroit	2.50	2.50	2.50	2.00	2.50	1.85
Baltimore, per ton	1.40	1.40	1.60	1.60	.70	.80
Montreal, per ton	1.50	1.25	1.50	....	1.25	1.40
Birmingham	....	3.25	....	3.75	1.43	1.25

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.
† Freight from quarry to Los Angeles is 80c. per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.90@2.00	$1.90	$2.15	$2.15
Chicago	2.50	2.15	2.50	2.15
St. Louis *delivered*	2.60*	1.90	2.60*	1.90
Dallas	2.80	3.50	2.80	3.50
San Francisco	2.25	1.50	2.25	1.50
Boston, *delivered*	3.00*	3.00	3.00*	3.00
Minneapolis, *at plant*	2.00	1.50	2.25	1.60
Kansas City†	1.25	2.35	1.40	2.35
Denver	....	3.75	....	3.75
Seattle *delivered*	3.50	3.50	3.50	3.50
Atlanta	2.50*	3.10	....	....
Cincinnati *delivered*	3.24	....	3.24	1.65
Los Angeles	1.70*	1.60	1.80*	1.70
Detroit	2.00*	1.75	2.00*	1.75
Baltimore	1.75*	1.60	1.75*	2.00
Montreal	2.00*	1.75	2.10*	2.00

*Per ton. †F.o.b. Joplin, Mo.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Lebanon or Bethlehem, Pa.	$1.00	$1.00	$2.50	$0.90
Easton or Catasaqua, Pa.	1.00	1.00	2.00	.90
Buffalo, N. Y. and Erie, Pa.	1.25	1.25	2.25	1.25
Emporium, Pa.	1.25	1.25		1.25
East Canaan, Conn.	1.25	1.35	4.00	1.10
Birmingham, Ala.	1.25	1.25	2.05	1.00
Toledo, Ohio	1.50	1.50	2.35	.
Atlanta, Ga.	....	2.40	...	.
Eastern Pennsylvania and New Jersey	1.20	1.20	2.50	.90
Western Pennsylvania and New Jersey	1.25	1.25	2.50	1.25

Birmingham, f.o.b. pit $1.15 (or $2.75 per cu. yd. on site)

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per 200-Lb. Barrel Finishing	Lump, per 200-Lb. Barrel Common
New York	$21.00	$19.00	$3.50* – at plant –	$3.30*
Chicago	20.00	..	....	1.75
St. Louis	26.00	20.00	....	2.50*
Boston	25.25	21.25	3.50	3.25
Dallas	27.50	25.00	....	3.00†
Cincinnati	17.60	16.00	....	13.10‡
San Francisco	25.40	22.00	....	2.25
Minneapolis	29.00	22.00 (white)	1.80	1.50
Denver	..	3.20 (bbl.)	1.00 (bu.)	..
Detroit	22.00	19.00	2.00†	1.80†
Seattle	27.00	..	3.25	..
Los Angeles	..	30.00	3.00*	3.00*
Baltimore	22.25	17.50	....	12.75‡
Montreal	30.00	..	15.00‡	..
Atlanta	22.50	18.00	1.60	1.40
New Orleans	..	17.00	2.75	2.00

* 300-lb. barrels. † Per 180-lb. barrel. ‡ Per ton.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$1.50
Kansas City (Ft. Scott)	1.60	1.60
New Orleans	3.36	3.36
Atlanta (Magnolia)	11.00 ton	1.00
Cincinnati (Louisville)	2.75	2.85
Boston (Rosendale)	3.00	....

PORTLAND CEMENT—Current prices are for barrels in carload lots, with net bags, to contractors:

	Current (Without Bags)	One Month Ago (Without Bags)	One Year Ago Without Bags
New York (delivered)	$2.80	$2.90	$3.30
New York, alongside dock to dealers	2.40	2.40	2.35
Jersey City (delivered)	2.89	2.64	2.47
Boston	2.86	2.86	2.60
Chicago	2.17	2.17	2.15
Pittsburgh	2.17	2.17	2.20
Cleveland	2.43	2.43	2.42
Detroit	2.43	2.43	2.28
Indianapolis	2.43	2.43	2.42
Toledo	2.49	2.49	2.28
Milwaukee	2.39	2.39	2.20
Duluth	2.10	2.10	2.20
Peoria	2.45	2.45	2.32
Cedar Rapids	2.51	2.51	2.43
Davenport	2.47	2.47	2.38
St. Louis	2.60	2.60	3.05
San Francisco	3.09	3.09	2.63
New Orleans	3.36	3.36	2.96
Minneapolis (delivered)	2.41	2.41	2.22
Denver	3.10	3.10	2.82
Seattle	3.10	3.10	3.03
Dallas	2.60	2.60	2.15
Atlanta	2.80	2.75	2.70
Cincinnati	2.57	2.57	2.90
Los Angeles	3.21	3.21	3.10
Baltimore (del.) dray lead lots	3.58	2.58	3.85
Detroit	2.43	2.43	....
Birmingham	3.05		....
Kansas City	2.55		2.56
Montreal	3.44	3.44	3.48

NOTE—Bags 10c. each, 40c. per bbl.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH by 4-INCH MESH

Style Number	Weight in Pounds	Pittsburgh, Mill	Chicago	Dallas	San Francisco
032	0.022	$0.87	....	$1.15	$1.38
049	0.028	1.11	....	1.46	1.74
068	0.035	1.35	....	1.80	2.14
093	0.045	1.73	....	2.30	2.75
126	0.057	2.14	....	2.86	3.42
153	0.068	2.55	....	3.40	....
180	0.078	2.93	....	3.93	....
245	0.103	3.86	....	5.15	....
287	0.119	4.46	....	5.96	7.16
336	0.138	5.18	....	7.32	....
395	0.160	6.00	....	8.00	....
		PAVING			
036P	0.017	$0.66	....	$0.88	....
053P	0.024	0.94	....	1.24	....
072P	0.031	1.18	....	1.57	....
097P	0.040	1.52	....	2.02	....
049R	0.024	0.94	....	1.24	....
067R	0.031	1.18	....	1.57	....
089R	0.040	1.52	....	2.02	....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 10% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd for painted are as follows:

Gage	Weight	New York Delivered	Chicago	St Louis	San Francisco	Dallas
27	233	$25 00	$27.50	$29 35	$34 20	$31 55
26	250	26 00	28.90	29 35	.	33.30
25	300	27 00	31.15	32 00		36.00
24	340	28 00	33.10	33 90	42 70	37.45
22	450	31.00	.....	.		43.30

BARS, CONCRETE REINFORCING—Current quotations per 100 lb:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Warehouse, Uncut: New York	Birmingham Mill	Chicago	St Louis	Dallas	San Francisco
¼ and larger	$2 10	$3 38	$2 35	$3.13	$3 22½	$3 75	$2 35
⅜ and larger	2.15	3 43	2 50	3.17	3.27½	3 80	2 40
½ and larger	2 20	3 48	2 50	3.23	3 32½	3 85	2 45
⅝ and larger	2 35	3 53	2 50	3 38	3 47½	4 00	2 60
¾ and larger	2.60	3.88	2.50	3.83	3.52½	4 45	2 85

*Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St Louis	Dallas
¼ in and larger	$2 35	$2 25	$4.25	¾	$2 65	$2 50	$3 40
⅜	2 40	2.30	4 30	⅞	2.65	2 75	3 45
½	2 40	2.35	....	1	....	....	3.50

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del)	$18 40	$18 40	$33 00	$47 25	$53 50
New York (at dock)	14@15	15 00	25 00		
Chicago	12 00	12 00	14 00	34 00	
St. Louis, salmon	15 00†	15 00	16 00		
Denver, salmon	14 00	14 00	17 00		
Dallas	15 00	16 00	24 00	44 00	
San Francisco	18 00	18 00	15 00		44 38
Los Angeles	15 50	15 00	13 50	(not used)	
Boston (del)	21.00	21 75	32 00	49 25	57 25
Minneapolis (del)	17@18	18 00	21 00	37 00	43 00
Kansas City	17 50		22 00		
Seattle	19 00	19 00	15 00	48 00	53 50
Cincinnati	19 00	20 00	24 00	50 00	
Montreal (del)	18 00	18 00	16 00	100 00	120 00
Detroit	18 50	18 00	23 00	50 00	55 00
Baltimore (del)	25 00	25 00	20 00	40 00‡	44 00‡
Atlanta	12 50	12 00		40.00	
New Orleans	14 00	17 50	24 50		

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †Hard brick $20 50 in St. Louis. ‡ Vitrified, f.o.b. plant, Baltimore

HOLLOW TILE—Price per block in carload lots for hollow building tile:

	New York: Current on Trucks*	One Year Ago	Chicago	St Louis building partition	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0 1190	$0 11475	$0 1095	$0 085	$0 145	$0 1[illegible]
6x12x12	1345	153	1642	[illegible]	21	1[illegible]
8x12x12	1704	204	1971	[illegible]	29	1[illegible]
10x12x12	2202		2463	1 26		[illegible]
12x12x12	2587		2956	2 66	1 70*	[illegible]

* per off for cash

	4x12x12	8x12x12	12x12x12
Boston	$0 1102	$0 [illegible]	$0 [illegible]
Minneapolis	.084	.161	[illegible]
[illegible]	.088	[illegible]	[illegible]
Cincinnati	069	148	[illegible]
Kansas City	.115	.207	
Denver	09	16	23
Seattle	13	175	30
Los Angeles Factory	11	192	23
New Orleans	[illegible]	[illegible]	3700
Detroit	1042	1953	2779
Montreal	29	[illegible]	55
Baltimore	16	27	45
Atlanta	08@[illegible]	175	
Dallas	11		

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	New York (del.)	Birmingham	Dallas	St. Louis	Chicago (del.)	San Francisco
Beams, 3 to 15 in	$2.20	$3.33	$2.20	$4 50	$3 32½	$3.23	$4 35
Channel, 3 to 15 in	2 20	3 33	2 20	4.50	3.32½	3.23	4 35
Angles, 3 to 6 in., ¼ in. thick	2.20	3.33	2 20	4 50	3 32½	3.23	4 35
Tees, 3 in. and larger	2.20	3.33	2 20	4 50	3 32½	3.23	4 35
Plates	2 40	3 33	2 20	4 50	3 32½	3.23	4 50

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York: Current	One Yr. Ago	Warehouse: Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3 70	$4 65	$6 00	$4 88	$4.97½	$6.40	$5 80

CONE HEAD BOILER

¾ in. and larger	3 80	4 75	7 10	4 98	5 07½	6.50	5.90
⅝ and ¾	3 95	4 90	7 25	5 13	5 22½	6.65	6 05
½ and 9/16	4 20	5 15	7 50	5 48	5 47½	7.00	6 30

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00@$3.25	$4.15	$5.25	$5.00	$4.10	$4.95
Cut	....	7.65	7.75	7.75	4.75	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2.15	$2.55	$3 00	$2.05	$2.45	$2 90
No. 2 grade	1.90	2.25	2.70	1.80	2.15	2.60

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $7.95 per square in carloads; $8.20 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices per ton f.o.b. New York:

Tar felt (14 lb. per square or 100-sq.ft. roll or 432 sq. f	$2 80
Tar pitch (in 400-lb. bbl.) per 100 lb.	2 10
Asphalt pitch (in barrels) per ton	39 50
Asphalt felt (light) per ton	80 50
Asphalt felt (heavy) per ton	84 50

SHEETS—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$3 10	$4 22½	$4 13	$6 00	$4 25
No. 12	3 15	4 27½	4 18	6.05	4 30
No. 14	3 20	4 32½	4 23	6 10	4 35
No. 16	3.30	4 42½	4 33	6.20	4 45
Black					
*Nos 18 and 20	3 85	5 30	5 20	6 80	4 80
*Nos 22 and 24	3 90	5 35	5 25	6 85	4 85
*No. 26	3 95	5 40	5 30	6 90	4.90
*No 28	4 00	5 50	5 40	7 00	5.00
Galvanized					
No. 10	4 00	5 50	5 70	[illegible]	5 60
No. 12	4 10	5 60	5 80	7 10	5 70
No. 14	4 25	5 60	5 80	7 25	5 85
Nos 17 to 21	4 40	5 90	6 10	7 40	6 15
Nos 22 and 24	4 55	6 05	6 25	7 55	6 30
Nos 25 and 26	4 70	6 20	6 30	7 70	6 45
No. 28	5 00	6 50	6 40	8 00	[illegible]

* For painted corrugated sheets add 30c. per 1000 lb. for 5 to 28 gage. 25c for 19 to 24 gage. For galvanized corrugated sheets add 15c. all gage.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl.)	$0 80	$1 73	$0 75	$1 78

WHITE AND RED LEAD—Base price per pound.

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Yr Ago Dry and In Oil
100-lb. keg	13 00	14 50	15 50	17 00	13 00	15 50
25 and 50-lb. kegs	13 25	14 75	15 75	17 25	13 25	15 75
12½-lb. keg	13 50	15 00	16 00	17 50	13 50	16 00
5-lb. cans	16 00	17 50	18 50	20 00	16 00	18 50
1-lb. cans	18 00	19 50	20 50	22 00	18 00	20 50

500 lb. lots less 10% discount; 2000 lb. lots less 10–2½% discount.

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

	Lumber Prices in Yards at San Francisco: 6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24 50	$25 00	$26 00	$28 00
3x6 and 8	25.50	26.00	27 00	29 00
4x4-6 and 8	26.00	27.00	28 00	29 50
3x10 and 12	26.00	27.00	28.00	30 00
3x14	26.50	27.50	28 50	30.50
4x10 and 12	26.00	27.00	28 00	30 00
4x14	27.00	28.00	29.00	31.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
†10	$25.50	$27 50	$28 50
6x14	27.00	29 00	29.50
8x10	25.50	27 50	28.50
3x14	27.00	29.00	29.50

New York, Chicago and St Louis

	Southern Pine: New York* 20 Ft. and Under	New York* 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x 4 to 8x8	$48 00	$48 00	$48 00	$49.00
3x10 to 10x10	48 00	49 00	50 00	51.00
3x12 to 12x12	48 00	44 00	52 00	53 00
3x14 to 14x14	48 00	49.00	57.00	58 00
3x16 to 16x16	55 00	56.00	62.00	63.00
3x18 to 18x18	67 00	68.00	66.00	67.00
4x20 to 20x20	.....	.....	69.00	70.00

* For long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis: Yellow pine, 22@24 ft long, 3 x 12@4 x 12, $42; 2 x 16, $53; 3 x 16 @ 4 x 16, $53; 6 x 10 @ 10 x 10, $37; 6 x 12@12 x 12, $41; 6 x 14@14 x 14, $45; 6 x 16@16 x 16, $51.

Over 24 ft—Add $1 for each additional 2 ft in length up to 30 ft for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20-Ft and Under: P.	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under: P.	Fir
Boston	$45.00	$53 00	$55 00	$50 00	$55 00	$56 00
Seattle		25 00	.....	.....		27 00
New Orleans	35 00	.....	.....	.....	38 00	.....
Baltimore	58 00		.....	.....	68 00	
Cincinnati	50 00	50 00	.....	.....	65 50	64 00
Montreal	78 00	85 00	68 00	78.00	78 00	100 00
Los Angeles	.....	47 00	46.00	.....	.....	49 00
Detroit		Quotations f.o.b mills only				
Denver	.....	37 25	.....	.....	.....	38 25
Minneapolis	43 00	48 00	34.00	.....	51.00	48 00
Atlanta	27 50	.....	.....	.....	40 00	
Dallas	35 00		.....	.....	40 00	
Kansas City	34 00	35 00	.....	.....	39 00	37.00

	1-In. Rough, 10 In. x 16 Ft. and Under: P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft.: P.	Fir
Boston	$45.00	$53 00	$50 00	$43 00	$48 00
Seattle		18 50	.....		
New Orleans	55 00	.....	.....	35 00	
Baltimore	42 50	.....	.....	40 00	
Cincinnati	70 00	80 00	.....	40 00	
Montreal	120.00	60.00	60 00	80 00	80 00
Los Angeles	.....	41.00	40 00	....	51 00
Denver	.....	31 25			29 25
Minneapolis	38 00	33 25	33 25	36 00	31 75
Atlanta	15.00			18 00	
Dallas		30 00		35.00	
Kansas City	36.00	30.00			

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Dimension and form lumber delivered on building site, $26 $28. For 8x8x20 and smaller, 85 per cent heart, $33; 12x12x20 and smaller, 85 per cent heart, $42; 1x10x16 and smaller, rough, $16; 2x10x16 t. and g., $22; f.o.b. mill.

Detroit—General quotations not available. Rough fir, 2 x 12 and 2 x 4, by 16 ft, $44; 3 x 12 x 16 ft., $46.50.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb, in carloads of 36,000 lb.

Baltimore	$0 33½	Detroit	$0 33
Birmingham	76½	Kansas City	81½
Boston	41½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66½†
Cincinnati	.33	Philadelphia	35
Cleveland	.24	St. Louis	47½
Denver	1.35*	St. Paul	.69½

Note—Add 3% transportation tax. * Minimum carload, 40,000 lb. Minimum carload, 50,000 lb, structural steel only, 80,000 lb for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEET PILING—The following price is base per 100 lb. f. o. b Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.55	$2.55	$2.55@$3.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York
Hercules red strand, all constructions	20%
Patent flattened strand, special and cast steel	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	22½%
Iron strand and iron tiller	5%
Galvanized iron rigging and guy rope	+12½%

San Francisco: Galvanized iron rigging and guy ropes +17½%; bright plow, 30% off.

Chicago: Plow steel, round strand, 30% off; flattened strand, 15%; cast steel, round strand, 17½%.

Western and California territory, 30% plow steel; +17½% galvanized iron rigging and guy rope

Montana, Idaho and Arizona, 25% plow steel; +22½% galvanized iron rigging and guy rope.

MANILA ROPE—For rope smaller than ⅝-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft., ½-in., 6; ⅝-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ⅝-in. and larger, in 1200-ft. coils:

Boston	$0 22	New Orleans	.19
New York	.18½	Los Angeles	.18½
Chicago	.21	Seattle	.20
Minneapolis	.22	St. Louis	.21
San Francisco	.19	Montreal	.30
Atlanta	.22	Detroit	.21
Denver	.23	Baltimore	.25
Cincinnati	.22	Kansas City	20½
Dallas	.29		

*780-ft. coils.

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb keg of black powder.

	Low Freezing 20%	Gelatin 40%	Gelatin 60%	Gelatin 80%	Black Powder
New York	.....	$0.3275	$0 3625	.....	
Boston	.225	2475	2825	$0.365	
Kansas City	.245	.28	315	.3575	$2.60
Seattle	.1825	.2025	2275	2950	2.60
Chicago	.2225	2425	2675	.335	2.50
Minneapolis	.2222	.2426	2682	.....	2.80
St Louis	245	.28	315	.3575	2.50
Denver	.2250	2550	.29	.3325	2.70
Dallas	.265*	29	.375	.....	2 90
Los Angeles	.22	27	32	.....	3.10
Atlanta	.2525	2875†	.3225	.3650	2 60
Baltimore	.2525	2875	3175	.365	2 50
Cincinnati	.2425	2625	.2875	.....	2.65
Montreal	.30	.32	.37	.38	4 10
New Orleans	.255	.275†	.300†	.....	2 80
Birmingham, delivered	.1575	.1925	.2275	.27	2 10

* 30 Per Cent. † Low freezing.

PILES—For spruce and plain pine piles, delivered New York, the price is as follows:

Spruce 10-in. butts, 5-in. tops, length 20-30 ft	$11 50
Spruce 12-in. butts, 6-in. tops, length 30-40 ft	10.50
Pine 12-in. butts, 6-in. tops, length 41-50 ft	13 75
Pine 14-in. butts, 6-in. tops, length 51-60 ft	22.50
Pine 14-in. butts, 6-in. tops, length 61-71 ft	25 25

	Dallas		St. Louis
6-in. x 20-ft	$4.60	6-in. x 30-ft	$7 90
		7-in. x 30-ft	10 10
6-in. x 30-ft	7.10	7-in. x 35-ft	15.55
		8-in. x 35-ft	16.55
8-in. x 30-ft	8 45	7-in. x 40-ft	16 05
		8-in. x 45-ft	27 05
8-in. x 35-ft	10 38	8-in. x 50-ft	28 05

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10.50	$10.25	$11.00
Stove plate	10 50	13 00	11 50
No. 1 machinery cast	17 50	13 75	15 00
Machine shop turnings	3.50	5.50	5.00
Cast borings	4.25	7.00	7.00
Railroad malleable cast	8.50	12.00	12.50
Re-rolling rails	10.00	13.00	13.00
Relaying rails	41.00	35.00	35.00

SHIP SPIKES—Current prices per 100 lb.

In.	San Francisco Galv.	San Francisco Black	Seattle Black
¾	$8 40	$5.40	$8 55
⅞	8 40	6 40	8 25
1	8 50	6 50	8 30

Pittsburgh base, $3 40@$3 65 per 100 lb.

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E. J. MEHREN Editor

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Storm and Flood

CENTRAL Colorado, flood stricken, is taking the toll of its victims as we go to press. Though loss of life and property destruction occurred mainly at Pueblo, second city of the state, the responsible causes involved a wide extent of territory, embracing much of the headwaters area of the Arkansas and the South Platte rivers. From present reports it appears that a large-area rainfall of great total depth was the originating cause of the flood. Such a storm visited Ohio and Indiana, in 1913, and in its devastation of the Miami valley cities it showed what damage may follow the conjunction of the enormous volumes of water represented by five to ten inches of precipitation extending over thousands of square miles. The engineering studies that followed the Miami flood showed these rainfalls to be rare, so rare indeed that we hardly have adequate data to measure the danger. If the detail reports show the Colorado storm to belong in this class of the epochal storms, it will add much to what we know about them, and through this better knowledge it will increase the effectiveness of the engineering works that must ultimately be the reliance against a recurrence of such flood disaster.

Engineers Recognized

THE Panama Canal is an engineering achievement, perhaps the best-known in the world today. For that reason the significance of the personnel of the just appointed Panama investigating commission may be lost by the general public. People are so accustomed to seeing engineers dealing with all projects on the Isthmus that most of them may not appreciate that the subject to be studied by the new board is one of administration or in the words of the preliminary report "how to make the Canal Zone more efficient and less expensive as a growing Government concern." The custom in the past too often has been to leave such questions to the lawyer, politician and business man. The Secretary of War in this case recognizes the rights and abilities of the engineering profession for he has appointed to the commission three engineers, two from the Government service, one from private practice, beside one man from the allied public utility field. The appointment is one of the most helpful recent signs of the progress of the profession.

New Outlook for Highway Thought

THE conference on highway traffic regulation held at Yale University two weeks ago, as described in the news columns of the last issue, emphasized the need for a new kind of thinking by state highway and municipal officials. Organized primarily to stimulate public interest in the general subject, with a view to securing more rational and effective legislation, a higher degree of public safety and a wise expenditure of road building funds, the meeting served the further end of indicating the enlarged scope of the problem which the highway administrator of today is facing. That problem, clearly reflected in the formal papers and the discussions at the conference, extends far beyond the narrow limits of design and construction details, to which engineers have been devoting their main effort during recent years, and reaches out into new fields of highway transport economics. In places this trend has been sensed and useful work is being done in studying volume and character of traffic as a basis for planning the location and type of new routes or the reconstruction of old ones, road classification and the designation of highways to form an interconnected state system, and motor vehicle legislation based on reasonable requirements as to weight, speed, and license fee, and similar topics. By and large, however, the great opportunity now at hand for the engineer to assume a position of leadership in the nation's thinking on highway matters and to mold road building policies along lines sound financially as well as technically is not being grasped. The country is just awakening to the importance of the highway as an essential agency in our industrial life. We have been passing through a period of road "boosting." Amid the clamor of the propagandists the highway engineer has not been heard. It is now his time to talk, and if we sense conditions correctly, the country, wearied with the band-wagon methods of "drives" for all manner of projects, is in a mood to grant the engineer a respectful audience, if he has a real message to deliver.

Governmental Co-ordination!

NEWS reports from Washington this week state that despite early opposition the Senate has authorized $35,000 for "scientific and technologic investigations concerning heavy clay products, cement, feldspar, slate and other non-metallics." This looks like characteristic Governmental lack of co-ordination. The sum is not very great but why divert it to another bureau, when the Bureau of Standards is already engaged in such studies? Some one should explain why two or three different branches of the Government should each be spending small amounts on cements and clays.

A Chance for Mare Island

POLITICAL rather than engineering considerations acted to defeat the initial appropriation for a huge naval base at Alameda, Cal., on the east shore of San Francisco Bay, but if the project is dead for this term of Congress it is to be hoped that in its revival the engineering factors will be more governing than they were in the selection of the site by the joint congressional committee. The relative advantages of Mare Island, where the yard now is, and the new sites on the Bay were stated in *Engineering News-Record*, Dec. 27,

1920, and it was then pointed out that the scrapping of Mare Island meant the virtual throwing away of millions of dollars in existing plant. This would be extravagant enough in ordinary times; just now it is almost criminal. If the Pacific Coast feels so strongly the need of additional naval insurance, it would do well to urge upon Congress the saving that would result if Mare Island were substituted for the site farther south on the bay.

Fortunate America

AMERICAN index numbers comparing present price conditions with those of 1913 range from 150 to 220, that is, they show increases of 50 to 120 per cent. If the United States had not entered the war, or if, in fact, the war had not occurred, it is probable that prices now would be at least 30 per cent higher than in 1913. This is indicated by the trends. Since the panic year of 1907 the cost of living has been rising, but it was the war that destroyed "normalcy" in this country, as elsewhere. Despite the recent improvement in business, the hopeful outlook and the determined effort that is being made to stabilize American industry, business conditions in the United States are still unsatisfactory. Both wholesale and retail prices have fallen sharply in the last four months. Nevertheless, the cost of living is still too high and the number of unemployed a serious factor. Facing the situation, it is as easy to be reasonably pessimistic. No special gift of sight is needed to see the cloud, but there is also the customary silver lining. For a contrast note the business conditions abroad. An index number of 200 gives occasion for congratulation, when compared with the index numbers of European countries. Italy's index number for wholesale prices in March, just received in this country, is 604 as compared with 1913, and 760.46 when referred to the old basis of 1901-1905. This means that present wholesale prices in Italy are approximately six times as high as in 1913. Conditions are better in England and France, it is true, but far worse in Germany and the remnants of Austria-Hungary. Contemplation of such a state of affairs demonstrates that the silver lining of American business is very bright indeed.

Freight Rates

WITH prices of construction materials coming down, and with labor being "deflated" in many sections of the country, stationary freight rates act as a counterweight against probable prosperity. In *Engineering News-Record* of March 3, p. 402, it was shown that the rates on finished steel products from Pittsburgh to New York or Chicago are 138 per cent in excess of those in effect in 1913. The base mill price of structural shapes is $2.20 per 100 lb., and the freight to either point is 38c. or 17 per cent of this price. In 1913, structurals cost $1.50, the freight being 16c. or about 10½ per cent. Proportioned on the 1913 basis, present freights would be not more than 24c. This would mean a reduction in carrying charges of $1,400 per 1,000 net tons. High freight rates are of course not confined to construction materials. They apply universally, to the detriment of all business. The car shortage of six months ago is not forgotten; it is made the more memorable by the fact that at present some half-million freight cars are lying idle. Senator Capper recently called attention to this situation, warning the railroads that unless a "live-and-let-live" policy were adopted by them, a return to government operation was inevitable. He stated that until a few weeks ago the chief railroad system in the United States was losing $250,000 per day in reduced traffic. "It is expensive for everybody," he said. "The way out is to encourage the people to use the railroads, by making it possible for them to ship goods and to travel; to give business a chance to create more business." To which statement we heartily agree—but we add, "Railroad wages must first be reduced, and the monstrous national agreements wiped out." The railroads surely would not be helping the country by throwing themselves into receivers' hands.

Change in Engineering Emphasis

CERTAIN types of engineering problems have at times overshadowed the engineering field. The development of waterways was once, in this country at least, the leading civil-engineering problem. At another time the railroads absorbed engineering attention. Then came the steel bridge, the structural-steel skyscraper, water purification, sewage disposal and reinforced concrete.

The present is, in this respect, no different than the past, but the interesting feature now is that we have swung back to a type of problem that was dominant in the days of the country's meager physical development. We are again in an era of transportation dominance—railroad terminals, highways, port developments and city transit are clearly the leading engineering questions.

The highway problem repeats the railroad history of former times. The day of building new roads is nearly passed. We are in the second stage, strengthening the roads that they may bear the increased traffic, just as, after the first period of railroad building, there set in an era of roadbed and bridge reconstruction.

In terminal work and in city transit the problems are somewhat different. The developments of the past have led to serious congestion, and our efforts here relate to the curing of conditions which the work of former days has brought upon us. In accomplishing a certain result, that of making city life possible and attractive—through water and sewerage, good paving and electric light—we have created new situations that urgently press for solution.

The dominance of these transportation problems at the minute does not, of course, detract from the importance to the community of other lines of engineering. They do indicate, however, directions in which we may expect rapid development as well as fields that are particularly attractive for the employment of engineering initiative and ability.

A Tax on Construction

EVERY contractor and engineer knows how union working rules hinder construction progress and add to construction costs. Jurisdictional disputes and trade dictation are the bane of the builder's existence. It is rarely, though, that the extent of these union practices are set forth as completely or as clearly as has been done by Col. C. R. Gow in the paper which is abstracted on another page. It would take a decidedly partisan mind to find complete justification for the unions in the face of so detailed an indictment.

Doubtless the working rules have grown up as an honest effort to meet familiar abuses on the part of the

employer and to insure the greatest good to the greatest number of workmen, but they long ago overstepped the bounds of economic propriety and they now include many stipulations looking only toward immediate gain to certain individual workers. Many of them, such as the ban on paint sprayers and the insistence on hand-cutting of pipe, are of precisely the same order of intelligence as the early efforts of the hand worker to prevent the introduction of machinery. Others, such as the requirement that iron workers place reinforcement, in a different way perpetuate the same economic fallacy. The result is sabotage, of just as vicious a nature as though the worker deliberately soldiered or broke machinery in order to reduce production.

Individual resentment on the part of the employer is not going to do much toward remedying this evil, for to the unionist these rules are the very essence of his creed and any attack on them is to him an attack on the basic principles of unionism. Yet it is so obvious that they should be not allowed to persist in their present radical form that concerted effort on the part of engineers and contractors should be made to present to the union leaders the specific faults they evidence. Many of the employers of construction labor sympathize with the aims of union labor and appreciate the advantages it can bring to construction in general. Such men ought to be able to persuade the clearer thinkers in union circles of the evils, both specific and general, of such rules as Colonel Gow cites. Engineering societies have hitherto refrained from any excursions into the labor controversy. Is not the time ripe for the engineers to break a new path in their activities and to try with the aid of the now well established Associated General Contractors to bring about some amelioration of these rules, which are so great a tax on construction and which therefore, in the long run, penalize alike the contractor, the engineer, the workman, and the public?

Wildcatting in Irrigation

SO MUCH publicity has been given to a scheme for a state-wide development of water resources in California, called the Marshall plan, that anyone interested in irrigation is likely to have heard a great deal about it. Because of the methods used in securing widespread publicity for the scheme, *Engineering News-Record* feels warranted in devoting space (p. 994) to an outline of the plan and a résumé of views held by those who oppose its adoption.

California now has excellent irrigation laws. They have frequently been copied in forming new water codes for other western states. In addition to the numerous irrigation districts operating under these laws, there are many proposed or partially completed irrigation and reclamation organizations in various stages of advancement. Most of these are well-considered ventures which should be encouraged in financing and carrying out their plans. Other developments of the same sort should be proposed and carried out from time to time. There is yet much land in California capable of being irrigated from near-by sources. Development is delayed chiefly by the difficulty of getting the necessary capital.

The organization formed to conduct a campaign for the Marshall plan began by securing widespread publicity in country newspapers and holding mass meetings where the future of a great state-wide irrigation system could be pictured in glowing colors. These methods do not make a favorable impression in financial circles, and it is there that confidence must be established before any great undertaking can be launched. Unfortunately they do attract a popular following. Public sentiment is credulous. The lay mind is prone to accept any "engineer" as authority on any and all engineering matters. But so long as comparatively inexpensive irrigation works such as are necessary in developing near-by sources can be financed only gradually, there is little prospect for consummating a development that, at best, would require the outlay of hundreds of millions of dollars.

Fundamentally the idea of making further studies of unknown water resources is good. It is also very desirable that all irrigation interests should work in harmony and study the possibilities of more efficient use of the waters of the state. These features of the Marshall plan are commendable. Beyond that there seems to be little in its favor. The director of the United States Reclamation Service has twice declared that neither the Reclamation Service nor anyone connected with it has anything to do with the scheme; engineering organizations in California have condemned it, and the best irrigation engineers of that state, who are vigorously opposing it, are citing numerous instances where it has delayed much needed development work.

In so far as the organization campaigning for the Marshall plan is stirring up a popular sentiment in defiance of the opinion of the best authorities on irrigation development in California; in so far as this sentiment may retard irrigation developments and unduly inflate the value of arid land in anticipation of an irrigation development whose practicability has yet to be shown; just so far, *Engineering News-Record* believes, will this activity be harmful to California.

Recently, since vigorous opposition has arisen, the Marshall plan campaign has been carried into new fields and its literature has appeared in many eastern newspapers. Because the campaign is skillfully managed it will doubtless attract some capital to investment in California land and will continue to secure subscriptions for the expenses of the campaign. If it develops that the Marshall plan is wholly impracticable, eastern speculation in arid lands dependent upon it will probably not retard later irrigation development in California so much as would speculation in those lands with the limited capital available locally, but in the long run the good name of the state would suffer more from the eastern speculation.

There is a vast difference between an engineering report on the general features of a project, such as a board of experts could prepare with little delay, and a half million dollar investigation such as the Marshall plan campaign aims to secure, or even the $200,000 study authorized by the bill which has just passed the Legislature. These sums are so large and the studies involved in their expenditure so pretentious as to imply that the project is feasible and that the matter has reached a stage where alternate methods and programs should be compared. Obviously, this is not the case, but the publicity campaign having been successful enough to lead the Legislature to appropriate $200,000, it should be the duty of all engineers in the state to see that the funds, if authorized by the Governor, be used not to boost any chimerical scheme, such as that proposed by Mr. Marshall, but that a sane, impartial study of California's water resources be made.

Clam-Shell Dredges of Large Size on the Sacramento

Use of 240-Ft. Boom Greatly Increases Range of Operations — Improvements Recently Made in Design of Hull and Rigging

NUMEROUS improvements in the design and construction of clam-shell dredges built in recent years for use in the Sacramento Valley in California, have materially extended the scope of canal and levee work that can be done with such equipment. Canals with a bottom width of 500 ft. have been constructed without rehandling any material. Modern dredges of this sort, with booms up to 240 ft. in length, operate buckets which carry as much as 8 cu.yd. of material. With only two cables through the sheaves at the end of the boom they perform the several operations of raising, lowering, opening and closing the bucket as well as swinging the boom. The boom itself is not raised during the dredging operations but merely swings from side to side. Counterbalanced sheaves are used in place of "sister-sheaves" which wore the cable rapidly, ballast tanks make it possible to swing the boom against high winds and by giving just enough forward overhang to the A-frame to offset the list of the hull, better control of the boom is secured. Descriptions of some of the earlier and smaller dredges of this type appear in *Engineering News*, Sept. 4, 1913, p. 457, and *The Engineering Record*, Feb. 20, 1915, p. 227.

There are certain limitations on this type of dredge. For example, it is impractical to deliver full loads to the right and left banks of the channel alternately, and the bucket ordinarily has to be dumped from the level at which its elevation was arrested (though of course the boom can be swung meantime). However, these points are not considered disadvantageous for most of the levee and canal work in the Sacramento Valley, and the simplicity of the rig required when these limitations are imposed makes it possible to use much longer booms than would otherwise be feasible.

The two lines which operate the bucket, known as the port and starboard lines respectively, run from their drums to sheaves on opposite sides of the A-frame near the bottom, thus having the advantage of leverage equal to nearly half the dredge width for swinging the boom. When material is being delivered to the port side of the dredge, the port line closes the bucket and, as the jaws meet, becomes a hoisting line, at the same time starting the boom swinging to port. When the bucket has reached the desired elevation, a decrease, though not a release, of the tension in the line arrests its vertical motion. Even a slight tension in the line, however, coupled with the list of the hull, is sufficient to keep the boom swinging to port, and this swing continues until arrested by tension in the starboard line. When the pull in the starboard line is increased sufficiently, together with a release of the port line, the jaws of the bucket are pulled apart and the load is dumped. Increasing still more the tension in the starboard line pulls the boom back toward its central position and there both lines are released to allow the bucket to drop again for its load. In well-regulated operation, the bucket is handled so that it rises diagonally, closely paralleling the water slope of the levee. In fact, a skillful lever man will smooth and compact the river slope to a very considerable extent by dragging over it the dripping, loaded bucket.

THE "NEPTUNE," SHOWING 240-FOOT BOOM AND SUPERSTRUCTURE DESIGN

It is impracticable to stop a loaded bucket and hold it stationary, in fact, it can be done only by an experi-

enced operator who can accurately control and balance the tensions on the two lines. When the dredge is to be changed over from port to starboard delivery, the bucket connections of the port and starboard lines are interchanged—an operation which requires two or three hours on the larger dredges.

With this cable arrangement a considerable element of safety for the boom is introduced by the fact that if the cable is jerked suddenly for any reason, the bucket will simply be raised and the shock will not be sustained by the boom. In order that this safeguard may be operative, however, it is necessary that there be a considerable space between the bucket and the end of the boom. Hence, as a matter of caution, the bucket is never drawn up close to the boom end.

THIS BUCKET HAS A CAPACITY OF 6 CU.YD. AND OFTEN HANDLES 8 CU.YD.
(Note arrangement of control lines, also leverage for closing jaws)

The strains that come on the boom call for an elasticity which is believed to preclude the use of any material other than wood. The longer booms are made up of 24 x 28-in. timbers in 110-ft. sections spliced with bolted, scarfed joints 27 ft. long. The principal member in the system of trussing used to strengthen the boom against lateral bending is a cable that passes through saddles on the ends of cross-arm struts. By being free to slip on these struts the bracing system is given the desired flexibility. Before the bucket is attached, the guys which support the boom in a vertical plane are tightened until the end of the boom is raised about 2 ft. This compensates for the bending of the boom caused by the weight of the bucket.

Determination of the proper amount of forward overhang of the A-frame is an important feature in the design of these dredges. Factors that enter into this are boom length, list of the hull for various loads and positions of the boom, and the center of gravity of the dredge. The overhang of the A-frame results in a tendency to raise the end of the boom as it is swung. (To make this obvious imagine an excessive A-frame overhang.) The list of the hull that follows the swing of the boom, on the other hand, tends to lower the boom end. These two opposite tendencies are balanced to secure the desired results. That is, by plotting the several factors that are involved in the case of each particular dredge, it is possible to determine an amount of overhang such that as the loaded boom swings from center to side, the boom end moves in an almost horizontal plane. In a well-designed dredge of this type there is very little "flyback" of the bucket on emptying. The effect of the overhang is allowed to dominate the opposite effects of list just enough so that when port and starboard lines are both slack the boom tends to swing of its own accord to the central position. On the larger dredges the overhang is between 4 and 6 ft. The boom is made to swing through a central angle of 130 to 180 deg., according to the work for which the dredge is designed.

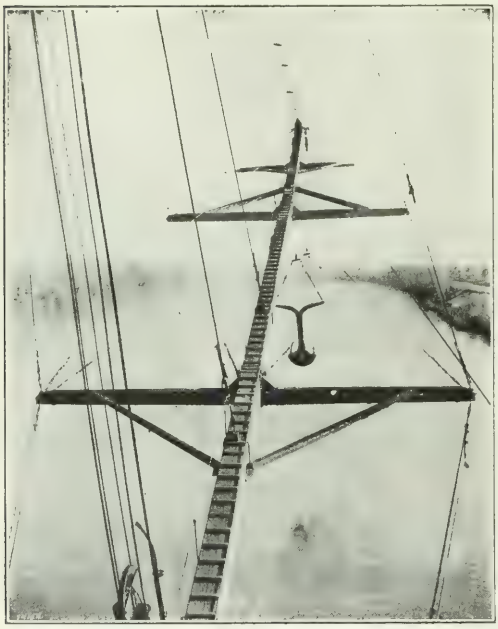
With a two-cable control, it was very difficult, if not impossible, to work the earlier types of dredges in the high winds which frequently prevail in the lower Sacramento Valley. A recent improvement, however, is the provision of water ballast tanks along both sides of the hull so that the hull can be listed either to port or to starboard so as to result, in combination with the overhang of the A-frame, in offsetting the effect of a side wind in retarding the swing of the boom.

Because of the wide range in position of the port and starboard cables for different positions of the boom, earlier dredges used what were called "sister-sheaves" for guiding them. A pair of these sheaves was attached to each side of the A-frame near its base and was to provide sheave action for the cable as much of the time as possible. In certain positions on each lift, however, the cable cut across the flange of one of the sheaves and caused very rapid wear. More recently, a single-counterbalanced sheave has been developed which is able to adjust itself to any position without causing more than one bend in the cable, thus very greatly increasing its life. In order to avoid the breakage and the consequent delay which occurs from worn cables, some dredge operators have formed the practice of cutting off a few feet of the cable at the outer or bucket end every few days, thus changing the point of maximum wear from time to time.

The following features of the dredge "Neptune" give an example of the latest practice in such equipment.

The hull of the "Neptune" is 70 x 150 ft. in plan and 13 ft. deep. Both steel and wood were used in the construction. It has three fore and aft and three

athwart-ships trusses, all of steel. In the longitudinal trusses the chords are made of 12-in. channels with 10-in. H-sections for struts and diagonals. In the cross trusses the chords are made of 12-in. channels with struts and diagonals of 6-in. H-sections. The side and bottom frames are made of 12-in. channels on 36-in. centers. The sides are made of $\frac{5}{8}$-in. plates. By making the bottom of wood, a cushion is provided in case the dredge strikes bottom. The A-frame and back-legs are of steel and are connected to the fore-and-aft trusses with gusset plates, thus greatly increasing the rigidity



LOOKING OUT THE BOOM FROM THE PILOT HOUSE

of the hull. The deck is made of wood and is cambered, both fore-and-aft and athwart-ships.

The top of the A-frame is 82 ft. above the deck and to its apex is attached the topping lift made up of 10 parts of $1\frac{3}{8}$ galvanized-steel cable. When swinging a full bucket the strain on this lift is about 110 tons. The bucket itself weighs 15 tons and carries a load of about 12 tons. The weight of the boom complete is about 12 tons.

When the boom has swung its maximum distance to one side with a full bucket, the load on the $3\frac{1}{2}$-in. hog rods, holding the A-frame, is from 145 to 160 tons with a corresponding compression load on the A-frame legs. The necessity for rigid construction is apparent from the fact that the bucket is swung from 30 to 35 times per hour and the dredges are worked 24 hours per day. The step plate at the lower end of the boom is designed to take a compression of 120 tons and a side pressure of a like amount. It has a steel center pin $10\frac{1}{2}$ in. in diameter and a base plate 5 ft. square. The gin sheaves on the end of the boom are 6 ft. in diameter, grooved for $1\frac{1}{2}$-in. cable and weigh with shackles about 4 tons.

The spuds are single pieces of timber, 36 x 36 in. in section and 70 ft. long, fitted with cast-steel points. In addition to the usual operation of the dredge by means of the spuds, the "Neptune" has a steam-operated fleeting gear with which the dredge can be moved forward any distance up to 9 ft. between swings of the boom. This is very useful in giving a smooth finish when "topping off" a levee.

The power equipment includes a 250-hp. oil-burning boiler which supplies steam for engines on the drums that operate the cables. The oil consumption is about 45,000 gal. per month. The port and starboard cables are $1\frac{1}{2}$ in. in diameter operated on a 4-ft. drum with frictions 9 ft. in diameter. Controls for all operating equipment are handled by the lever-man in the pilot house which is about 100 ft. away from the engines and 65 ft. above water level. There are also spud engines capable of raising all three spuds simultaneously. The displacement of the "Neptune" is 1,300 tons. Quarters are provided on board for 15 men, from which are made up three crews working 8-hour shifts. The superstructure is sheathed with asbestos-protected steel which serves the dual purpose of decreasing the fire risk and keeping down the interior temperature in the summer.

Levee Dimensions

With a machine of this size, the very large levees required in the Sacramento Valley are easily built. Typical dimensions for the larger levees in that district are as follows: Height about 25 ft., 1 to 3 slope and a 30-ft. berm on the river side and a 1 to 2 slope on the land side. During low water periods, to reach the rear edge of the levee crown, material must be placed about 175 ft. from the edge of the dredge hull.

For the most part dredges of this type are owned by dredging companies which lease them to the state, reclamation districts, etc., on the basis of a stated rate per working hour, that is, delays due to broken machinery, foggy weather, etc., are not paid for. The rate varies with the length of the boom, the size of the bucket and the reputation of the dredge as a producer, but depends chiefly on the length of the boom.

As an example of the cost of operating equipment of this sort, it may be stated that contracts with the United States Government in July, 1920, were as follows: For a dredge with 175-ft. boom, $9.17 per hour; for a dredge with 200-ft. boom, $11.02 per hour. The rate on the Neptune with its 240-ft. boom is $13.08 per hour. While the long booms ordinarily have a slower swing, they usually carry larger buckets than do smaller dredges and hence net more yardage. The yardage handled varies, according to material and dredge, from 50,000 to 90,000 cu.yd. per month. On 8.26 mi. of levee built for the Natomas Consolidated in 1914, 592,000 cu.yd. was moved at a cost of 9.3c. per yard. This was in hard clay where considerable blasting was necessary. The present rates are stated to be about 35 per cent more than 1914 prices. The dredges which did most of this 1914 work had 168- to 200-ft. booms with $4\frac{1}{2}$- to $5\frac{1}{2}$-cu.yd. buckets.

Experiments are now under way with a so-called "dredge-meter," an instrument for recording the side and forward list of the hull. The function of this device, which is not yet fully developed, is to record the yardage actually handled by the dredge. In theory it is based on the fact that the forward list of the dredge is a function of the weight of material handled and

hence of the yardage. The number of swings to the side records the number of loads handled.

In the preparation of the foregoing data acknowledgment is made of material supplied by Fred H. Tibbetts, consulting engineer of San Francisco, and F. F. Cooper, Olympian Dredging Co., San Francisco.

Concrete Road Building Demands Best Contracting Skill

CONCRETE road building can best be carried forward by attracting to it the responsible contractor, by standardizing in so far as is possible kinds of construction and methods of operation, by establishing definite programs of development that may spread over a number of years, and by the co-operation of engineers and contractors to secure the least expensive construction consonant with good workmanship. These opinions were voiced by W. A. Rogers, president of the Rogers Construction Co. of Chicago, in a recent meeting of the executive board of the Associated General Contractors of America held in Washington.

It is just as necessary, said Mr. Rogers, that reputable and experienced contractors enter the concrete-road construction field as it was for them to assist materially in the development of the railways of the country. The construction of concrete highways, he said, was of such a highly technical character that competent organizations with expensive plants, compared with the volume of the work, should have a major part in it.

"In the past," said Mr. Rogers, "highway work, because of the conditions surrounding it, has not been considered desirable by responsible contractors generally. In fact, it has proved to be one of the most hazardous forms of contracting, because of conditions surrounding this work over which the contractor has no control. It is absolutely dependent for its economical handling on a uniform regular supply of materials delivered over the railroads and in the past this has been difficult, if not impossible, to obtain."

As to standardization, Mr. Rogers asserted that there were practically as many types of highway, varieties of specifications as to materials and workmanship, methods of payment and types of organization for handling the owner's side of the work, as there are states in the United States. He said that the difficulties of one contractor, becoming accustomed to the method of operation and construction demanded by one state, and then moving to another to operate, were obvious.

The need to stabilize construction so that definite programs covering a period of years might be adopted was emphasized by Mr. Rogers. He asserted that the investment in plant and organization for highway work was greater than that of almost any other contract work in proportion to the volume done. Before making such large outlays he said that contractors should have the assurance that expensive plants would be more or less continuously occupied.

Mr. Rogers asserted that there was a large opportunity for the Associated General Contractors to co-operate with engineers and owners in securing the best concrete highways; and that elimination of non-essentials in specifications was not only desirable but necessary.

Mr. Rogers said that with standardization, stabilization and co-operation in effect, the greatest return with the least expenditure of money would be secured.

A Short Method for Swing Bridge Calculations

Statically Indeterminate Stresses Found From Determinate Cases of Loading by Multiplying by Ratio of Influence

By Charles A. Ellis
Professor of Structural Engineering, University of Illinois, Urbana, Ill.

A SHORT method for obtaining the stresses in the members of a continuous truss was discovered by the writer in 1914 and since that time has been presented to graduate students, and to those undergraduate students at the University of Illinois who do major work in structural engineering. The writer's belief that the method is new has been strengthened by recent conversations and correspondence with a number of eminent bridge engineers in America. An explanation of this method will be made in connection with the swing bridge of two equal spans as illustrated in Fig. 2. The live load on each rail is a Coopers E 40 as shown in Fig. 1.

The stresses for five cases or conditions of loading are usually considered:

Case I—Dead load, bridge open or wholly supported at the center.

Case II—Dead load, bridge closed, both ends raised until a definite reaction at each end is attained.

Case III—Live load on one arm only, acting as a simple span.

Case IV—Live load on one arm only, continuous girder action.

Case V—Live load on both arms, continuous girder action.

Positive Shear in End Panel

Case III—The influence line *abc* for shear in the panel is shown in Fig. 3, from which the criterion for maximum shear may be developed. This criterion is well known. If P_1 is the load in the panel 0-1, and P is the total load on the span 0-6, then we know that $P_1 \leqq P/6$. When the train is moving to the left, wheel 4 passing L_1 satisfies this criterion, and the maximum shear in the panel is 162,000 lb. The area of *abc* is 62.5, and the equivalent uniform load is 162,000/62.5 = 2,590 lb. per lin.ft.

Case IV—With left arm loaded, the influence line *defghij* for shear in the panel is shown in Fig. 4. The ordinates are determined by assuming that the truss functions as a beam of uniform section continuous over three supports. The criterion for maximum shear may be stated as follows: If P_1 is the load in panel 0-1, P_2 the load in panel 1-2, etc., then $793\ P_1 \quad 200\ P_2 + 187\ P_3 + 165\ P_4 + 138\ P_5 + 103\ P_6$. Wheel 4 passing L_1 satisfies this criterion also, and the maximum shear determined by taking the sum of the products of each floor-beam load and its corresponding ordinate in the influence line diagram, is 139,700 lb.

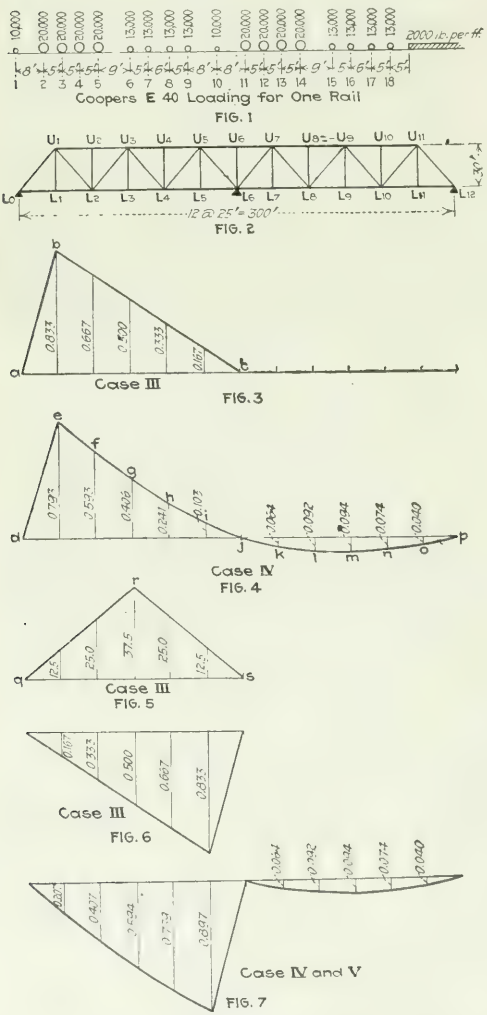
If the influence line *defghij* were straight from *e* to *j* the criterion for maximum shear in the panel would be the same as for Case III. The difference between the broken line *efghij* and a straight line from *e* to *j* is so slight in this or any similar truss that the criterion for maximum shear in the panel will, in general, place the train in the same position or approximately the same position as will the criterion for Case III. A very close approximation to the shear of 139,700 lb. can be made

very quickly by assuming the same equivalent uniform load in both cases; or in other words, by assuming that the shears in the panel for the two cases are directly proportional to the areas of the respective influence-line diagrams. These areas are proportional to the sums of their respective ordinates, thus:

$$\text{area } abc : \text{area } defghij :: 2.5 : 2.14$$

Hence the shear in the panel for Case IV equals 162,000 $\times$ 2.14/2.5 or 138,300 lb. This is a reasonably close approximation to the actual shear of 139,700 lb.

It is now obvious that the stresses in $L_0\ U_1$ and $L_0\ L_1$



APPROXIMATE INFLUENCE-LINE METHOD FOR SWING BRIDGES

may be quickly determined for Case IV with sufficient accuracy by multiplying the stresses for Case III by the ratio 2.14/2.50. This ratio for panel 0-1 remains the same for any bridge having six equal panels in each arm irrespective of the length of the panel.

Case IV—With right arm loaded, the influence line *jklmnop* is as shown in Fig. 4. The criterion for maximum negative shear in panel 0-1 is 64 P_7 + 28 P_8 + 2 $P_9 \leqq$ 20 P_{10} + 34 P_{11} + 40 P_{12}.

There are two positions of the train which satisfy this criterion when the train is moving toward the left, namely wheel 11 at L_0 and wheel 8 at L_6. The maximum shear, occurring when the train is in the latter position, is — 22,770 lb., as found by taking the sum of the products of each floor-beam load and its corresponding ordinate. This value may be approximated very quickly as follows: Since the influence line has its longest ordinate at the center of the arm, it will be compared with the influence line *qrs* (Fig. 5). The latter is the influence line for moment at U_2 for Case III, and the sum of the ordinates is 112.5. The stress in L_2L_4 for Case III is 235,200 lb., hence the moment at U_2 is 235,200 $\times$ 30. The sum of the ordinates in the diagram *jklmnop*, Fig. 4, is —0.364. Hence the approximate maximum end shear in panel 0-1 is 235,200 $\times$ 30 $\times \frac{-0.364}{112.5}$ = —22,830 lb., which compares favorably with the actual shear of —22,770 lb.

Negative Shear in Panel 5–6

The influence lines are shown in Figs. 6 and 7.

Case III—The maximum negative shear in panel 5–6, when the train is moving toward the right, occurs when wheel 4 is at L_5 and equals —162,000 lb. The maximum negative shear when the train is moving toward the left, occurs when wheel 16 is at L_6 and equals —151,700 lb.

Case IV—The criterion for maximum negative shear in panel 5–6 is: 897 P_8 138 P_9 + 145 P_4 + 187 P_3 + 200 P_2 + 207 P_1. Wheel 4 at L_5 satisfies this criterion and gives the maximum shear as —184,700 lb. By the approximate method the shear is —162,000 $\times$ 2.864/2.5, or —185,600 lb.

Case V—When both arms are loaded the maximum negative shear occurs when the train is moving to the left with wheel 17 at L_5. The right arm supports a uniform train load of 2,000 lb. per lin.ft. The maximum shear, determined by taking the sum of the products of each floor beam load and its corresponding ordinate in the influence line diagram, is —191,700 lb.

By the approximate method the shear caused by the load on the left arm is —151,700 $\times$ 2.864/2.5, or —173,800 lb.; the shear caused by the uniform load of 2,000 lb. per lin.ft. on the right arm is —0.364 $\times$ 50,000, or —18,200 lb.; and the total shear is —173,800 —18,200 = —192,000 lb.

Reversals of Stress

The method gives equally satisfactory results when applied to web members. It should be noted, however, that the influence line in passing from a positive to a negative area does not cross the base line at the same point in a panel for Case IV as for Case III. For this reason the approximation will be somewhat closer if the ratio of the areas is taken instead of the ratio of the sums of the ordinates.

Whenever each arm has six or more equal panels a reversal of stress for Case IV, but not for Case III, occurs in one or more chord members of the loaded arm adjacent the center support. The member $L_4\ L_6$ is an example. The stresses for Case IV cannot be approximated as heretofore because of the dissimilarity of the influence line diagrams. In such instances the equiva-

lent uniform load may be approximated by the use of diagrams; see "Modern Framed Structures," 9th ed., Part I, p. 251, or D. B. Steinman's article in *Engineering News*, Vol. 73, page 781.

Application to Arches.—This proportional method is applicable to the solution of stresses in the members of a two-hinged arch. A third hinge is assumed at the center. The influence diagrams are then drawn for the two-hinged and the three-hinged arches. After the criterions have been developed and the stresses determined for the three-hinged arch by the use of a moment table, the stresses for the two-hinged arch may be quickly approximated by means of the ratio of the respective areas of the two diagrams.

Centrifugal Pumps for High Head at Shenandoah, Pa.

By Farley Gannett and Jacob L. Crane, Jr.
Of Gannett, Seelye & Fleming, Inc., Engineers, Harrisburg, Pa.

The municipal water-works at Shenandoah, Pa., recently completed an installation of two electric-motor-driven, 2 m.g.d. centrifugal pumps, which work against a total head of 1,000 ft. and have an over-all efficiency of 62 per cent. The pumps, which are only three-stage, together with certain details of installation, are of unusual interest. Incidentally, but by no means least important, pumping costs are reduced by over $12,000 per year, a reduction of 35 per cent.

Shenandoah is a community of about 32,000 people, situated in the heart of the lower anthracite coal region of Pennsylvania. The valley in which Shenandoah is located is so honeycombed by coal operations that it is impossible to secure water either from the surface or from under ground. It therefore became necessary to secure water in the adjoining valley, separated from Shenandoah by Locust Mountain, about 800 ft. high. The water-works plant uses the surface flow from several small mountain streams, impounded in a small reservoir, the water formerly being forced by steam pumps over Locust Mountain to the distribution reservoir and thence to the city.

These steam pumps, as well as the boilers and pumping station, now twenty years old, were at the end of their useful life. Still more critical, the advancing costs of coal, and of the two-mile haul from railroad to pumping station, and of operators' wages, had so increased the cost of steam pumping as to cause a serious situation.

The high-voltage transmission line of the Harwood Electric Co. was built near by after the steam pumps were installed; the electric rates, which are not expected to advance, show a large saving over steam power; the electric-driven centrifugal pumps cost less than new steam pumps, require less space, are more easily and satisfactorily operated and make it possible to take power from the electric lines to the greatest advantage. It was therefore decided to put in electric-motor-driven centrifugal pumps.

The cost of the two pumps was $13,380; the building, $5,000; piping, $5,400; electrical equipment (transformers, substation, switchboard, instruments, etc.), $12,155. The total cost was about $40,000, including the engineering.

The pumps were built by the American Well Works and are three-stage units, lifting 333 ft. per stage, a most unusual type of pump. The shells are of cast steel, the wearing rings of bronze, shaft sleeves of bronze, shafts of forged steel and the impellers and diffusion vanes of "U. S. Government Bronze." The 500-hp. motors are directly connected to the pumps and have a speed of 1,750 revolutions per minute.

Against a head of 1,000 ft. an efficiency of 62 per cent is being obtained. It is expected to clean the force main in 1921, which will reduce the head to below 900 feet.

The discharge is into a 12-in. steel force main 12,000 ft. long and twenty-six years old. The danger of blowing out this line when the pumps close down suddenly and the water slams against the check valves at the

NEW PUMPING STATION FOR SHENANDOAH
Houses two motor-driven, 2-m.g.d., three-stage centrifugal pumps working under head of 1,000 feet

pumps, creating a water hammer that might be disastrous, in view of the length of line and high head, seemed so great that special provision was made to prevent it. The force main is divided into four sections by three check valves and just above each check valve, and also at the pumps, an automatic blowoff valve is placed. This serves to divide up the length of the line and also the pressure, and allows the pressure to be relieved at each of the division points. This scheme was designed to relieve the water hammer and has done so very successfully.

The old pump broke down the day after the new centrifugal pumps were completely installed, and these pumps have supplied the borough with water continuously, without any shutdown for repair or adjustments, so often necessary in new installations.

This installation we believe to be the largest of its kind in the United States, the two three-stage centrifugal pumps having a capacity close to 4 m.g.d., pumping against a head of 1,000 feet.

Tunnel Under Thames Proposed

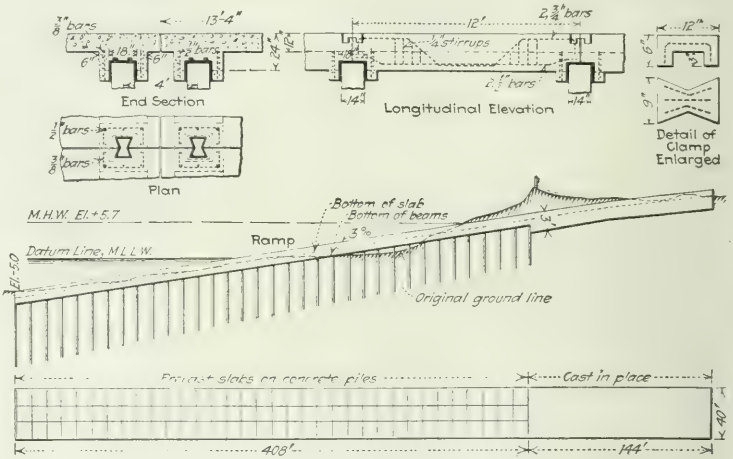
Parliamentary sanction is sought by a private company for the construction of a tunnel at the mouth of the Thames to link up the north and south banks. At present a substantial amount of shipping is berthed in Tilbury Docks on the north side with goods consigned to Gravesend which is on the south. Under the conditions obtaining now these goods have to travel to Gravesend via London, a distance of nearly 60 miles, though Tilbury and Gravesend are almost within shouting distance. The tunnel has extensive support throughout the country and a deputation is to await on the Ministry of Transport urging an early commencement of the task.

Precast Slabs Set on Submerged Concrete Piles

Unit Construction Plan Made Possible by Precise Methods in Building Ramp for Seaplane Landing in San Francisco

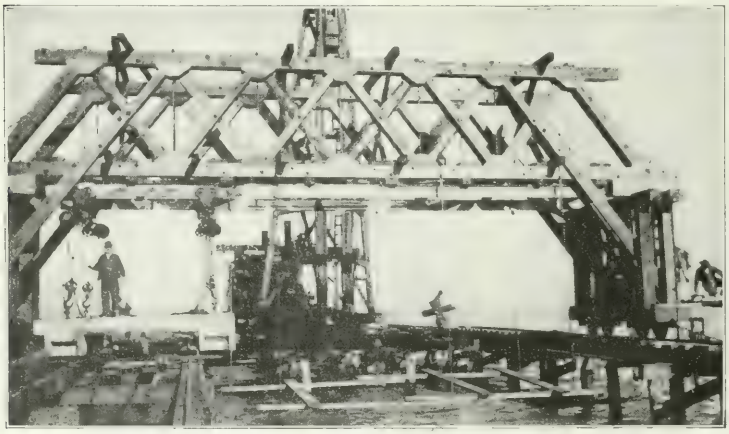
A RAMP on which to bring floating seaplanes ashore has recently been completed at the air coast defense station in the Presidio on San Francisco Bay. The ramp surface is made up of precast concrete slabs which were poured in a casting yard and placed by means of a gantry crane on accurately located concrete piles. The open caisson method of construction was not feasible, it was thought, because the porous bottom would have made it difficult if not impossible to unwater a caisson. Even on the lower end of the work where the slabs had to be set in place with the aid of divers the alignment of each slab was checked to the nearest hundredth of a foot by means of a bolt-and-thread device for adjusting the thickness of grout on top of the supporting piles. One hundred and two slabs, each weighing about 18 tons, were placed in the ramp which, after being completed, is reported to be in such good alignment that the joints are not apparent. The width is 40 ft. and the full length, on a 3 per cent grade, is 550 ft. The site chosen for the ramp was at a spot where the natural slope of the shore approximated the 3 per cent grade desired. Thus not much excavation was required. Such excavation as was necessary below water level was done with a floating derrick and that above the water line by means of scrapers and teams. A pile falsework was then built over the 408-ft. section of the ramp on which the precast slabs were to be used. This falsework carried rails for the ramp gantry crane, which had a span of 50 ft., the pile supports for the rails being outside the ramp on both sides.

A piledriver, working on this falsework, then drove the concrete piles. These were 14 in. square and ranged in length up to 25 ft.; four piles were placed for each slab. The piles were located in the exact position desired with a transit. Steel extension leads were used on the driver, arranged to slide down below the ends of the permanent leads as much as might be necessary to rest on the bottom at the point where each pile was driven. A No. 1 Vulcan hammer was used and a 2-in. jet was put down with all piles. The excavation was calculated so the piles would project about 2 ft. above the bottom when driven to exact grade. The elevation of the tops of the piles was an important matter. In order to check this closely a hardwood follower was used, well banded at the ends to prevent brooming, and the shore side of this follower was marked with graduations similar to those on a level rod and reading to hundredths of a foot. A level instrument was kept focused on these graduations as the pile went down, and the steam engineer on the driver took signals direct from the levelman.



DETAILS OF REINFORCED-CONCRETE SLABS AND PLAN AND ELEVATION OF SEAPLANE RAMP

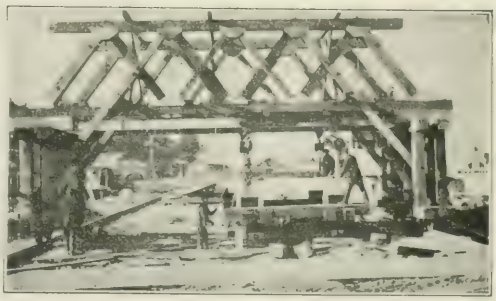
The casting yard was laid out at right angles to the center line of the ramp at its shore end. The forms for the slabs, which were about 12 x 13 ft. in plan, were laid out on the ground, reinforcing was placed in them and concrete was poured directly into the forms from hand buggies wheeled on planks laid out on top of the forms. Concrete was poured at the rate of about 80 cu.yd. per day. The slabs were cast three tiers high, form lumber being used to separate successive tiers. Loops of reinforcing steel



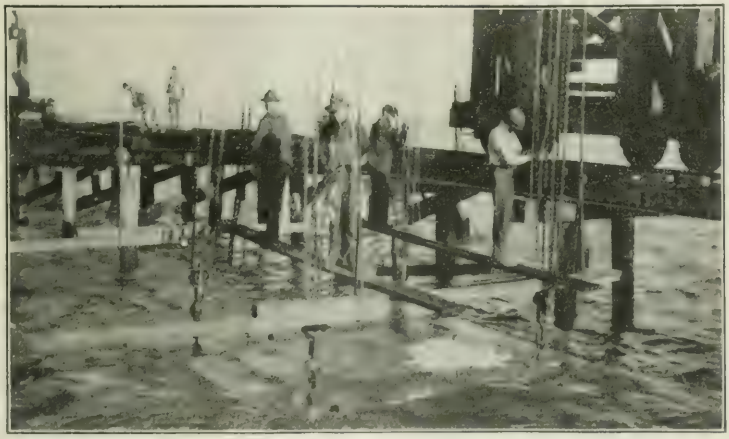
RAMP GANTRY WITH SLAB SUSPENDED OVER DELIVERY TRACK

were placed in each of the four corners of the slabs to afford convenient means for lifting them when they were ready to be placed.

A 40-ft. wooden gantry crane spanned the casting yard and by means of four differential chain blocks, operated by hand, raised the slabs from the forms as they were needed on the work. This gantry delivered the slabs to a car of 10-ft. gage, operating on a track under the gantry. A turntable was located on this track at the head of the ramp and here the car with its slab was turned through a right angle so it could run down a track laid on the pile falsework and deliver the slab to chain-blocks on the ramp gantry. The chain-blocks on both gantries were suspended from carriers running the full gantry span on I-beams. Both gantries and the car operating between them were moved by means of cables running to a steam winch. There were also hand winches on the ramp gantry by means of which the four carriers and their chain-blocks could be moved as a unit in either direction across the ramp.



GANTRY OVER CASTING YARD



LOWERING SLAB TO SUBMERGED PILE SUPPORTS

The slabs are 12 in. thick and have two longitudinal beams with an overall depth of 24 in. Rectangular recesses were left in the ends of each beam for the piles, as shown in the accompanying drawing. Before pouring the slabs eight 1-in. bolts, each carrying two nuts, were placed in the bottom of the forms. Two bolts were put in each corner, with the heads projecting downward into the recess cast to receive the pile heads. When the concrete had hardened around the nuts the bolts could be turned in them and would thus be extended downward. With this arrangement, after a slab had been placed and until the grout in the joints had set, the slab was supported on the bolt heads. That is, the bolt heads rested directly on the tops of the piles. As the slabs were brought out on the ramp ready for placing two rod readings were taken on each pile at the exact spot where the bolt heads would rest. The difference between these readings and the desired level of the finished ramp surface at this point determined just how much the bolt projection should be and this was adjusted accordingly before lowering the slab into place.

Just before the slabs were lowered a bag or cushion of grout was fastened in the top of each of the recesses into which the pile heads were to fit. These bags were about 18 in. square and 1½ in. thick. The weight of the slab was so great that the bolt heads crushed through the bags to direct contact with the pile tops and the grout was forced into the space around the top and sides of the pile. Where additional grout was required to completely fill the joint this was supplied by the ordinary pressure grouting equipment. Keyways were left in the tops of the slabs and reinforced-concrete keys or clamps were fitted into these after the slabs had been placed. The keys were also grouted.

The 144 ft. at the upper end of the ramp located above high water line was poured in place as monolithic paving. In preparation for this paving the surface of the ground was merely worked down to grade. A beam or inverted curb, 3 ft. deep, was poured at either edge. Except for the inverted curbs the thickness in the paved section is 12 in., the same as in the precast section.

Information from which the foregoing was compiled was supplied by the Healy-Tibbitts Construction Co. of San Francisco, contractors on the work.

Wood and Steel Ties in England

High cost of wood ties in England is directing the attention of some of the railways to substitutes for wood as creosoted ties of Baltic fir which cost $1 to $1.25 before the war now cost $5 (at the old rate of exchange). A steel tie now being tried on the Northeastern Ry. is designed with the idea of employing standard rolled shapes and thus reducing the cost. It consists of a rolled channel 9 x 3 in., 8 ft. long, having near each end a pressed steel saddle or rail seat of inverted channel section, the sides of the saddle fitting inside the tie and being riveted to it. These saddles are shaped to give the rails the standard cant or inward inclination of 1 in 20. Flange rails of 100-lb. per yard are secured to each saddle by two bolted clips. The weight of the tie, apparently exclusive of the saddles, is 197 lb. This tie was designed and patented by C. F. Bourgough, chief engineer of the Northeastern Ry.

Sewage Treatment Plant for Calumet Region of Chicago Sanitary District

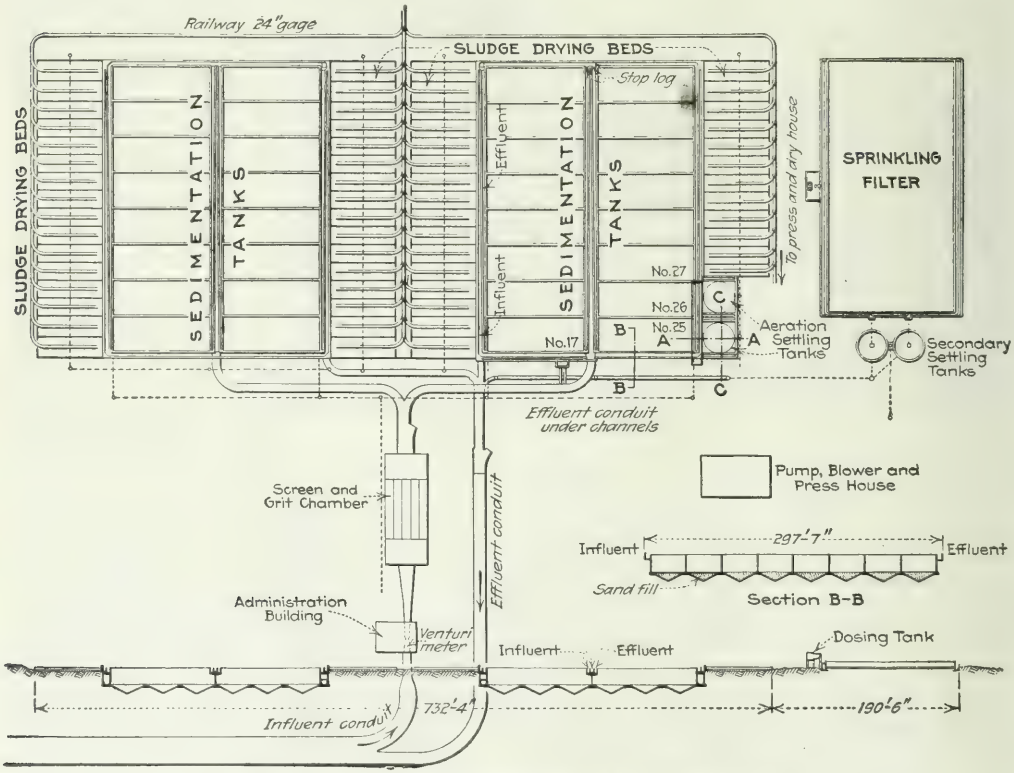
Imhoff Tanks Are Convertible Into Activated Sludge Tanks—Experimental Sludge Units and a Sprinkling Filter Are Provided

By Langdon Pearse
Sanitary Engineer, Sanitary District of Chicago

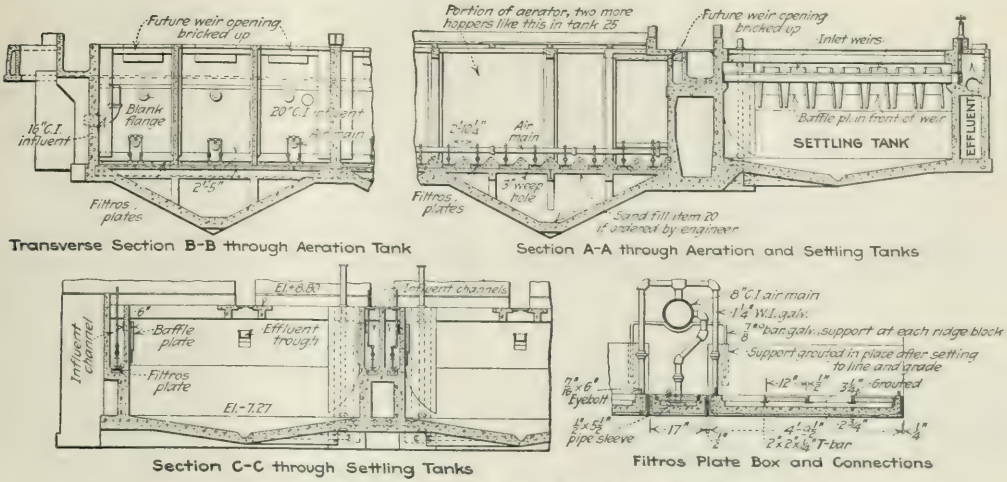
In connection with the intercepting sewer system being built in the Calumet region. The Sanitary District of Chicago now has under construction a sewage treatment plant to serve 150,000 people and eventually an area of 18,000 acres. Its purpose is to remove the settling solids from the sewage before discharge into the Calumet Sag Channel. The plant includes Imhoff tanks, designed to permit ready conversion into aeration tanks; sludge drying beds; two activated-sludge units, one of which is to be tried on settled sewage, and one sprinkling filter unit with dosing tanks and secondary settling basins. Provision is to be made in the plant for dewatering and drying the activated sludge. The plant is fed by the Calumet sewage pumping station, the treated sewage returning to the station to enter the outfall. The effluent from the settling tanks will be pumped to the sprinkling filter.

The population tributary in 1922, when the plant will be completed, is estimated at 152,000, producing an average sewage flow of about 57 sec.-ft. The minimum flow has been taken as 70 per cent of the average. When the flow in the main interceptor, which picks up the drainage of 12,000 acres, is increased by storms, to a point where the hydraulic grade will not permit a return of the effluent to the outfall, the treatment plant will be shut down or the sewage discharged direct into the Calumet River through the emegency outlet. Owing to the presence of considerable ground water a somewhat weak sewage is expected, largely of domestic origin.

The sewage treatment plant is located on a 106-acre site a half mile east of the Calumet sewage pumping station. In between lie railroad yards of the Illinois Central and the Chicago & Western Indiana, with 53 tracks. The sewage will be pumped to the plant by the dry-flow pumps in the station, the station being equipped with sluice gates in the dryweather discharge basin for this purpose (see *Engineering News-Record*, Nov. 4, 1920, p. 872). The effluent from the treatment plant



GENERAL PLAN OF NEW CALUMET SEWAGE TREATMENT PLANT



DETAILS OF THE SETTLING AND OF THE AERATION TANKS

will be handled through the discharge basin of the pumping station for passage to the outfall to the controlling works of the Calumet Sag Channel, or to the emergency storm outlet to the Calumet River.

The pumping station will be connected to the treatment works by a novel three-barreled semi-elliptical conduit built in tunnel under the railroad yards (see *Engineering News-Record*, March 24, p. 500). The raw sewage will be carried in a 5½-ft. or a 7½-ft. barrel or both, according to the flow, to maintain sufficient velocity. The capacity of the two influent or the one effluent barrel is 200 sec.-ft. (estimated for 1950 to 1960). In addition to the sewage conduits, a 6-in. city water pipe has been laid across the railroad yards and an electrical conduit for the power and lighting cables.

Sewage entering the plant first passes through a 72 x 36-in. Venturi meter and then an inclined rack-bar screen with openings 1 in. in the clear. An 8½ x 5-ft. conduit delivers the sewage to a junction chamber, feeding the two double batteries of tanks by conduits each 6½ ft. x 3¾ ft. There are 32 tanks, arranged in four parallel batteries of eight each, planned to handle the sewage flow till 1932. Thirty are Imhoff tanks, the other two being converted into aeration tanks. Stoplogs in the distributing channels will control the operation of the tanks. Provision is made for reversing the flow. The channels are shaped to maintain approximately uniform velocities. To control the flow to each tank, orifice plates will be set in the three 12-in. cast-iron pipes which feed each tank, and adjustable weirs will be placed on the outlet. Each inlet also has a 12-in. sluice gate, the inlet being set 4 ft. 3 in. below the surface.

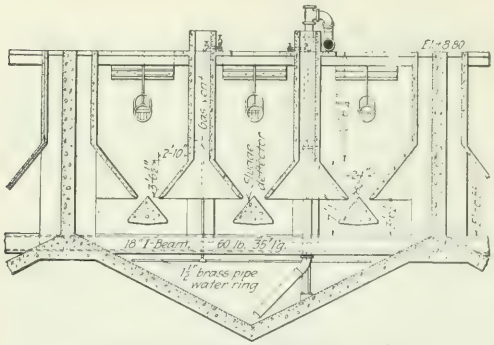
Imhoff Tanks—Each Imhoff tank unit is 103½ ft. long by 34½ ft. wide, with a total depth of 26.4 ft., including a freeboard of 18 in. There are three hoppers, each 8½ ft. deep with bottom slopes of 2 horizontal to 1 vertical. The settling chamber has a bottom baffle slope of 1 horizontal to 1.5 vertical. Each tank is designed to have a settling capacity of 29,000 cu.ft., or a detention period of 2.9 hr. with 1.77 m.g.d. flow. The sludge capacity is about 16,300 cu.ft. or 2.3 cu.ft. per capita. The ratio of vent to total tank area is 17 per cent. Slot openings are 8 in. Each sludge hopper is equipped with a water ring of 1½-in. brass pipe having ⅛-in.-holes, spaced 15 in. c. to c., pointing downwards and ⅛-in. holes, 48 in. c. to c., pointing up. The sludge will be removed from each hopper by an air lift in an 8-in. cast-iron pipe. Scum-boards are provided in front of each outlet weir, extending 12 in. below and 9 in. above the surface.

The buttresses of the 16-in. outside walls are tied together at the bottom. Over the center of the hoppers, 18-in., 60-lb. I-beams are used, and between the hoppers, nine 1-in. round bars. At the top the ties are eight ¾-in. round bars. The center supply channels are placed on a single wall to facilitate removal if the tanks are ever converted.

Sludge Beds—The sludge beds are designed on the basis of 1 sq.ft. of bed area for three persons. This may be low based on the experience at Columbus but ample provision is made for expansion when needed. In winter it is possible that the Imhoff sludge may be handled experimentally in the press and dry house. The beds are 66 ft. long by from 17 ft. 7 in. to 20 ft. 3 in. wide, underdrained by a 12-in. tile main drain with tight joints and two 4-in. tile lateral drains with open joints. The filtering material varies in depth from 12 to 19 in., consisting of a top layer of 1½-in. river or lake sand, then 3 in. of 1/16- to ¼-in. sand, 4 in. of ¼- to ⅞-in. broken stone or gravel and a bottom layer, 3½ to 10½ in. thick, of ⅞- to 2-in. broken stone or gravel.

For the removal of the sludge, 17-cu.ft. cars operate over a 24-in. gage industrial railway provided with 16-lb. rails on steel ties laid flush with the surface of the sludge beds. At the start the sludge will be dumped on vacant area.

Aeration Tanks—Each of the two aeration tanks is 103½ ft. long by 34½ ft. wide and has a water depth over the filtros plates of 14 ft. 4 in., the tank volume being 362,000 gal. Two longitudinal baffles divide each tank into three compartments giving a travel of 310 ft. With an average flow of 1.75 m.g.d., and 25 per cent allowed for returned sludge, the detention period is 4 hr. One tank is to be fed with the effluent of an Imhoff tank and the other with raw sewage.



SECTION THROUGH IMHOFF TANK

The bottoms are similar to those at the Desplaines River sewage works (see *Engineering News-Record*, Dec. 9, 1920, p. 1134) with pre-cast concrete containers each holding four filtros plates, set between precast ridge blocks. The ratio of gross plate to tank area is 1 to 4.21. Air is supplied by an 8-in. galvanized cast-iron main header, through 1½-in. connections taken off the top of the main header. Venturi meters with continuous registering devices will measure the air and automatic steam traps will remove the condensation from the air pipes which are laid to drain.

Sludge is returned to the inlet end of the tanks by air lifts, equipped with V-notch weir measuring boxes feeding wooden troughs.

Aeration Settling Tanks—Each aeration unit is provided with a settling tank 34 ft. square at the top. From a depth of 5 ft. 4 in. below the flow they warp to a circular bottom. The bottom slope is 1¾ to 12 in. The central water depth is 15 ft. The aeration tank liquor enters the tank on opposite sides over 15 rectangular weirs, and pass under adjustable baffles set 2 ft. 10½ in. below the flow line. The effluent passes out over continuous overflow weirs on an effluent trough at the center. The sludge is swept to the center by a Dorr thickener, operated from an overhead bridge, and passes through an 8-in. outlet pipe under the floor to an air lift. The area of each tank is 1,135 sq.ft. which, with a flow of 1.75 m.g.d., gives a daily rate of 1,550 gal. per square foot.

The aerated liquor is conveyed from the aeration tanks to the aeration settling tanks in channels provided with filtros plates.

Sprinkling Filter—The sprinkling filter takes the flow from one Imhoff tank. It is 130 x 248½ ft. in plan, or 0.742 acre, and is constructed almost entirely above ground, being enclosed by a reinforced-concrete retaining wall. From the dosing tank, located on one side of the filter midway between the ends, runs the main feed header in either direction along one side—a 14-in. cast-iron pipe, reducing by successive sizes to 8 in. at the far end of the filter. Twenty 6-in. cast-iron laterals run across the filter from the main header and are supported just below the filter surface by the stone. The nozzles, tapped directly into the laterals, are of the Worcester circular type, with 1⅜-in. orifices, 14 ft. c. to c., arranged at the apices of equilateral triangles. On alternate lines half nozzles are used adjacent to the filter walls. Each lateral has a shut-off valve to its junction with the main header and a blow-off valve at the far end discharging through a down pipe into the filter effluent channel.

The filtering medium consists of 5 ft. 10 in. of 1- to 2-in. crushed and washed limestone, underlaid by from 6 to 12 in. of 2- to 4-in. stone.

The underdrain system is of the Fitchburg type, consisting of alternate flat-topped ridges and collection channels. Over the channels are laid concrete bricks, 4 in. high and 1½ in. wide, staggered between alternate ridges. The underdrains have a summit at the center of the filter and discharge toward the two sides into the effluent collectors running to the secondary tanks.

Dosing Apparatus—Duplicate dosing tanks with hopper bottoms shaped to secure equality of distribution discharge by overhead siphons into a common feed tank supplying the main filter headers. Settled sewage from the Imhoff tank is discharged alternately into the two dosing chambers through a slot in the bottom of the pipe. The flow is shifted by an adjustable float-operated tipple plate. The filter is designed to operate at an average rate of 1.75 m.g.d. with 50 per cent increased allowance for storm flows, but provision was made in the designs of the dosing apparatus for increasing these rates by 50 per cent. The present average rate means 2.35 m.g.d. per acre with 9,400 people per acre.

Secondary Settling Tanks—The secondary settling tanks are two in number, of the Dortmund type, 30 ft. in internal diameter with a cylindrical portion 10 ft. 10 in. deep below the flow line and a hopper bottom 9 ft. 4 in. deep with side slopes of 3 horizontal to 2 vertical. Sewage enters at the center through a down-tube 3½ ft. square, extending 9 ft. 10 in. below the flow line and flows out over a peripheral gutter having 16 weirs, each 24 in. long. The effluent passes to the main effluent conduit.

Sludge, withdrawn through an 8-in. cast-iron pipe, flows by gravity to the press and dry house where it will either be mixed with the waste activated sludge and pressed and dried or be pumped into the raw sewage conduit and settled out in the Imhoff tanks for digestion.

The settling volume of each tank above the bottom of the downtake tube is approximately 54,500 gal. and the sludge hopper below the top of the cone 17,650 gal. With an average flow of 1.75 m.g.d. and both tanks in operation, the detention period is 1.5 hours.

In addition to the plant described other contracts cover an administration building, housing the laboratory and locker rooms; a blower house in which will be located the air screens and compressors, also the pumps to supply the sprinkling filters, and a press and dry house for the dryer and devices for reducing the original moisture of the activated sludge as removed from the tanks. The choice of apparatus between filter presses and centrifuges has not yet been made.

Until his resignation in December, 1920, this work was carried on under the general direction of E. J. Kelly, chief engineer of the Sanitary District of Chicago. Albert W. Dilling was made chief engineer when Mr. Kelly resigned. The engineering staff working on the plant includes the writer as sanitary engineer; C. R. Dart, chief structural engineer, since resigned; H. L. Steffa, mechanical engineer, and F. L. Barrett, architect. L. B. Barker, assistant engineer, is in charge of the construction of the conduits and treatment plant. L. C. Whittemore, assistant sanitary engineer, has been in charge of the preparation of the contract plans for the treatment plant under the direction of the writer. The T. J. Forschner Contracting Co. is contractor for the treatment works and the American Sewer & Drain Construction Co. for the conduits.

Traffic Study Proves Two-Lane Road Widths Sufficient

Figures Show 500 Vehicles Daily Represent Average Volume of Travel on State Highway Systems—Seasonal and Hourly Variations Noted

By A. N. Johnson
Dean, Engineering College, University of Maryland

Paper presented May 23 at the conference on Highway Traffic Regulation, held under the auspices of Yale University, New Haven, Conn.

THE public as well as highway engineers have been asking what may be the traffic that our highways will be called upon to carry. Are the provisions for width, for example, sufficient or should much wider roads—roads that will carry three or four lanes of traffic—be provided? It is of manifest importance to find some answer to this question. If it can be shown that the traffic that may be expected is within certain limits the plans for various state highway systems can be more accurately and scientifically made. It is not sound planning that makes provision for a wider highway than a reasonable expectation of the traffic to be accommodated justifies.

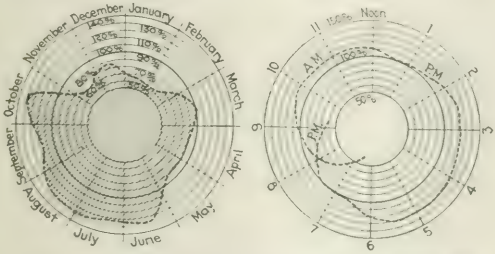


FIG. 1 (LEFT). SEASONAL TRAFFIC VARIATIONS ON WASHINGTON-BALTIMORE ROAD

Results obtained at St. Denis, near Baltimore, are plotted as percentages of the daily average traffic for the years 1917-1920, inclusive. The full circle is the average, taken as 100 per cent.

FIG. 2 (RIGHT). DIURNAL VARIATION OF TRAFFIC

Adapted from data in report on California highway system by U. S. Bureau of Public Roads, 1920. The full circle is the hourly average, taken as 100 per cent.

As a basis upon which to attack our problem there are presented three factors which govern the amount and density of traffic upon the highways. These are: (1) The number of vehicles that use the highways; (2) the mileage actually made by these vehicles in a given time; and (3) the mileage of highways that are available for traffic. The larger the first two of these factors and the smaller the third factor, the greater will be the number of vehicles to be accommodated per mile of highway in a given unit of time. Keeping in mind the effect upon the resulting number of vehicles per mile per unit of time that will come upon our highways, the following statistics become very significant:

Nation's Vehicle-Mileage Computed

The total number of motor vehicles, including motorcycles, in the United States, from the latest available information as compiled by the U. S. Bureau of Public Roads, is placed at 9,449,441. While this number includes taxicabs and many other motor vehicles that seldom use highways outside of city limits, no deduction is made from the total as here given in the discussion which follows.

The average mileage made in a given time, say one year, by each motor vehicle is not known accurately. From data in the possession of the American Automobile Association it is estimated that an average of 6,000 miles yearly may be taken as reasonably approximate, while the U. S. Bureau of Public Roads places it nearer 4,500 miles per year per vehicle. Let us take the higher value of 6,000 miles and apply it to the total number of motor vehicles. There results a yearly mileage of approximately 57,000,000,000 vehicle-miles. As this total includes all vehicles, whether confined to city streets or using the highways, it is fair to assume that the highways as a whole today do not develop a total motor traffic in excess of 57,000,000,000 vehicle-miles per year.

The total mileage of highways in the United States, excluding city streets, is given by the U. S. Bureau of Public Roads as 2,478,552 miles. It is generally the opinion of those who have given the subject close attention that 20 per cent of the total mileage of all the highways carries not less than 90 per cent of all the traffic. As it may be some time before any considerable number of states will have improved 20 per cent of their total highway mileage, and as most state highway systems under construction today seldom exceed 10 per cent of the total highway mileage in the state (see Table I) it will be more significant to the present discussion to consider the amount of traffic that may be carried upon 10 per cent of our highways. The opinion generally prevails that we may expect 10 per cent of the highways, if judiciously laid out, to form a comprehensive state highway system to carry 75 per cent of all the traffic.

TABLE I MILEAGE OF FIVE STATE HIGHWAY SYSTEMS—AS PER CENT OF TOTAL

State	Total Mileage	State Highway System Miles	State Highway System Per Cent of Total
California	61,039	5,560	9 1
Illinois	95,647	4,800	5 5
Iowa	104,074	6,619	6 4
Maryland	16,459	1,726	10 0
New York	79,398	3,772	4 7

Upon these data it is practicable to determine the traffic that would develop today on state highway systems were they completed. Seventy-five per cent of the total traffic is approximately 43,000,000,000 vehicle-miles per year, which is to be carried upon 250,000 miles of highways, or a traffic per mile per year of 172,000 vehicles. There thus results an average traffic per mile per day a little under 500 vehicles. It is evident from the rather large values given the factors that control this result that the actual traffic is probably well within the value here found.

Seasonal Variations of Traffic

The average daily traffic throughout the year does not give the number of vehicles that should be provided for, due to the seasonal and diurnal variations in the volume of traffic. A road must carry comfortably the usual increase over the average traffic that comes regularly at certain seasons and during certain hours of each day.

The seasonal variation that occurs will vary due to climatic conditions. In the vicinity of Baltimore on the Baltimore-Washington road the seasonal traffic variations are shown in Fig. 1. From this diagram it is noticed that from the middle of June until the middle of October the daily traffic is about 135 per cent of the average daily traffic for the year. The traffic records available in Maryland do not show the hourly variations which, however, are brought out from the data presented in a report on the California highways by the U. S. Bureau of Public Roads and have a fairly wide application. In that report the results are plotted to rectilinear co-ordinates, which are here shown (Fig. 2), plotted to polar co-ordinates. From this curve it is seen that the maximum hourly traffic is about 30 per cent in excess of the average hourly traffic for the day. It is this high hourly average traffic occurring during the months of high average daily traffic for which provision should be made. If the average daily traffic for the year is 500 vehicles, the daily traffic during the heavy traffic months is 675. Based on a twelve-hour day this gives

an average hourly traffic of 56 vehicles, and a high average hourly traffic of 73 vehicles. If the daily average is 1,000 vehicles then an hourly traffic of 146 vehicles may be expected.

It will now be interesting to compare with these figures the traffic discharge of a two-track road, i.e., a road which accommodates two lanes of traffic. During the rush-hour on many roads a large proportion of the traffic at a given point is in one direction—just what proportion cannot be stated without much more data at hand than are available. It will be assumed, however, that all of the traffic is in one direction and is confined to a single lane.

The number of vehicles that pass over a given road will be designated as the vehicle discharge. The number of vehicles that may pass a given point in single file or the total discharge of a single lane of traffic depends upon the velocity and the spacing or interval between the vehicles. If the velocity is expressed in miles per hour and the distance from the center of one vehicle to the center of the next in feet, the total number of vehicles that will pass a given point in one hour is equal to 5,280 times the velocity in miles per hour divided by the distance in feet from center to center of the vehicles or $N = 5{,}280\ V/D$.

The accompanying traffic discharge diagram (Fig. 3) enables comparisons to be made readily under varying conditions. If the distance from center to center of vehicles remains constant, then it is clear that the number of vehicles passing a given point will vary according to speed in miles

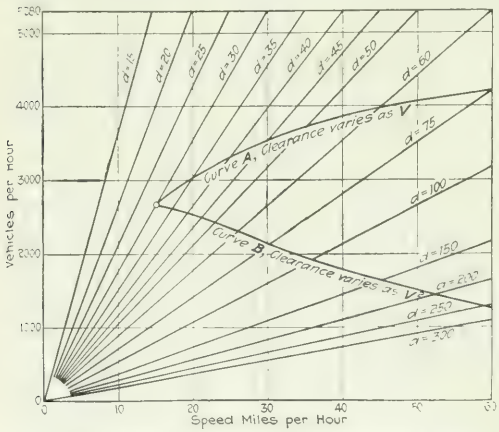


FIG. 3. TRAFFIC DISCHARGE DIAGRAM FOR SINGLE LINE OF VEHICLES
d = distance, center to center, of vehicles
$d - 15$ = clearance between vehicles.

per hour, and we have the series of straight lines as shown in the diagram. Thus, taking the average overall length of vehicles as 15 ft. and a clearance of 15 ft., D becomes 30 ft. and for a speed of 15 miles per hour the discharge of a single traffic lane will be 2,640 vehicles per hour. This point on the diagram has been taken as the starting point for the two discharge curves A and B. In curve A the clearance between the vehicles is assumed to vary directly as the velocity. Thus, if the speed be increased to 30 miles per hour, the clearance is increased 15 ft. or a total distance of 45 ft. and the total number of vehicles that pass in an hour is 3,500. For the lower curve, B, the clearance between the vehicles is taken to vary as the square of the velocity. Thus, at 30 miles per hour as compared with 15 miles per hour, the clearance is increased four times or 60 ft. Add to this the length of one vehicle and we have the distance from center to center, D, equal to 75 ft., and the number of vehicles passing is 2,150 per hour.

From some observations made on traffic on the Washington-Baltimore road during a special rush hour it was observed that vehicles moving 25 to 30 miles an hour in

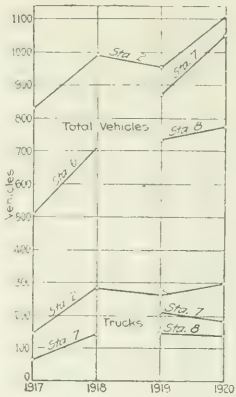


FIG. 4. INCREASE IN TRAFFIC AT VARIOUS POINTS ON WASHINGTON-BALTIMORE ROAD

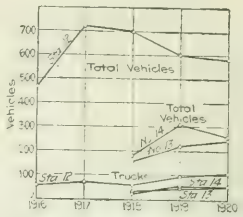


FIG. 5. AVERAGE DAILY TRAFFIC ON YORK ROAD

groups of 6 or 7 did not space themselves nearer together than 50 to 60 ft. or, allowing for the length of the vehicle, the distance between centers was about 75 ft. It was also observed that vehicles moving 10 to 15 miles per hour frequently were spaced as close as 15 ft. or about 30 ft. center to center. This indicates that the clearance between vehicles may be taken to vary as the square of the velocities within practical road speeds.

If the clearance between vehicles does vary as the square of the velocity we have the interesting fact that a larger number of vehicles will pass a given point at a speed of 15 miles per hour than at 30 miles per hour.

As a matter of fact the greatest number of vehicles observed on the Baltimore-Washington road did not exceed 400 per hour, the average speed being about 25 miles per hour which would require an average spacing of 330 ft. If 1,000 vehicles were to pass in a single file in one hour at a speed of 25 miles per hours the spacing, center to center, of vehicles would be 132 ft. Thus a highway paved for a width to accommodate two lanes of traffic can readily handle a total traffic in both directions of 1,000 to 1,500 vehicles per hour and temporarily, during a special rush, may handle over twice these amounts.

Observed Traffic Volume

Traffic on the Baltimore-Washington road for 1920 is somewhat in excess of that for 1919 and 1918. The average number of vehicles per day per mile was 1,000 for the year 1920. In Fig. 4 are shown the curves of increase in traffic at various points on this road for the past few years. All of these diagrams are based upon traffic counts taken for a period of 12 hours during one day each month, although at some of the stations during certain months no counts were made. A diagram similar to Fig. 4 has been made for the York road, as shown by Fig. 5. The York road leads northerly from Baltimore, but does not carry much, if any, through traffic, i.e., traffic from one large center of population to another, as in the case of the Baltimore-Washington road. On the York road a slight decrease in traffic has occurred during the past few years.

The following data are presented for comparison with similar data presented in the first part of this paper. There were in Maryland in 1920 approximately 125,693 motor vehicles and a state highway system of 1,726 miles, practically completed, so that traffic may be said to have found the roads and the roads have received their traffic. On the bases before assumed that each motor vehicle travels 6,000 miles a year and that 75 per cent of all such travel comes upon our state highway system (that of Maryland being very close to 10 per cent of all the highways) we have a total travel of 565,618,500 vehicle-miles or a daily average of 900 vehicles per mile. This agrees closely with the traffic noted on the Baltimore-Washington road, which was seen to be about 1,000 vehicles per day on the average throughout its length. The York road averages much less

Time has not permitted careful analysis of the traffic records of all the roads of the state highway system of Maryland, but it is to be noted that there are some roads averaging well over 1,000 vehicles per day, while the larger portion of the state highway system receives much less traffic. Thus it is probable that the traffic as here computed to come upon our state highway systems is reasonably close.

The traffic upon the roads of the Maryland highway system is not increasing at an extraordinarily rapid rate; in fact, in some instances it actually decreased for 1920. The explanation is not difficult to find. The number of motor vehicles is reaching a practical limit of man power to drive them, the numbers of owners possessing more than one motor vehicle is increasing, thus decreasing the average yearly mileage made by each motor vehicle; the use of roads other than the state highways is increasing. All of these conditions combine to produce a retarding effect on the increase of traffic upon the main roads of the state.

In conclusion it may be stated that there is no reasonable expectation that our main roads comprising the state highway systems, when completed and carrying their full quota of the traffic, will be called upon to carry on the average more than 500 vehicles per day throughout the year, so that a highway paved for a width sufficient to accommodate two lanes of traffic will suffice for many years to come. It is not to be concluded that there are no sections of highways that will not require more than two traffic lanes, but the mileage of such routes is and will continue to be but a small fraction even of the restricted mileage of the state highway systems. Any highway plans contemplating an extended system of highways constructed for a greater width than required by two lanes of traffic are extravagant.

Ruling on Ethics of Dual Allegiance

The Council of the American Institute of Consulting Engineers has recently passed upon a hypothetical question of professional ethics, listed in their rulings as Case 18. The ruling is as follows:

Statement.—In a case involving the respective rights of a water-supply company owning the surface water rights over certain lands, and the owners of the lands, a (supposedly) friendly suit at law is instituted to determine the legal status of the parties. An engineer, employed in the inception of the water-supply project, is asked by the land owners to accept a retainer as expert witness in their behalf. The engineer consulted the officials of the water company who stated that they (the water company) had intended to retain him as expert witness in their case, but that there would be no objection whatever to his testifying on the other side, since his testimony would no doubt be the same in either case. After further conference with both parties and having their assurance that his action would be satisfactory to both, he accepted the retainer of the land owners.

Question.—Was the action of the engineer in accordance with correct professional ethics?

Answer.—The circumstances in this case are somewhat unusual, inasmuch as the suit at law is represented as being a "friendly" one to determine the legal status of the parties thereto; and that the retaining of the engineer by one of the parties was with full knowledge and consent of the other.

The acceptance of the retainer under these conditions was permissible and should not be regarded as unethical.

Sand and Gravel Production

According to a recent bulletin issued by the United States Geological Survey, the total quantity of sand and gravel produced in 1920 was nearly 78,000,000 tons, or about 7,000,000 tons in excess of the 1919 output, a total value increase from about $46,000,000 to more than $62,000,000. The production of building sand increased nearly 4,000,000 tons. The output of molding sand increased more than 1,000,000 tons.

How Labor Union Working Rules Raise Building Cost

Some Impeding Regulations Imposed on Contractors Are Cited by C. R. Gow, Who Had Charge of Boston Army Base

UNDER the title "The Responsibility of Organized Labor for the Stagnation in the Building Industry," Charles R. Gow read a paper recently before the Boston Society of Civil Engineers reciting in detail a number of the rules and agreements under which the various labor unions in the building trades work. These rules are mandatory and no contractor operating a closed shop can conduct his business without obeying them. They are, according to Col. Gow, the most serious cause of the inefficiency in present-day building operations and one of the principal causes of the high cost of construction. Col. Gow is a well known Boston engineer and contractor and during the war was the army officer in charge of the construction of the Boston Army Base, which work was carried out under the Baker-Gompers agreement—a closed-shop plan.

The following paragraphs set down some of the more important rules which serve to impede construction progress:

Rules Affecting Foremen

Substantially, all working rules require that foremen shall be members of unions. The effect of this provision is to subject the foremen to two conflicting influences. If he is loyal to his employer he may be deemed offensive to his union; and if he satisfies the union, it often is because he has been disloyal to his employer.

During the construction of the Army Base a foreman's union card was taken from him and he was debarred by the union from further connection with the work. Upon inquiring of the union officials I was informed that the charge heard against him was that he used profanity to the men. It appeared that his case had been considered by a secret tribunal which had recommended his expulsion, and the findings were approved by the union membership. The records showed that he was one of the most efficient foremen on the work in the matter of low production cost and satisfactory workmanship. It seemed clear to me at the time that he had been disciplined because of too much insistence upon results from his men.

The trade rules of the carpenters' district council provides that "While all foremen should prove their efficiency as such they shall not rush, use abusive language or otherwise abuse workmen under their direction. A violation of this rule is punishable by a fine, expulsion from the job, or both."

The rules of the plumbers' union provide that "It shall be the duty of all foremen to report any man late on the job to his employer at the time it occurs." This rule appears to be commendable in its nature until it is explained that the union insists that, inasmuch as this is the only expressed stipulation of its kind in the rules, it therefore follows that the foreman can report only this infraction and no other to his employer.

A foreman in the painters' union is prohibited from commenting as to whether a man is doing a proper or improper amount of work.

The electricians and lathers both submitted demands Jan. 1 last requiring that on jobs employing three or more men a foreman shall be employed, or at least one of the men should receive a foreman's pay.

Another matter which has been taken from the employers' control by the unions is that of selecting and employing apprentices in the several trades. Young men desiring to learn a trade in former years were accustomed to apprentice themselves to an employer who undertook to train them and eventually fit them to serve as finished jour

neymen. This system some years ago became offensive to the unions because it was believed that too many journeymen were being educated for the welfare of the unions. Also apprentices were used for many of the simpler duties to the exclusion of union journeymen. Therefore, the unions ultimately insisted that apprentices should be furnished only through the unions.

Since that time many rules have been established by the unions regulating the selection, employment, and work of apprentices. The general tendency has been to restrict greatly the allowable number of such apprentices and to select them with regard to their union proclivities and affiliations.

Limitation of Equipment

As to rules which prohibit work being done in the most economical manner it is provided by the plumbers' and steamfitters' unions that all piping up to 2½ in. in diameter must be cut on the job by hand. It would, of course, be very much cheaper to have all of the piping cut to exact measure in the shop, using power machines for the purpose, or even to cut it on the job using power.

The ornamental work in plastering was once cast in molds at the shop and erected as units by the plasterers. Now the union requires that all of this work must be done in place by hand work. Paint-spraying machines have recently been invented which may be effectively used for painting flat surfaces. Government tests have demonstrated their efficiency and cheapness as compared with hand painting. The rules of the painters' union, however, prohibit their use. The painters' union also prohibits the use of a brush more than 4½ in. wide in applying paint by hand. The plasters' union specifies the particular size of hod to be used and also requires that no bag material shall weigh more than 100 lb. The evident intention of the rules just referred to is to make work for more men regardless of economic considerations.

Another group of rules is aimed to compel the use of high-priced, skilled mechanics to do unskilled work which any intelligent laborer might do. For example, plumbers must handle all plumbing materials after they have been delivered on the first floor. An employer might prefer to lift the bathtubs for the upper stories by means of a derrick, but the rules provide that they must be handled by plumbers. Automatic electric pumps are frequently installed for permanent drainage of subways and deep basements, and are found to require only occasional inspection for oiling. On a construction job, however, such a pump requires the constant attention of a union engineer at $1 per hour. Similarly, a small gasoline-driven diaphragm pump of the type formerly operated by hand now requires a union engineer, although any intelligent water boy is competent to do the actual work required of him in addition to his other duties.

Overtime Pay

A steam-operated derrick engine on a certain job properly required a hoisting engineer. An electrically driven concrete mixer on the same job did not necessarily require a skilled engineer, but employed one nevertheless. On the same job there were two other machines installed, an electrically operated cable drum for hauling charging cars, and a small air compressor also electrically driven to furnish air for some jack hammers. The union temporarily could not supply engineers for the two latter machines, but provided that the wages which would have been paid to an engineer on the compressor should be divided between the two members of the union who were employed. Also it was directed that upon any day on which the cable drum was operated an additional two hours' pay should be allowed one of these men. No service was rendered by these men in connection with the operation of either machine, but each man received twelve hours' pay for eight hours' work, and if the second machine was operated one man was allowed fourteen hours' pay for his eight hours' work.

On another job two piledriver engines were employed, each operated by a union engineer. Two small electrically driven concrete mixers were in use at the same time and the only labor required to be done upon them was that of throwing in the switch to admit the electric current. This work was done by the concrete foreman. The union required that each engineer on the piledrivers be paid two hours' extra each day, although neither engineer ever tended the apparatus in question.

The carpenters' union requires that all temporary work, such as erecting working stagings and the like, shall be done by union carpenters; also that the stripping of forms from concrete-surfaces must be done by carpenters, although it has until very recently been done in a perfectly satisfactory manner by laborers.

All men employed on or around piledrivers and lighters which are engaged upon wharf building, except the engineers, must be union wharf builders, a branch of the carpenters' union. Many of these men do purely laboring work, but because of their rating draw skilled men's pay.

For several years after reinforced-concrete work was introduced into this locality the steel reinforcing bars used to strengthen the concrete were handled and placed by common labor. Later it was provided in the rules of the iron workers' union that all of this work should be done by members of that organization. A recent job in this locality was done by a non-union contractor using laborers to handle and place the reinforcing steel at a cost of $7 per ton. A similar union job going on at the same time required union iron workers for this purpose at a cost of $37 per ton.

Mechanics Have Specific Tasks

Union iron workers must also be used to do any work in the nature of rigging; that is, the erecting, dismantling or operating of derricks (other than operating the engines); loading or unloading of machinery; erecting, moving or dismantling towers, chutes, etc. At the Army Base job there were used a large number of very light derricks hoisting small buckets out of the foundation excavation. The men actually used for signaling the engineer when to start and to stop were recruited from various walks in life, some being former street sweepers, some retired bar tenders, others having served as janitors, but all at that time rated under a union permit card as skilled union iron workers.

Stoves used at night for the drying out of plastering may not be looked after by the ordinary watchman, but must be attended by a member of the plasterer tenders' union. Similarly all dirt or debris made by the plasterer must be cleaned up by a union tender and not by unskilled labor.

Union plumbers must be used to lay temporary piping for construction purposes only, as well as the suction and discharge piping of pumps. Union sprinkler fitters must be employed to lay underground cast-iron pipe which conduct water to the sprinkler system, and union plumbers similarly must lay cast-iron water pipe connecting with the building plumbing. Neither of these trades is as efficient as a trained labor gang experienced in this class of work.

Unions' Power Over Contractors

There are numerous rules of a purely dictatorial character which serve to restrict the employer in the exercise of his natural functions, as, for instance, the plumbers' rules provide that the employing plumber, or one of them if it is a firm, may do so-called jobbing work in the shop provided he does not do more than 50 per cent of all the jobbing to be done. The plasterers' union rules provide that "the employer shall be allowed the privilege of closing his weekly payroll on Thursday night in the Greater Boston district."

A revised constitution of the lathers' international union adopted at the annual convention at Toledo in September of last year provides that "all locals shall have power to regulate the granting of permits to contracting lathers, provided: First, that the fee charged the contractor or solicitor shall be left to the discretion of each local but not to exceed $100 and the resident limit cannot exceed one year." The effect of this rule is actually to prohibit any contracting lather from doing business unless he first se-

cures from the union a permit not to exceed the sum of $100, which permit must be renewed yearly.

The lathers' union rules also contain a provision that men working less than four hours shall be entitled to at least four hours' pay and if more than four hours he must be paid at least eight hours' pay.

The painters' union requires that men shall not go to the shops for tools or materials during the noon hour, but may only do so during the working time. Similarly, the lathers' union provides that men shall not be shifted from one job to another during the noon hour.

Both lathers' and plasterers' unions insist that when employers have occasion to do work within the jurisdiction of another local 50 per cent of the men must be hired from that local. The lathers' union specifies the particular kind of nails and staples which the employer must furnish.

Pay While Not Working

The hoisting engineers' union directs that men who report for duty shall be paid two hours' pay for reporting if not put to work unless they have been notified at the end of the previous shift not to report. Thus, if it happens to be stormy in the morning so that no work can be done, the engineers must still be paid $2 for reporting. If an engineer is put to work at all on the day shift he is entitled to at least four hours' pay and eight hours' pay if he starts to work on a night shift. The engineer must be paid one hour's pay for getting up steam, which work he shall do unless the night watchman is also a licensed man, in which case the latter may get up steam for the engineer.

If any work is done or with an engine during the absence of the regular engineer, he must be paid just as if he had been present. In one case an engineer was requested by his employer to work on Saturday afternoon and Sunday in order to make some needed repairs on his engine so that the work would not be tied up on the following Monday. The engineer refused because of another engagement. Thereupon the employer hired some machinist from a near-by shop who made the desired repairs. The engineer subsequently made a claim for and received pay at double-time rates for the period during which the machinist worked.

Some steel reinforcement was placed by union iron workers on a Saturday. On the following Sunday a gang of laborers was used to place concrete around the rods. The steel was found to be not in its correct position, and so was taken out and replaced by the laborers. The iron workers subsequently demanded and received pay for the work as if they had been present.

A hoisting engineer can be used to operate only a particular machine. Even though his engine be temporarily idle he cannot be shifted to another, but a second man must be employed for this purpose. On one job some repairs were to be made upon a large grab bucket. Machinists were brought out on a Sunday to do the work. An occasional lift by means of a derrick was required for a few minutes at a time. An engineer who was on duty looking after the pump was competent to do the necessary work, but he could not be used because the rules required that the regular engineer on the derrick was the only man who could touch the machine at any time. As a result the regular man was used and paid at double-time rates to make about six or eight lifts, while the other engineer was an interested spectator. Incidentally it costs an engineer $5 fine if he is caught breaking this rule.

Miscellaneous Regulations

A hoisting engineer not only must confine himself to his own machine, but he must not furnish steam to a second unit until he receives two hours' extra pay per day for so doing. Furthermore, not more than one extra machine can be attached to his boiler. No engineer is permitted to take the place of a discharged engineer without first securing the permission of the business agent of the union.

Practically all the unions have adopted a rule that members must be paid off during working hours and are entitled to pay at overtime rates for all time while waiting for pay after hours.

The cement finishers' union insists that the employer cannot hire his men direct but only through the union office.

A contractor cannot choose which engineer he desires to keep when one or more machines are shut down. He must release the man whose engine is dispensed with even though this be his best man.

Engineers are not allowed to operate the water valve on a concrete mixer although the valve is purposely placed within easy reach of the operator of the machine. The engineer must step aside each time the mixer is turned to allow a laborer to take his place for a few seconds to turn the water valve.

The electricians' union rules require that members working in the harbor shall be paid from time of leaving to return, and in no case for less than a full day. The minimum period for which an electrician may be paid is one-half day. The 1921 demand of the engineers' union provides, respecting overtime, that "an engineer shall receive not less than two hours' pay for any fraction of an hour's work." The stone cutters' union, in order to penalize any work done outside of its jurisdiction, provides that its rate of pay shall be 5c. an hour more than the normal rate for work done on stone which has been partially worked elsewhere.

A certain wood carver paid his men the union rate and in addition gave them a bonus for all work over a definite amount. The union agent upon discovering this fact ordered the practice stopped on the ground that it served as too much of a spur to the men.

Jurisdictional Disputes

One of the annoying and expensive features of trade unionism in the building industry is that pertaining to jurisdictional disputes. There are some twenty-seven separate trade unions which have to do with building work. Frequent questions arise between them as to which one is entitled to do certain work. For instance, carpenters and iron workers quarrel over the question of which has the right to set steel sash and door frames. The iron workers and steam fitters both claim the right to install pipe railing.

Electricians and elevator constructors disagree over the placing of certain devices in connection with electric control. Iron workers and metal lathers both claim the work of placing steel reinforcing. Cement finishers and bricklayers each insist upon pointing around steel sash. Stone cutters and cement finishers each claim the rubbing down of concrete surfaces.

During the construction of the Army Base a number of pulsometers were used in connection with the foundation work. They required frequent relocating and each time they were removed it necessitated the use of two steam fitters to disconnect and reconnect the steam pipes; two plumbers to remove and replace the suction and discharge pipe; then iron workers to hoist and lower the apparatus in the holes and an engineer to turn the steam valve. The engineer and a good laborer could have done all of the work required in much less time and in an equally satisfactory manner.

Four-Inch Gun Travels 25 Miles Per Hour

A 105-M.M. howitzer, recently tested at Fort Winfield Scott in San Francisco, is mounted on a tractor which can travel over highways at 25 miles per hour. The gun and its mounting complete weighs 6½ tons. A caterpillar tread is used, the width of the track being 12 in. and the length of the ground-contact 81 in. The driving mechanism is similar to that with which the army tanks were equipped, except that rubber is used on the sprockets and plates to reduce the vibration of high speed travel. The new gun, which is reported to have made a very creditable showing in the San Francisco tests, was made by the Holt Manufacturing Co. of Stockton, Cal.

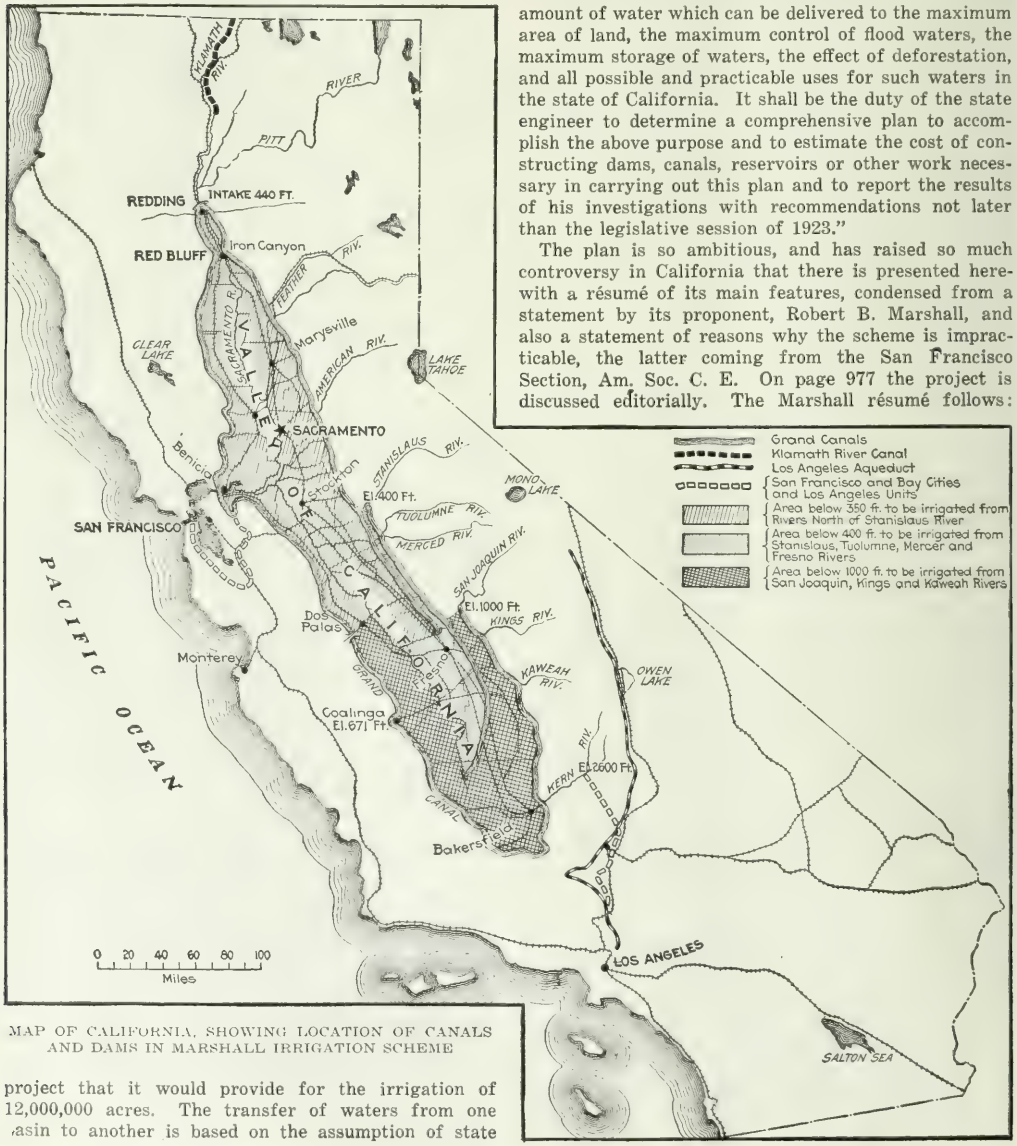
The Marshall Plan for Utilizing California's Waters

Résumé of Proponents' Statement of Vast Project and of the Objections Made by Various California Engineers

THE Marshall plan is a program for a statewide development of the water resources of California. By means of reservoirs in the great central valley of the state and canals it is proposed to utilize all the important streams of California for irrigation, power and domestic uses in accordance with a plan for supplying all parts of the state. It is claimed for the project that it would provide for the irrigation of 12,000,000 acres. The transfer of waters from one basin to another is based on the assumption of state control of all water rights. A most extensive promotion and publicity campaign favoring the scheme is being conducted in the state, with an appropriation of $500,000 for an engineering investigation as an immediate goal, but with the adoption of the Marshall scheme as the ultimate aim.

While the campaign did not succeed in getting the $500,000 appropriation, the Crittenden bill, just passed by the legislature and signed by the Governor, carries an appropriation of $200,000 for the investigation of possibilities for storing, controlling and diverting water for public use throughout the state. The act contains the following provisions: "The state engineer is hereby authorized and instructed to determine the maximum amount of water which can be delivered to the maximum area of land, the maximum control of flood waters, the maximum storage of waters, the effect of deforestation, and all possible and practicable uses for such waters in the state of California. It shall be the duty of the state engineer to determine a comprehensive plan to accomplish the above purpose and to estimate the cost of constructing dams, canals, reservoirs or other work necessary in carrying out this plan and to report the results of his investigations with recommendations not later than the legislative session of 1923."

The plan is so ambitious, and has raised so much controversy in California that there is presented herewith a résumé of its main features, condensed from a statement by its proponent, Robert B. Marshall, and also a statement of reasons why the scheme is impracticable, the latter coming from the San Francisco Section, Am. Soc. C. E. On page 977 the project is discussed editorially. The Marshall résumé follows:



MAP OF CALIFORNIA, SHOWING LOCATION OF CANALS AND DAMS IN MARSHALL IRRIGATION SCHEME

From a diversion dam to be built across the Sacramento River just above Redding, water would be carried in large canals down each side of the Sacramento Valley and thence up each side of the San Joaquin Valley. These main canals would operate by gravity, siphons or pumps as may be expedient. On the main west side canal opposite San Francisco a large supply would be diverted for the use of that city and vicinity. The main east side canal would be twice ended and each time started again at higher levels where new supplies are available. Separate in construction and operation from these two systems, a third system or Los Angeles unit would be dependent upon the Kern River which would be diverted through a long tunnel for use in southern California. To offset the diversion of the Kern River waters from the San Joaquin Valley, the Klamath River would be diverted below Klamath Falls and carried into the upper Sacramento River near Shasta Springs. Above all these main canals the tributary streams would be drawn upon through reservoirs to be built along their courses. Further flexibility of the total flow would be provided by additional storage below the canals.

The funds for this development would be raised through a state-authorized bond issue, and the interest on these bonds would be met by revenue from the sale of hydroelectric current to be generated as construction proceeds. A surplus would be created for maintenance, depreciation, etc., leaving the users of water to pay the cost of construction by the purchase of water from the state for a period of say fifty years.

The Klamath River would be diverted at El. 4,000 ft., taken by tunnels and canals for a distance of 40 mi. over Shasta Pass at El. 3,792 ft. and dropped 1,250 ft. into the Sacramento River near Shasta Springs.. This would develop 375,000 hp. and add more than 2,000,000 acre-ft. to the water supply of the central valleys.

The east side main canal would leave Redding at about El. 440 and would flow southeast on a grade of about 6 in. per mile, picking up water from each stream traversed. This canal would follow the foothills on the east side for most of its length and would end at a point where it approached a crossing of the San Joaquin River. Above this point a second section of the east side main canal would start from a diversion dam on the Stanislaus River at about El. 400 and be carried thence high above and east of Fresno to a point above Tulare Lake. A third section would start from about El. 1,000 on the San Joaquin River and flow south past Bakerfield, around the south end of the San Joaquin Valley and thence north again on the west side.

The west side main canal would leave Redding at about El. 440 and would flow south along the foothills through Creston Pass, delivering water at Benicia at El. 300 where an inverted siphon would carry it across Benicia harbor. The route would pass thence through the Martinez tunnel, into the Concord Valley and up the west side of the San Joaquin Valley toward the terminus of the other canal built around the head of the valley. A dam would be constructed across Carquinez Straits to prevent the encroachment of salt water into the central valleys.

San Francisco would be served direct by means of a pipe line laid on the Dumbarton dam, a structure which would be built across the lower end of San Francisco Bay to reclaim the marsh lands south of that point. The Santa Clara Valley, as well as Oakland, Richmond, Berkeley and Alameda, would be served by a supply brought in by canal and tunnel lines from the main west side canal.

The only ample water supply for southern California lands not now served is the Kern River. This could be made to supply all the water southern California can reasonably get and perhaps all that territory would need for 150 years. To accomplish this a 300-ft. dam would be built across Kern River impounding a reservoir with a surface area of 40 sq.mi. at El. 2,700 ft. This supply would be taken through a 33-mi. tunnel to a crossing about 700 ft. under the present Los Angeles aqueduct in the Mojave Desert. Continuing south to a point near Clearwater, about 90 mi. from the Kern reservoir, the conduit would drop about 300 ft. to another intersection with the present aqueduct, which would be paralleled from that point on For additional storage and power, four 200-ft. dams would be built on the south fork of the Kern River, developing a total drop of 4,000 feet.

In conclusion it is recommended: (1) that the California Legislature appoint a committee of five to report within three months as to the general practicability of the proposed plan, and make the necessary appropriation for the expenses of this investigation. (2) That upon a favorable report from the committee the Legislature at once enact the necessary measures to put these plans into effect. (3) That Congress be requested to allow railroad and highway bridges to be built across the straits of Carquinez and to turn over the control of the navigable portions of Sacramento and San Joaquin rivers to California.

Views in Opposition to Marshall Plan

The San Francisco Section, Am. Soc. C. E., after thorough consideration of the Marshall plan, and in accord with the advice of engineers with many years of irrigation experience, cites a number of reasons why the Marshall plan is not feasible. Some of these are extracted in the following:

(1) There are no storage sites in the main Sacramento River basin that can be used for storing anything like the total flow of the Sacramento River.

(2) One-half to one-third of the Sacramento River flood waters must waste into the ocean—the only way to store these floods would be in reservoirs located in the main river channel itself and such reservoirs are not available. Thus, only part of the largest floods can be stored and this part is not more than sufficient to supply irrigable areas in the Sacramento Valley itself.

(3) If some statewide canalization project were feasible, its cost must be many times that of present irrigation projects which are costing all that the irrigated areas can afford to pay for water.

(4) The attempt to divert water from almost every important stream in the state into other watersheds would result in endless litigation over water rights.

The following has been taken from a review of the Marshall plan prepared by V. S. McClatchy, for many years president of the California State Reclamation Board:

The Marshall plan is a slight modification of a plan suggested tentatively, and in the absence of engineering data, in 1874 by D. S. Alexander, G. H. Mendel and George Davidson, and which was presented before the flood control committee of Congress in 1916 in an endeavor to defeat the Sacramento Valley bypass system which is now being carried out. My report on this, made as president of the Reclamation Board, pronounced the project practically impossible and perhaps physically impossible, as well.

How shrewdly the old plan has been revived for promotion purposes and why it has met general support after superficial examination becomes apparent when it is noted that the present scheme promises everybody something—and frequently something which he had no hope of obtaining. The arid lands west of the San Joaquin River, which have no available water supply, are promised water from the east side of the San Joaquin. The insufficient supply on the east side of the San Joaquin is to be replenished with water from the Sacramento. The Sacramento Valley itself is promised water from floods now wasting in the sea. Los Angeles and the south, always hungry for water, are promised the entire flow of the Kern. San Francisco and San José are offered water for municipal purposes and so on.

If the Marshall plan cannot be carried out, its promotion at this time will do the state serious injury. Real estate speculators are preparing a campaign to sell at liberal prices blocks of land which have no water for irrigation and which have had in the past no available sources of supply, but to which the Marshall plan promises adequate irrigation facilities.

All engineering authorities who have investigated the matter agree that most of the available reservoir sites in the Sierras are above and not below the sources of flood and therefore of no value in conserving flood flow, and that the known available reservoir capacity below the sources of flood is entirely inadequate to hold back even the ordinary floods.

The Sacramento River flood control report (House No. 616, Session 1916) states that to carry a flow of 200,000 sec-ft. (one-third the excess flow of the Sacramento) would require a canal 1,800 ft. wide and 20 ft. deep, if built on a grade of 0.8 ft. per mile. Suppose a canal of only half this capacity were sufficient for the Marshall plan. Would any engineer assert the practicability of constructing a canal of this size along the foothills of the Sierras, commencing at or above Red Bluff at El. 400 to 500 and running down into the San Joaquin Valley? If physical obstacles and property that might be damaged by a break in such a canal did not prevent its construction, would not the cost alone end further consideration of the plan? The canal considered in the Congressional report above referred to, extending from Red Bluff to Dos Palos, was estimated to cost $700,000,000 under most favorable conditions in 1916.

The maintenance of such great canals high above the Sacramento Valley would be a menace to the inhabitants of the valley below them. Breaks cannot be prevented with certainty and would have to be expected. When they occurred the result would be enormous damage and probable loss of life and there is serious question at to whether breaks at certain critical points could be repaired without almost prohibitive cost.

Promotion of the Marshall plan is retarding development. The promises made by the promoters are of such universal application that they would call for an entire change in the state system of water distribution. Land owners hesitate to go forward with present plans in the doubt as to whether their local sources of supply are to be commandeered and used in a statewide distribution system.

Any investigation aimed toward improving present conditions is worth while; but let us not deceive ourselves nor assist the bunco fame of a few real estate speculators who care more for their own profits than for benefit to their customers or the prestige and permanent welfare of the state.

This suggestion is not intended in any way as a reflection upon Mr. Marshall, whose good faith in this matter is not questioned and whose abilities in his own field are fully recognized.

For previous references to the Marshall plan see *Engineering News-Record*, Feb. 10, 1921, pp. 273 and 277, and April 7, p. 606.—EDITOR.

State Co-operation in Steam Gaging

Thirty-three states and several municipalities are co-operating in the stream gaging work of the Water Resources Branch of the U. S. Geological Survey, congressional appropriations being inadequate for the investigations needed. This condition was stated in a paper read at the recent meeting of the National Drainage Congress by N. C. Grover, of the U. S. Geological Survey, in order to make plain that any considerable extension of the steam-gaging work is impossible at present. From these outside sources more than $160,000 were made available during the past fiscal year. The Federal appropriation was $175,000, which must provide also for the cost of investigations of ground water and quality of water. The demand for additional work is insistent in states already co-operating and also in states where little or no work is now being done. To meet this demand and to provide for increased cost of work due to the depreciation of money values, the estimates for stream gaging for the next fiscal year have been increased to $300,000.

Principles of Traffic Regulation on City Streets

Trained Officials the First Requisite—Education of Public Important—Uniformity Needed in Traffic Codes

By William P. Eno
Specialist in Traffic Regulation, Washington, D. C.

Paper presented May 23 at the Conference on Highway Traffic Regulation held under the auspices of Yale University, New Haven, Conn.

THE science of highway traffic regulation consists in the knowledge of how to regulate the movement of vehicles and pedestrians so that they interfere with one another as little as possible and are enabled to go from point to point in the shortest time compatible with safety. Traffic regulations are divided into two parts—general and special. General highway traffic regulations are those which contain all things essential for the largest city and nothing superfluous for the smallest village. Such regulations should be standardized and their general use insisted upon throughout the whole country. Failure to realize this fact has always resulted in chaos and unnecessary loss of life.

In the scientific regulation of traffic, the first and most important step is the education of those to be regulated. If this principle is followed the work of the police becomes that of promoters and assistants rather than that of enforcers. Drivers and pedestrians, when they know their rights, become the real regulators, as they resent infraction by those few—a constantly diminishing number—attempting to over-ride the rights of others. This was once a theory, but to those familiar with the work it has long since proved to be a fact. If educational measures are relaxed traffic regulation goes backward.

It is essential that general traffic regulations be brief or they will not be read, clear or they will not be understood, reasonable or they cannot be enforced, uniform or they will result in confusion and danger. The first set of general highway traffic regulations was adopted in New York on Oct. 30, 1903. These have gone through many revisions. They were officially issued in Paris on July 10, 1912. On May 8, 1919, a new revision, most carefully prepared, was offered for standardization by the Council of National Defense through its highways transport committee. It is not probable that any other set will be compiled in the near future which will be better, although arrangements should be made so that, from time to time, suggestions for improvements can be considered.

Trained Direction Necessary

The greatest trouble in traffic now is that many of the cities have delegated aldermen, commissioners or police officers to formulate traffic rules. These officials, with few exceptions, not content to profit by the experience of others, appear to have been actuated in their legislative efforts by a desire to originate and satisfy a pride of authorship. The result of their efforts has been that while they have plagiarized themselves by adopting everything of value in the New York regulations, these have been so distorted by rearrangement, rewording and by important omissions and unimportant additions that the patchwork thus produced has been confusing and much too long. The sets of regulations given to some of our cities contained over 6500 words, lacking both sequence and order and mixing up special regulations with general regulations.

Traffic regulations should never be in the form of an ordinance, but there should be an ordinance or some other law empowering the police departments to adopt the Council of National Defense code without change of any kind. This is the practical way of attaining uniformity so much to be desired because absolutely necessary for safety.

The Council of National Defense Code is printed in a 4 x 6-in. four-page folder in an especially approved form, containing marginal notes, and on a placard about 14 x 20 in. The folders should be kept for distribution at every police station and every driver should be obliged to pass an examination on the regulations and carry a copy with him when

driving. The placards should be displayed in public garages, stables, schools and station houses, and on standards in public places in order that pedestrians as well as drivers may have an opportunity to become familiar with them. Schools should instruct their pupils in the regulations and hold examinations and drills. We must rely on education of pedestrians through directions which appeal to common sense.

In trying to educate the public in general regulations we should eliminate all thought of special regulations, which must not under any circumstances be written into or form a part of the general regulations. In addition to the folders and placards of regulations cities should issue a pamphlet setting forth the special regulations, particularly those in regard to the approach to and departure from places of assembly, a list of one-way traffic streets, the method of obtaining licenses for driving, registration for vehicles, laws on equipment, etc, etc. This, however, is a separate and distinct thing and must not be confounded with general regulations.

Special Regulations

Special regulations are those which can be brought about by traffic guides consisting of lines, signs, standards, bumpers, dummy cops, semaphores, crowsnests, direction lights, etc., which can be extensively employed to guide the movements of both pedestrians and drivers.

Lines are of exceeding importance but not when unscientifically placed. Trained experts should be employed to lay them out.

Signs should denote their meaning, as far as practical, by their shape and color, different color combinations being used for different purposes. The best combination consists of vivid yellow letters, arrows or graphics on a black background. These should be used for moving vehicles. Secondary signs for stationery vehicles should have these colors reversed and tertiary signs, or those for the control of pedestrians, should have red letters, arrows or graphics on a white background.

Standards should never be joined by ropes, chains or pipes, as such practice is dangerous. They should be only sufficiently heavy to remain in place in a high wind. Their bases should be of special pattern to avoid rolling if knocked over. It is better to accentuate their visibility by placing them within painted lines or on a white disk. The bases and tops of portable standards should be painted bright red and the pipes with black and white bands from 8 to 12 in. wide, the top and bottom bands being white.

Bumpers should be kept painted white and should stand on a painted white disk so that they can be more easily seen.

"Dummy Cops," or posts designed as substitutes for traffic officers, first recommended in 1904, have multiplied so that there are now hundreds of thousands of various designs. They should be standardized as far as possible, painted in the same way as traffic standards, placed on white disks and effectively lighted at night. The dummy cop is far more effective and certainly more economical than anything else except an expert traffic officer and when such an officer is not available a dummy cop should be used.

Semaphores should be so constructed that their signs may be placed in a neutral position and then they may be left as dummy cops when there is no traffic officer on duty.

Crowsnests, such as used in Detroit, have proved of inestimable value and should be investigated carefully for use in every city.

Traffic Regulation Lights should be given further study in order to develop them for traffic purposes.

Role of Police in Traffic

The general and special duties of police in traffic regulation, uniform code of signals, traffic bureau, traffic court, etc., are treated at length in the text book entitled "The Science of Highway Traffic Regulation" [by W. P. Eno]. There are, however, certain points that should be insisted upon if we expect to reduce the loss of life and increase the saving of time.

The head of a police department should never attempt traffic regulation himself, but should delegate his powers to an officer not responsible to any one except the head of the department. He should have full authority and be held accountable for results only. Members of the traffic squad and other policemen when detailed on traffic duty should be under his control. He could have ready for use at all times a motor car in order that he may keep in close touch with his work.

The only way the world can make up for the cost of the war is by administering public as well as private enterprises in the future so that they may function without avoidable waste of life or money. In computing what traffic regulation can do, we are forced to adopt premises more or less conjectural though founded on experience. The figures are given for what they are worth.

Traffic Accident Losses

It is not possible to obtain an accurate count of lives lost by traffic accidents because many of the injured get away and die afterward, leaving no record. Estimates of the yearly loss of life in the United States [from traffic accidents] run from 10,000 to 57,473, the latter estimate being from an official report from Australia for the year 1920. This report states that during the nineteen months when the United States was in the war 48,000 men were killed in battle or died of wounds. That during the same nineteen months 91,000 were killed on the highways, 25,000 of these being children of school age. This is at the rate of 57,473 in a year, and at $10,000 per life—the amount the courts usually allow—it means a loss of $574,730,000. This sum, added to the financial loss through accidents to persons and property, the saving of time and money to people and the increased efficiency of vehicles through traffic regulation, indicate a loss of more than $3,000,000,000.

We may fairly suppose that if there were no traffic regulations twice that amount would be lost, and we may also assume that if traffic regulation was twice as good as it is we would save at least half of what is now lost or $1,500,000,000 per year.

These figures, inaccurate though they may be, since they are founded on assumed premises, I believe not to be exaggerated. It is now time for us to realize that the subject of traffic regulation must be taught in schools and in universities and the problems worked out by engineers of ability.

Nearly ten years ago, many of our city planners and other engineers began to take an interest in traffic regulation until now the subject may be regarded as a legitimate branch of civil engineering and as such it should be in the hands of men thoroughly trained for the purpose.

The great loss of life, time and money is largely due to the fact that practically every city has been allowed to make its own regulations, which are usually enforced by untrained traffic officers. Such methods are uneconomical and should be superseded by those of intelligence.

Propose Large Irrigation Project

Estimates recently prepared and submitted to Governor Hart of Washington and to members of the state reclamation board, show that costs of complete development of the proposed Horse Heaven Irrigation District, lying between the Columbia and lower Yakima rivers in south central Washington, will aggregate $31,522,644. The figures were compiled by a committee representing landowners in the district. Plans as outlined provide for a main canal system following the east side of the Klickitat canyon, concrete-lined throughout with riveted steel pipe for siphon crossings, and a system of reinforced-concrete distribution and lateral canals. Three reservoirs are contemplated. The first plan, however, is to use the natural flow without impounding. On this basis, the cost of the supply canals, intake, etc., is placed at $20,295,928, and the cost of the distribution system $3,678,000. Storage reservoirs to be built later are estimated to cost $4,595,152.

B. Welchii as Test for Safe Water and Cause of Water-Borne Diarrhea

Conclusion of Survey of Practice and Opinion—B. Welchii Technique at Montclair and Jersey City, N. J., and Method Used by D. D. Jackson for Detecting and Isolating B. Sporogenes and B. Welchii

A tabular summary of reports from 66 engineers, bacteriologists and others as to the use of the B. Welchii test for water and the liklihood that the germ causes intestinal disturbances appeared in Engineering News-Record *for June 2, page 929, with a number of supplementary statements. These statements are here concluded and some notes on laboratory technique are given. The numerals preceding the names of each correspondent refer to the table printed in our issue of June 2, 1921, pp. 330-331.*—EDITOR.

Further Supplementary Statements

31. *N. J. Howard, Toronto, Ont.*—In many laboratories there is a tendency to assume that a certain type of bacteria, not killed by chlorine, and which produces abundant gas formation (usually after 48-hr. incubation), is B. Welchii. I think that in the great majority of such cases careful morphological and biological studies would show that the organism, while belonging to the anaerobic group, was not the typical B. Welchii.

The temperature of the water in Toronto during at least two months of the year is below 34 deg. F., yet an examination of the records covering a period of six years, and based upon the examination of six samples a day during that period, shows no evidence that chlorine is not absolutely effective in sterilizing the water. We are satisfied that, at least in Toronto, the efficiency of the sterilization process is not impaired by cold water conditions. This may not apply to other cities where the content of the water may be entirely different. We have no record showing the prevalence of seasonal epidemics in Toronto. A few years ago the accidental opening of a water valve controlled by an industrial concern resulted in some untreated water being drawn into the city mains. The area supplied by these mains was plotted out, and a house-to-house inspection made. It was expected that an epidemic would result, but, apart from some vomiting which affected children only, no ill effects were recorded.

Recently I published an article (*Canadian Engineer*, Jan. 20, 1921) on the prevalence of typhoid fever in Toronto during the summer months, when the raw water was most seriously polluted. It had been pointed out in England by Sir A. C. Houston, director of water examination, Metropolitan Water Board, that the prevalence of typhoid fever did not generally follow the worst water periods, as judged by chemical and bacterial tests. I showed that in Toronto, as in many American cities, typhoid fever cases did increase and follow the worst water periods of pollution, but that since bacterial examination of the water after filtration and chlorination clearly showed the water to be sterile, there was no indication that typhoid fever in Toronto was water borne.

Does Not Cause Epidemics

I know of very little evidence that B. Welchii causes gastro-enteritis epidemics. As isolated from water and sewage the germ is almost universally regarded as non-pathogenic in character. Possibly certain types of spore formers somewhat similar to B. Welchii, and which have been frequently isolated from water and milk supplies, are capable of causing epidemics of diarrhea. But in these cases the organism would have to be present in considerable numbers before an epidemic would result, and it is hard to see how this could happen in a water that had been efficiently chlorinated. Even if the spores resisted chlorination, it is probable that they would be weakened and much less liable to be of a virulent nature.

Where it is claimed that B. Welchii is the actual cause of an epidemic, it should not be difficult to establish the fact. Bacterial examination of the feces of those affected should show the presence of B. Welchii in enormous numbers. The bacillus is normally present in the intestinal flora, but in an epidemic, if it was the direct cause, it would predominate.

If it can be clearly shown that B. Welchii is direct cause of intestinal disturbances a very difficult controversy will arise, involving a radical change in present ideas of the efficacy of chlorine in eliminating water-borne epidemics. The results of effective chlorination have been so conclusive that one hesitates to accept any such new theories, because, if the contention were a sound one, epidemics would be of frequent occurrence in almost all American cities.

Classifying Bacteria

During the war much work was carried out by American and British authorities on the classification and study of anaerobic bacteria. Several types of these anaerobes have been isolated from water and sewage, including B. Welchii, B. Aerogenes Capsulatus, B. Sporogenes, B. Enteritidis, Sporogenes, and at least ten others not classified. It is probable that some of these are one and and the same bacillus, the morphology having been slightly altered by the cultural methods used. The typical B. Welchii does not form spores, whereas both B. Aerogenes Capsulatus and B. Enteritidis Sporogenes of Klein are spore formers. There is, however, an atypical variety of B. Welchii which forms spores. This would seem to have a distinct bearing upon the efficacy of chlorine, and upon the powers of the spore formers to resist effective chlorination. Some years ago when Klein isolated the B. Enteritidis Sporogenes, following an epidemic of diarrhea in St. Bartholomew's Hospital, London, England, he found the stools of the sixty cases involved to be literally swarming with the bacilli, but the epidemic was traced to the milk supply.

The B. Welchii test is still made in England but is known as the B. Enteritidis Sporogenes test. Houston in his "Studies in Water Supply" (London, 1913, pp. 157-8) says in part:

> The milk tubes are examined and those showing the B. Enteritidis Sporogenes phenomenon (gas formation, separation of the whey from the casein with precipitation of the latter) are registered as positive results. It may be objected that a variety of microbes may produce these changes, and the writer has always frankly admitted that he regards the test primarily as a test, and not necessarily as proving the presence of a particular microbe, and that microbe alone.
>
> The above changes in milk culture were described by Klein as characteristically typical of the growth of B. Enteritidis Sporogenes, and so it is both complimentary and convenient to retain the name, although the word *test* should be added as signifying that, in recording a positive result, one is not necessarily committed to the view that the characteristic changes are produced solely by one microbe, and that the one described by Klein. The practically important point is that sewages commonly yield a positive result with 0.001 c.c. and pure water a negative result with 10 c.c. or even more.

32. *S. C. Prescott, Cambridge, Mass.*—Doubtless the number of B. Welchii in water indicates to some extent the degree of pollution. Because B. Welchii is a spore former it may indicate remote pollution, but if it occurs with even small numbers of B. Coli it confirms in a striking way the evidence of recent pollution supplied by the colon finding. Tests for B. Welchii are very useful in water examination. Occurrence of the germ should not be regarded as indicating merely a very remote degree of pollution. The B. Welchii test should not be considered as a substitute for the B. Coli test, but as supplementary.

I am strongly of the opinion that heavy infection of water with B. Welchii may give more or less serious intestinal troubles, such as we had in Cambridge for a day or two in 1920. [See also report from Prof. M. C. Whipple.—EDITOR.] Following the break-up of snow and ice, and probably as the result of the inrush of surface water, there was perhaps a week during which the consumers of Cambridge water were quite markedly infected with a diarrhea. Apparently with the settling of the water [in the storage

reservoirs.—EDITOR.] this disappeared. When we first made examinations we were able to demonstrate organisms of both the colon and Welchii types. A temporary chlorination plant was established. The water quickly resumed its normal condition and there was no further trouble. I do not regard the Cambridge water as entirely unpolluted as it is possible to get from time to time a colon reaction and also B. Welchii. That it is not a grossly polluted water is shown from the drop in the typhoid rate. [Cambridge for years past has had a very low typhoid rate.—EDITOR.]

Probably waters generally free from pollution are quite likely to cause intestinal disturbances when some gross contamination from surface wash or other material takes place, whereas consumers of constantly polluted water acquire a sort of immunity to the casual organisms. We have no statistical evidence of this but some practical evidence seems to be given by cities with badly polluted water supplies—for example, by Pittsburgh before filtration. We are still quite a bit in the dark as to the significance of B. Welchii.

34. *R. S. Weston, Boston.*—In 1899 I studied the B. Welchii organism (which is the same as the B. Enteritidis Sporogenes of Gaertner and Klein, described by the latter in the Report of the Medical Officer to the English Local Government Board, 1901-2). I did enough work on B. Welchii to find it in many waters, and to prove that it was as prevalent here as in England. Not being a real bacteriologist, I dropped the matter, particularly as most of my bacteriological friends were not in favor of searching for the organism in the ordinary routine and also because it was then necessary to inoculate guinea pigs with the organism in order to demonstrate its presence. Since then, the methods have been improved, and I believe that the organism should be looked for in all our water supplies, particularly those supplying communities where intestinal disturbances are prevalent.

I do not believe that the ordinary dose of chlorine, say 0.5 p.p.m., affects the spores of B. Welchii, although Houston states that a larger percentage of the latter organism than of B. Coli is removed by filtration. This he believes is because of the greater motility of the B. Coli and the larger diameter of the spores of B. Welchii. Because both these organisms are intestinal forms and are abundant in sewage and silt, and also because B. Welchii is very prevalent in richly manured soil, there is no reason why the organisms which are most easy to detect should be selected for study and the search for B. Welchii neglected, particularly in waters which have been treated with chlorine in doses insufficient to kill the spores of the latter. Houston and others have advocated the super-chlorination of water (followed by the use of an antichlor) to make sure that not only B. Coli is killed but also the spores of B. Welchii.

THE CAMBRIDGE OUTBREAK

35. *M. C. Whipple, Cambridge, Mass.*—The Cambridge outbreak [mentioned in the foregoing letter by Prof. Prescott.—EDITOR], was very elusive and in my mind never pinned down to facts, chiefly on account of the lack of analytical data. An outbreak of diarrhea occurred about the middle of March, 1920, following a heavy thaw. For years we had been making analyses of Cambridge water practically every week and sometimes oftener. I had expected that the bacterial content of the water would increase about this time, and it did, but the analyses I had and any others I saw did not show conditions to be as bad as they had been in some previous years—that is, the bacterial content was not as high nor were B. Coli as numerous as at some other times.

Unfortunately, there were no analyses by any laboratory for 3 or 4 days before and after the date set by the state epidemiologist for the onset of the disturbance. The outbreak lasted only 2 or 3 days. The state epidemiologist intimated that there might have been about 1,000 cases but the true number is uncertain as all the cases were mild, many not requiring a doctor. The public was unduly frightened by a warning to boil the water, this being sent out after the bulk of the cases had occurred. Chlorination has been quite regularly practiced for some months past. [Bids for filters were requested in April, 1921.—EDITOR.]

I made an extensive study of the Fresh Pond reservoir as soon as the trouble started and also of the watershed streams. The results were not as bad as expected, probably due to dilution by the large run-off from melting snow. If the main reservoir, Fresh Pond, had been polluted to any great extent the pollution would have manifested itself for a considerable time. This reservoir holds 1,400,000,000 gal. and the water is pumped from it to the distributing reservoir. On the whole, the case against the water supply was not a strong one, but certain epidemiological evidence pointed to it, such as the fact that the majority of cases had nothing in common but the water supply. If pollution occurred, it was for a very short time only and escaped notice in routine analyses.

We have not regularly made tests for B. Welchii. In fact, I have never been able to appreciate the significance of this test. I fail to see what it indicates that B. Coli does not, unless the fact that B. Welchii may form spores points to pollution far in the past. This does not seem to be a great desideratum in view of the fact that all of the intestinal pathogens succumb, so far as we know, in water before B. Coli succumbs. Furthermore, B. Welchii is a common inhabitant of the soil.

I think we have all felt that there may be disturbances caused by water which we have heretofore disregarded because of the greater importance of typhoid. There is a question whether these relatively slight disturbances, if due at all to water, are the result of a mechanical or chemical irritation or are caused by bacterial infection.

EXPERIENCE AT SACRAMENTO

36. *Frank Bachman, New York City.*—B. Welchii and other allied lactose-splitting organisms have interested me for a number of years, especially since the advent of chlorination. My best opportunity to study B. Welchii was at Sacramento in 1916. The city was furnishing dirty river water, treated with liquid chlorine only. Early in December, 1916, an agitation against chlorination arose due to the disagreeable tastes. The taste, chlorine-like, was very marked for a period of over a year prior to this time. Among the many theories advanced as to the cause of the tastes were: chlorination, microscopic organisms, and drainage from rice fields some distance above the town. The city chemist claimed that the taste was due to chlorine—or that at least it was similar to chlorine—but his tests for free chlorine in the tap water were negative. The rice fields had been drained sometime previous, so that source was more or less eliminated. Microörganisms were few in number in the raw water, which also precluded the possibility of tastes from this source.

The local health board decided to cut off the chlorine supply for several days and see if the tastes disappeared (a rather criminal procedure). The State Board of Health asked for an immediate hearing at which it was decided to put the chlorine plant into the state's hands.

As chemist of the State Board of Health, I was immediately detailed to Sacramento. I found that the city dosing with chlorine at the rate of 4.2 lb. p.m.g. or about 0.5 p.p.m. Studies showed that 1 lb. eliminated tastes and that no B. Coli were found in the treated water, while 2.2 lb. gave a slight taste. It was decided to use 1.8 lb. p.m.g. to keep below the taste point and still give a high factor of safety. The city has been using this dose ever since with practically no complaints from tastes and no cases of typhoid or other intestinal diseases attributable to the city water.

The city laboratory was using lactose bile as a presumptive test. (Standard Methods, A. P. H. A., of that time). Its desire was to eliminate gas-producing organisms completely in 50 c.c.; consequently the high chlorine dosage. I had it changed over to lactose broth and confirmed all gas formers on endo medium. The city chemist took some exceptions to this procedure, as it was not standard, but he later found that the Standard Methods of 1917 were practically the same as I had outlined.

An intensive study was made to determine the organisms producing gas in lactose bile and resisting chlorintion. I isolated B. Welchii from seven different tap samples around town when the water had a distinct chlorine-like taste.

My identifications were verified by bacteriologists at the University of California. In lactose broth, little or no gas was formed by B. Welchii in 24 hr., but considerable in 48 hr., while in lactose bile much gas was found in 24 hr. I explain this as follows: B. Welchii will develop immediately in lactose bile or milk because these media are favorable to this organism; whereas lactose broth is not so favorable and the organism will not propogate until the medium is strictly anaerobic. It is well known that lactose broth contains dissolved oxygen, especially after it has stood in the ice box for days. At Sacramento, when using lactose broth, a prolific growth of organisms took place in the first 20 hr., which consumed the oxygen, after which B. Welchii took a start and in 48 hr. large quantities of gas were noted.

The taste in the Scramento River supply when using large quantities of chlorine was due to chloramine compounds (NH_2CL) or combinations of chlorine and organic matter. The bacteria being vegetative unite with the chlorine first, as their cells are easily oxidized and unstable. This seems reasonable, as B. Coli elimination can be accomplished without taste if the chlorine is properly applied.

The literature indicates that B. Welchii are widely distributed. They are in fact more widely distributed than B. Coli because of their resistance, and of their ability to change from the vegetative form to the spore or resting stage. In the Sacramento River water, B. Coli were present in the raw water in from 10 to 1,000 per c.c. while B. Welchii were found in much smaller numbers, about 1 to 5 per 50 c.c. Studies on the Potomac have shown that a lower ratio of B. Welchii to B. Coli exists near the source of pollution and a higher ratio further down stream. [See summary by W. F. Wells.—EDITOR.] This means that as the river purifies itself the B. Coli die off, leaving the B. Welchii in the same or somewhat reduced numbers. B. Welchii are commonly found in milk. Much difficulty has been experienced in the pasteurization of milk, due to the resistance of B. Welchii. Many pasteurization plants have been condemned because the laboratories have found gas formers in the pasteurized product. The literature is filled with epidemics attributed to B. Welchii. The best publication on this subject is a monograph by Dr. J. P. Simonds.

Interest Largely Historical

The fact that I found B. Welchii in the Sacramento River water gave the city officials some work and they claimed that this organism should be eliminated. It has not been eliminated from the supply in the past four years and no epidemics have occurred. Dr. Simonds and Dr. Fisher, the latter a well known bacteriologist and pathologist of the North of California Medical School, both wrote letters to me at the time stating that in their judgment B. Welchii as found in water supplies is non-pathogenic.

It has always seemed to me that B. Welchii has more of a historical than other interest in determining the character of a water supply. Also, that if B. Coli is eliminated from the supply, bacterial purity is established. The differentiation of the various groups of B. Coli into grain, human, etc., is a rather risky procedure, especially if the purity is to be based on the source of the B. Coli. One state, a few years ago, held that a water supply may contain B. Coli other than the fecal type. With the present knowledge of water purification, this stand is criminal, as the differentiation of B. Coli into the various groups is not sufficiently substantiated. My opinion is that if we eliminate the vegetative forms (B. Coli, etc.) we eliminate those organisms apt to give intestinal troubles. The epidemics from B. Welchii have been traced to milk in which it is known that this organism will multiply very readily, while it is present in water usually in the spore state.

37. *W. S. Coulter, New York City.*—My experience has been that water containing B. Welchii may be successfully disinfected with liquid chlorine. As an instance, I may cite the case of Talladega College, Ala., where I installed liquid chlorine apparatus, following a sanitary survey in 1915. This institution secured its water from the City of Talladega, from wells in fissured limestone. Previously, the city supply had been secured from so-called springs, which were in fact outlets from cavities in the limestone, which probably received pollution from the surface. Examinations of the city supply and of water from an old well on the college grounds showed B. Welchii frequently in 1 c.c. and occasionally in 0.1 c.c.

Following the disinfection of the college supply (0.33 p.p.m. of chlorine) an immediate improvement in the health of the students was noted. Soon after, Talladega put in a disinfecting plant for its entire supply. Since then, the formerly recurring epidemics of dysentery, typhoid and paratyphoid in the city and at the college have entirely ceased. Here was a sporogenes-bearing water, furnished to a community in which dysentery was common and typhoid outbreaks frequent, the disinfection of which brought about the practical disappearance of these diseases.

Inferior as Pollution Indicator

While B. Welchii is frequently found in the discharge of dysentery patients, I do not understand that it has yet been demonstrated that it causes the disease rather than a type of organism which finds the conditions established by dysentery congenial to its growth. B. Welchii may be considered as an indicator of pollution, but is inferior to B. Coli, although in certain cases a knowledge of its presence may be useful. It is difficult to identify and isolate from a water supply a specific bacterium causing dysentery in a given instance. That such bacteria are intestinal in type may be accepted and, if B. Coli is absent, it may be reasonably assumed that other intestinal bacteria are likewise missing. A predominating indicator, such as B. Coli, seems to me to afford a most reliable means for presumption. That resistant bacteria remaining after disinfection are peculiarly spore formers, such as B. Welchii, or that spore formers constitute an abnormal proportion of the type surviving, has not, I think, been demonstrated.

Bacterial examinations are suggestive rather than conclusive, and I would not care to proceed very far in any case on bacterial information alone. Should it, however, be conclusively demonstrated that spore-forming bacteria causing dysentery or other diseases often survive present methods of disinfection in active condition, it would indeed be unpleasant news to the sanitary engineer.

41. *Dr. H. D. Pease, New York City.*—While we have not been systematically employing any particular method of testing for B. Welchii in our investigations of water, milk and other food, we have made fairly extensive observations with respect to the presence of spore formers and products of these types. We have probably made more observations of this sort in connection with shellfish studies than in the case of any other food examined. As shellfish problems are more or less directly related to sewage pollution of tidal waters, our observations are perhaps pertinent.

Where tidal waters receive much pollution and such pollution is not carried by the tidal current very rapidly in the direction of the oyster bed, and especially where there are opportunities for sedimentation and preliminary purification, we have noticed a very decided tendency for our analyses of oysters during the non-hibernating period of the year to show very considerable numbers of B. Welchii, although B. Coli may not be in excess of the numbers permitted by practically all of the health supervisory organizations having charge of oyster inspections and examinations. Undoubtedly, many oysters of this sort have been consumed, especially in September, October and early November. If this has caused intestinal disturbances, the numbers of cases do not appear to have been notable. It is well known that in any substantial instances where oysters have been responsible for the development of outbreaks of typhoid, the onset of this disease has been preceded by many cases of diarrhea and other intestinal derangements among those who have consumed the oysters.

The relation of B. Welchii to milk supplies has received considerable attention by English bacteriologists under the name B. Sporogenes. The subject has been extensively dealt with by Dr. W. C. Savage in his book, "Milk and the Public Health." The whole question of finding spore-forming bacteria in milk supplies requires considerable investigation. I am inclined to believe that the findings will vary in differ-

ent localities, not so much on account of the possibilities of differences in the original contamination of the milk, as because of the varied systems of heating the milk as it passes from the farm to the consumer. One has only to stop to think that it is far easier to destroy vegetative forms of bacteria than it is the spores to realize that whenever spores gaining access to milk have a chance to develop into the vegetative form, they are much more easily destroyed by heating processes than they are if they have never had a chance to grow out of the spore stage. It is therefore more common to find spore-forming bacteria in very excellent milk supplies than in the ordinary run of pasteurized Grade B milk. One would hesitate to suggest that all milk should be somewhat incubated before it is pasteurized—so as to destroy spore-forming bacteria—and yet as a practical proposition, that is what actually happens in the very considerable amount of the common Grade B milk supplied to the public after pasteurization.

Disease-Bearing Evidence Not Satisfactory

42. *Dr. W. W. Ford, Baltimore.*—B. Welchii is a normal inhabitant of the intestinal tract of man and of the domestic animals and is present in their dejecta. A claim has been made that an increase in the number of B. Welchii occurs in certain diseases, as in pernicious anemia and in summer diarrhea of children. There is no satisfactory or convincing evidence that this is so.

The spores of B. Welchii are widely distributed in nature, having been isolated from the dust of rooms, street dust and from a great variety of soil. They are constantly present in natural waters, both polluted and unpolluted, and their presence in water has absolutely no sanitary significance. I pass a water as satisfactory which is free from B. Coli, despite the fact that the water contains B. Welchii. I know of no diseases in this part of the country which can be traced to the entrance of spores into the intestinal tract from drinking water. It is theoretically possible that both B. Coli and the spores of B. Welchii would go through a filter and that B. Coli would be destroyed by chlorination while the spores of B. Welchii would resist chlorination, but one ought not to draw conclusions from hypothetical conditions of this character.

A short paper "On the Occurrence of B. Welchii (B. Aerogenes Capsulatus) in the Dejecta of Sewage," by J. H. M. Knox, Jr., and W. W. Ford of Johns Hopkins University (the Johns Hopkins Hospital Bulletin, January, 1915) contains this conclusion:

> It is evident from the results of this inquiry that B. Aerogenes Capsulatus must be regarded as a normal and constant inhabitant of the intestinal tract in children except in breast-fed infants . . . attaching pathological significance to the presence of this species in the intestines can, therefore, properly be made only when evidence can also be adduced to show its excessive development. In view of the fact that in several of our normal cases the majority of the milk tubes gave positive results, we are of the opinion that satisfactory evidence of an abnormal proliferation of this species in pathological cases has not thus far been brought.

46. *M. F. Stein, Chicago.*—The definition of B. Welchii is somewhat dependent upon the cultural characteristic used for its identification, as there are a number of more or less closely allied types. Since B. Welchii is found not only in the human intestines but also in those of animals and in richly fertilized soils, and is a spore-former capable of resisting adverse conditions, it would not seem to be as good an indicator of recent pollution as B. Coli, which is more akin to the serious water-borne diseases. However, it would be valuable to study its frequency in filtered and chlorinated water, as this would shed light on the efficiency of chlorination relative to spore formers.

In view of the many strains of lactose fermenters which have been traced out by bacteriologists, and the numerous complicated (sometimes contradictory) cultural tests which have been advocated recently, I favor a simple fermentation test which will include all suspicious bacteria, even though it may also include many harmless forms; then, for raw water, prove such suspicions by a thorough field survey rather than by more laboratory work, which is less direct and less conclusive. In the case of filtered supplies, I am inclined to consider the bacterial finding more of an indication of filter efficiency, and to give less attention to the type of organism found, since the action of filters is not preferential. By sanitary control of the watershed so as to maintain the raw water in a condition such as can be made safe by filtration, and by maintaining good filter efficiency, a safe filtered water is assured. There are of course many water problems where more elaborate bacteria procedure is justified.

47. *Max Levine, Ames, Iowa.*—I do not use the B. Welchii test as a routine matter, but where the positive presumptive tube shows no growth on the confirmatory plate, I note that the gas production was probably due to an anaerobic spore-former. I believe that the use of B. Welchii as an index of the probable presence of such intestinal disease organisms as typhoid and dysentery is without adequate foundation, for there is no question at all but that a stored or chlorinated water may contain spore-forming anerobes long after all typhoid and dysentery bacilli have been destroyed by the treatment. If, however, B. Welchii is to be regarded as a specific cause of infection, there may be some justification for such a procedure. This organism has been considered by some bacteriologists as sometimes responsible for diarrhea. Some strains produce an irritation in the intestinal tract, supposedly due to the production of butyric acid, but members of the Welchii group are so frequently encountered in milk that it would seem that the occasional organism, which may be present in water, would be insignificant. If further observations indicate that B. Welchii is really responsible for water-borne diseases, it would be necessary to determine the characteristics of the responsible strain. The term B. Welchii is used by water bacteriologists in a very loose sense to include all spore-forming anerobic organisms capable of fermenting lactose. Most of these forms are non-pathogenic, so that I question the condemnation of water merely on finding spore-forming anerobes. It will be necessary to determine the particular species of anaerobe present.

Laboratory Technique

D. D. Jackson, Department of Chemical Engineering, Columbia University, New York City.—Most water supplies are now treated with chlorine so that the bacterial content is greatly reduced and B. Coli and nonspore-forming disease germs practically eliminated. The amount of sterilizing agent used is not great enough, however, to kill the spore forming organisms[1] and an amount necessary to kill spores would be beyond the practical limit for drinking water purposes, although such amounts may be used in the treatment of sewage or factory waste[2]. The group of anaerobic spore-forming gas-producing organisms are known to be associated with certain diarrheal disturbances. Of this group, B. Sporogenes and B. Welchii are the most common. The pathagenicity of B. Sporogenes having been established,[3,4] and its presence in feces and sewage demonstrated by Klein, Houston[5] and others, it is important that a simple and rapid method should be employed for the determination of its presence in public water and milk supplies.

The usual procedure is to heat various dilutions of the sample in sterile milk to 80 deg. C. for ten minutes, and incubate anaerobically for from two to three days. After this time, if the bacterium is present in the spore state in the dilutions used, there will be a strong acidity produced, and a complete separation of the curd and whey with a strong odor of butyric acid.

This test is, however, somewhat indefinite, as there are several other spore-forming bacteria which give this reaction. It should also be noted that the method described considers specifically the spore state of the bacillus and would fail to detect it if it were present only in the vegetative condition. It is also true that exposure to such a high temperature might kill the spores, if they are somewhat attenuated. It is probable that this condition may exist if they have been in the water any length of time.

These sources of error have been eliminated by a method which also serves to isolate B. Welchii, a spore and gas forming organism equally prevalent in polluted water and which has been found by the author on several occasions in abnormal numbers in the feces of children suffering from

SPECIES.	FERMENTATION. Dextrose Broth		Lactose Broth		Saccharose Broth		Dulcite Broth		Raffinose Broth		Mannite Broth		Lactose Bile Broth		Liver Broth.				Motility	Anaerobic	Growth at 37½° C.	Growth at 20° C.	Nitrate Reduced.	Indol Produced	Gelatin Liquefied	Milk Coagulated	Aesculin Bile Salt
	Total Gas	% CO_2	Total Gas	% CO_2	Total Gas	% CO_2	Total Gas	% CO_2	Total Gas	% CO_2	Total Gas	% CO_2	Total Gas	% CO_2	Total Gas	% CO_2	Spores	Strong Odor									
B. Sporogenes	70	50	0	0	0	0	0	0	0	0	0	0	0	0	0	78	54	+	+	+	+	+	−	−	+	+	−
B. Welchii.	67	37	60	40	50	40	12	−	57	32	0	0	95	35	90	39	−	−	−	+	+	+	+	−	−	+	−

DISTINGUISHING CHARACTERISTICS OF B. SPOROGENES AND B. WELCHII

serious intestinal disturbances. In one case of severe recurrent diarrhea it rose in numbers at the time of attack till it was by far the predominating organism present in the intestine. The following is the mode of procedure:

1. Inoculate various dilutions (usually 0.1, 1.0 and 10.0 cc.) of the water or milk to be tested into fermentation tubes containing liver broth [7,8] and incubate for 24 hr. at 37 deg. C. If B. Sporogenes is present either in the spore or vegetative state in the dilutions used, there will be gas formation, accompanied by an offensive cheesy odor, and microscopic examination will show numerous and vigorous spores. B. Welchii in liver broth gives no odor and no spores, but an abnormal amount of gas (see table). By observing in which dilutions they are present, the relative degree of contamination of these bacteria will be apparent. Numerous bacteria, both vegetative and spore-forming, have been examined but none have been found that give this strong peculiar odor in liver broth except B. Sporogenes. This is the presumptive test for the presence of B. Sporogenes. Large rounded bacilli with heavy gas formation, no spores and no odor is the presumptive test for B. Welchii.

2. To complete the test for B. Sporogenes and isolate a pure culture of the organisms, transfer the entire contents of each tube showing gas plus characteristic odor into separate sterile Erlenmeyer flasks or large test tubes and heat to 80 deg. C. for ten minutes. Any attenuated spores or vegetative bacteria present in the original samples will have formed vigorous spores, and the heating destroys all species of vegetative bacteria that might interfere with its further separation.

3. One cubic centimeter or less of broth containing sediment may be withdrawn from the bottom of the flasks or tubes after heating and planted separately into a second set of serile liver broth fermentation tubes and incubated for 24 hr. at 37 deg. C., after which time gas formation and characteristic odor will again be observed. Microscopic examination will reveal the presence of numerous large sluggishly motile bacilli containing spores. Often B. Sporogenes is now present in pure culture.

A stab culture made from this 24-hr. liver broth culture into dextrose liver gelatine[7,8] will demonstrate the presence of B. Sporogenes by its characteristic growth. Within 48 hr. after incubation at 20 deg. C. a distinct anaerobic growth will be observed, beginning about 2c.c. below the surface. Liquefaction will be well advanced and gas bubbles will accumulate at the top of the liquefied area.

4. To obtain colonies of B. Sporogenes on agar plates it is necessary to transplant a few drops of broth and sediment from the second set of fermentation tubes, in step 3, into a third set of tubes and incubate for from 3 to 5 hr. at 37 deg. C. After that period a distinct anaerobic growth will be observed in the closed arm, and a few bubbles of gas will be found at the top. The B. Sporogenes is now in the vegetative state and this is the only condition in which it will grow on the plates.

The contents of the closed arm are transferred to the bulb by tilting forward and plating in dilutions of 1.0 to 0.00001 c.c. on dextrose liver agar, and incubating for from 12 to 18 hr. in hydrogen at 37 deg. C. Typical colonies will then be visible, consisting of one or more gas bubbles surrounded by a delicate white fringe. The plate cultures also have a disagreeable cheesy odor.

5. From one of these colonies a deep stab culture is made into dextrose liver agar and incubated for 24 hr. at 37 deg. C. A distinct anaerobic growth will be observed along the line of puncture, and sometimes the agar is split into two or three layers by the gas evolved. A liver gelatine tube inoculated and incubated at 20 deg. C. will also give a very distinctive anaerobic growth.

6. A sub-culture may also be made into litmus milk and incubated for 48 hr., anaerobically, after which time there will be a complete separation of curd and whey and a strong odor of butyric acid. Sometimes the curd adheres to the sides of the tubes and has a peculiar shredded appearance.

Many other types of spore forming bacteria may be isolated by this method. By this procedure the author has several times isolated large numbers of B. Vulgaris and other similar species from condensed milk which caused diarrheal disturbances. As B. Welchii does not form spores in liver broth it must be isolated direct from the liver broth without heating.

Distinguishing Characteristics

There has been considerable discussion as to whether B. Sporogenes and B. Welchii are the same organism. Cultures of bacteria isolated from water at the Mt. Kisco Laboratory, New York, conform with B. Welchii in that they are strictly anaerobic, readily ferment dextrose and lactose and are non-motile. These and the other distinguishing characteristics are given in the accompanying table. The culture of B. Welchii used was obtained from Dr. Welch of Johns Hopkins University and the culture of B. Sporogenes from Dr. Klein's laboratory in London, so that both should be authentic. This ought to settle the discussion as to their being identical. They are decidedly two different species. They are indicative of contamination in water, are both pathogenic to guinea pigs and have often been found by the author and others in cases of intestinal disturbance, particularly among small children where the resistance is low.

The spore-forming organisms commonly found in water which are aerobic are B. Mycoides, B. Subtilis and a few others. These are nonpathogenic and are easily eliminated as they do not grow in the closed arm of the fermentation tube which is under anaerobic conditions.

Anaerobic bacteria other than B. Sporogenes and B. Welchii are also found in water as B. Anthracis (facultative), B. Edematis, B. Symptomatici, B. Tetani, B. Botulinus and B. Butyricus. All of these are pathogenic except the last and may be distinguished by their morphology and general cultural characteristics in case the bacillus found does not conform to the two common organisms of this group, B. Sporogenes and B. Welchii. The occasional presence of organism of this character is becoming more apparent since the removal from water and sewage of a large proportion of the numerous other species by chlorine treatment, and much more attention should be paid to the determination of the presence of members of this group than has been the case in the past. It is evident that where such organisms are found in drinking water efficient filtration as well as chlorination should be applied.

[1]Jackson, D. D., The Interpretation of Water Analysis. *Proceedings*, Am. W. W. Assoc., 1911.
[2]Jackson, D. D. and Buswell, A. M., The Sterilization of Tannery Wastes, *Journal* Am. Leather Chemists' Assoc., Feb., 1917.
[3]Klein, E., Morphology and Biology of Bacillus Enteritidis Sporogenes; on association of this Microbe with Infantile Diarrhea and with Cholera Nostras; and on its Relations with Milk, with Sewage and with Manure. Local Government Board. Medical Officer's Report, 1897-8, page 210.
[4]Klein, E., Further Report on Bacillus Enteritidis Sporogenes. Local Government Board Medical Officer's Report, 1898-9.
[5]Houston, A. C., Studies in Water Supply. Macmillan.
[6]Welch, W. H. and Nuttall, G. H. F. *Bulletin* of the Johns Hopkins Hospital, July, 1892.
[7]Jackson, D. D. and Muer, T. C. Liver Broth. A Medium for the Determination of Gas-forming Bacteria in Water. *Journal of Infectious Diseases*, Vol. VIII, No. 3, April, 1911, pp. 289-294.
[8]Standard Methods of Water Analysis. Am. Pub. Health Assoc., 1913, pages 131-3.

Dr. George E. McLaughlin, Sanitary Adviser and Bacteriologist, Bureau of Water, Jersey City. The method used in Jersey City water-works laboratory in testing for B. Welchii follows: A total of 14 fermentation tubes, half containing lactose bile media and half lactose broth media are inoculated with the water sample. In each set of seven there are one 0.1 c.c., one 1 c.c. and five 10 c.c. tubes, making a total of 102.2 c.c. of water for both sets. Any tubes of either media showing gas during 72 hr. incubation at 38 deg. C. are examined for B. Welchii, which as a rule produce a high percentage of gas—80 to 100 per cent and usually the latter within 36 hours. Five steps follow:

1. With a small pipette, 2 c.c. is drawn out from the bottom of the tube and inoculated 1 c.c. into a culture tube containing 10 c.c. Krumwiede triple sugar agar with Andrade indicator, and 1 c.c. into a culture tube containing 10 c.c. of whole milk, both these tubes having been very recently boiled to drive off contained oxygen.
2. Both these tubes are then put in a water bath and kept at a temperature of 80 deg. C. for 15 minutes, to kill any B. Coli type of organisms that might have been present.
3. The two tubes are then placed in a Novy jar and the oxygen exhausted, allowing the tubes to cool before putting in the incubator.
4. The tubes are incubated for 24 to 48 hr. at 38 deg. C.
5. If the B. Welchii type of bacteria is present a stormy fermentation takes place, blowing the agar media to pieces with a beautiful pink coloration of the same; and in the milk tubes showing gas formation and separation of the whey from the casein, with precipitation of the latter.

It may be objected that a variety of microbes may produce these changes, but I frankly admit that I regard this procedure primarily as a test, and not necessarily as proving the presence of any particular microbe, and that microbe alone.

I consider step 5 important, for I have obtained this phenomenon with B. Coli types when not using the heat to kill this group of organisms.

H. B. Larner, Health Officer, Montclair, N. J.—In making the B. Welchii test at the Montclair Board of Health laboratory 10 c.c. samples of water are inoculated into each of five fermentation tubes containing lactose peptone broth. The tubes are incubated at 37.5 deg. C. for 72 hours. From tubes showing the production of gas in amounts varying from 40 to 100 per cent, and having a typical butyric acid odor, a loopful of media is placed in a petri dish and an endo plate poured (*not smeared*) about ¼ in. thick. The plates are incubated at 37.5 deg. C. for 24 hours. A typical red colony showing a bubble of gas at the bottom of the dish is then fished and inoculated into a tube containing 5 c.c. of sterile whole milk which has been recently boiled to drive off absorbed oxygen. Hot sterile paraffin is next poured on top of the milk so that when cool it forms a solid air-tight seal about ½ in. thick with the production of anaerobic conditions. The tube is then incubated 24 hours at 37.5 deg. C. Coagulation of milk with typical stormy fermentation and gas production, which forces the paraffin seal to the top of the tube, is taken as confirmatory evidence of the presence of B. Welchii.

Three States Authorize City-Manager Plan

Legislation enacted in March of this year, according to a circular issued by the National Municipal League, makes it possible for any and all cities in Indiana and Wyoming to adopt the city manager plan, while in Missouri the option was granted to third-class cities. The city manager act for Indiana was largely drafted by A. R. Hatton, staff consultant for the National Municipal League, and the Wyoming bill was submitted to representatives of the League for criticism and suggestions. Up to April 13, 19 Indiana cities had communicated with the League regarding the adoption of the city-manager plan under the new statute. The secretary of the National Municipal League is H. W. Dodds, 261 Broadway, New York City.

Steel Trash Racks Coated with Concrete Placed by Cement Gun

IN ORDER to protect the steel frame trash racks at its hydro-electric power station at Vernon, Vt., and to provide as smooth a waterway as possible, the New England Power Co. has encased the steel in concrete placed with the cement gun. The main girders of the racks were first coated with the gunite and then erected in place and the ties made with further gunite.

The extension to the plant where these improvements were made contains two water wheels, each of which has a water capacity of 1,800 ft. per sec. This water passes

GUNITED BEAMS BEING ERECTED IN RACK

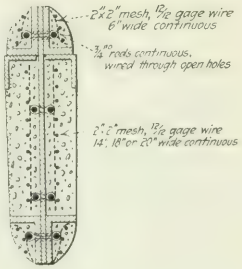
through racks which cover an opening in front of each unit 45 ft. wide and 26 ft. high. The racks are supported by four intermediate lines of built-up structural steel girders which in turn are supported at each side and at the center of each unit opening. Thus there are 16 of these girders, part of them 21 ft. 6 in. long and part 25 ft. 9 in. long, varying in width from 28 in. to 34 in.

Before erecting these supporting girders in place, the steel, which was never painted, was thoroughly cleaned and wire mesh fastened securely to the girders on all surfaces and spaced in general about ¾ in. from the surface of the beam. Each beam was then laid horizontally and gunite applied to bring the section of the final beam out to a uniform line. After the gunite had set, the beam was turned over and the other side completed. The beams were then handled to place by derrick.

After bolted connections had been made and small vertical interconnecting members placed, the beams were concreted in at the ends and the middle piers

respectively and connection pockets and the small steel members gunited in place.

The plant extension was designed and the work carried out by the Power Construction Co. of Worcester, Mass. The particular feature of the work here described was also designed by the same company. All of the work of guniting the beams and ties, however, was done under the personal supervision of a Cement Gun Company expert.



SECTION THROUGH GIRDER SHOWING GUNITE COVER

Diagram for Plotting Vertical Curves

By Harold T. Avery
San Luis Obispo, Cal.

THE plotting of vertical curves on grade profiles, which is usually a minor detail in the drafting work for railway and highway projects, is becoming of greater importance with the development of highway engineering, for almost invariably a highway or road profile is made up of steeper and shorter grades than a railway profile, thus increasing the frequency and curvature of the vertical curves. Although a vertical curve plotted on any of the ordinary profile scales is a portion of an elongated parabola or ellipse, that portion so nearly approximates a circular arc that in most cases it may be plotted as such without appreciable error. The rapid and accurate plotting then depends upon the easy determination of the proper radius, facilitated by a set of even-radius curves, or even-degree curves.

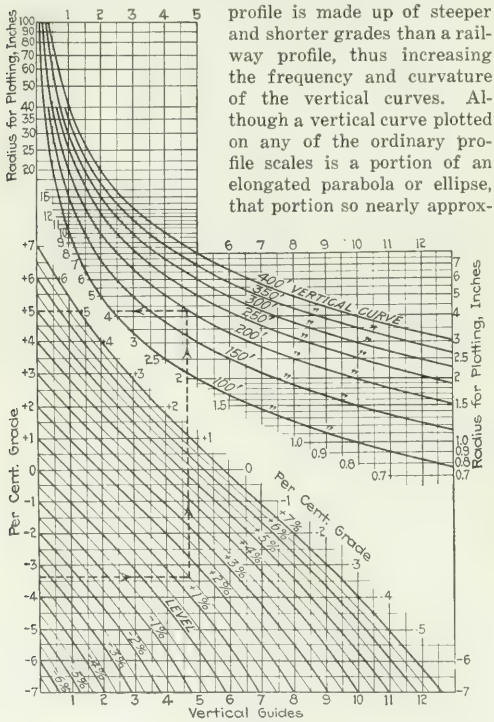


DIAGRAM FOR VERTICAL CURVES

If the intersecting grades, as plotted, do not make more than about 20 deg. with the horizontal, and if the maximum length of curve, as plotted, is in the neighborhood of four inches, the proper radius may be determined conveniently as a function of the per cent change in grade and the length of curve, by formulas 1 and 2. The word "scale" in the formula means the number of field or actual units per unit of length on the plot, as 10 when the scale of 1-in. equal 10 ft. is used. These formulas will give the radius in inches, if the length of curve is given in feet and the scales in feet per inch.

$$\text{Radius} = C \times \frac{\text{Length of curve}}{\text{Per cent change in grade}} \quad (1)$$

$$C = \frac{100 \times \text{vertical scale}}{(\text{horizontal scale})^2} \quad (2)$$

When the length of curve as plotted is much over four inches, or especially when the intersecting grades, as plotted, make over 20 degrees with the horizontal, this formula cannot be depended upon to give results sufficiently close for plotting. In fact, using the scale of 1 in. = 100 ft. horizontally, and 1 in. = 10 ft. vertically, which scales are ordinarily used on federal-aid road projects, the error in the case of grades over 5 per cent becomes appreciable. To meet this condition, the writer has devised the accompanying diagram, in which the intersecting grade per cents are used directly in determining the radius, instead of using merely the per cent change in grade. The radius thus determined is that of the circular arc which when placed tangent to the intersecting grade lines will pass through the proper point at the middle of the curve.

In the diagram the horizontal lines representing the radii for plotting are so drawn as to make one line correspond to each curve of the ordinary set of even-radius curves. If an office is equipped with even-degree instead of even-radius curves, they may be used by re-labeling these lines accordingly. If an office ordinarily makes its profiles on other than the scales mentioned above, the diagram may be adapted to the desired set of scales by re-labeling the grade per cent curves, using the formula (3), and re-labeling the curves for the various lengths of vertical curves, with new lengths determined by formula (4).

$$\text{New grade per cent} = \frac{10 \times \text{vertical scale}}{\text{horizontal scale}} \times \text{old grade per cent} \quad (3)$$

$$\text{New length} = \frac{\text{Horizontal scale}}{100} \times \text{old length} \quad (4)$$

With the diagram thus adjusted to the scales and equipment of the particular office, all vertical curves may be plotted quickly with ease and accuracy.

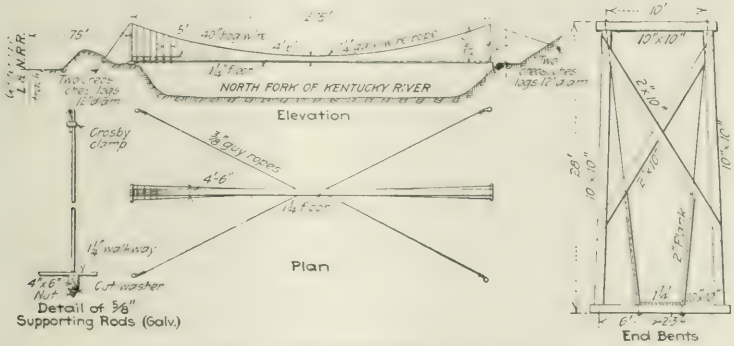
In using the diagram, from the intersection of horizontal and diagonal lines representing the grade per cent of two intersecting grades, follow vertically upward to the intersection with line representing required length of vertical curve. The horizontal line at this point gives the desired radius. For example, a 200-ft. vertical curve between grades of — 3.37 and + 1.50 per cent takes a $4\frac{1}{4}$-in. radius. For vertical curves of length not shown, read the 100-ft. curve line and multiply by length in stations. For scales other than those shown in the diagram multiply both grade per cents by horizontal scale ÷ (10 × vertical scale) and multiply required length of vertical curve by 100 ÷ horizontal scale, using the values thus obtained in following the diagram.

Letters to the Editor

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

A Suspension Footbridge Worth Study

Sir—Some of your readers who are fond of calculating suspension bridges may be interested in attached drawing of a suspension foot bridge which was constructed in Kentucky during the year 1920. The attached drawing was traced from the engineer's drawing, by which the bridge was constructed. I am told that the bridge has had as many as 50 people on it at one time. Of course, neither the writer nor the company with which he is connected had anything to do with its construction.



A NEW KENTUCKY SUSPENSION BRIDGE

C. H. Blackman,
Principal Asst. Engineer Louisville & Nashville R.R. Co.
Louisville, Ky., May 16.

Non-Ferrous Slag in Concrete

Sir—I observe that an editorial note at the head of the article, *Engineering News-Record*, May 19, 1921, p. 840, describing the Bingaman St. viaduct, Reading, Pa., built of slag concrete, says that, "Contractors will observe the evidence that slag concrete is more workable than concrete with a stone aggregate; there is less weight to be handled per unit volume of concrete and the mixture flows more readily through chutes and fills the forms with less labor":

Evidently the slag used is the product of the blast furnace in smelting iron ore. The slag produced in the West in the smelting of gold, silver, copper and lead is heavier than any stone aggregate; breaks into exceedingly sharp and angular pieces, and when used in concrete produces a mixture of low flowability, comparatively difficult to handle. On account of its weight and fire-resisting quality this slag is especially suitable for retaining walls, and for concrete subjected to the combination of high temperature and water such as occur in railway ash pits, for example, but on account of its greater weight it is not suitable as the aggregate in reinforced-concrete column, beam and slab work. It would place a sharp limitation on the use of reinforced concrete in high building construction.

This Western slag makes, in my opinion, a ballast for railroad track better than any rock ballast. It exists in vast quantities at the copper smelters and is extensively used as railway ballast. It weighs about 3,400 lb. per cu.yd. when broken up to ballast size as against about 2,400 lb. per cu.yd. for ordinary rock.

J. L. Campbell,
Chief Engineer, El Paso & Southwestern System.
El Paso, Tex., May 28.

Mixed Construction

Sir—I note Mr. Hagarty's letter in your issue of May 12, p. 825, entitled "Concrete Building Failure Shows Monolithic Nature of Frame," in which he makes reference to the reconstruction work on the United States National Bank Building in Denver, Col., described by myself in your issue of April 7.

The incident which Mr. Hagarty describes of two interior columns in the ground story of a seven-story reinforced-concrete building failing without cracking the slabs and beams which were supported by these two columns is very remarkable. I assume that the failure was "incipient" and not complete, and that the columns were removed and replaced with structural steel columns because they showed signs of failing. The query at once arises why these two columns were not replaced with reinforced concrete, as could have been easily done. If we are to understand that the two columns actually collapsed so that they no longer carried any portion of the load of the floors above, then indeed it is very remarkable that the floors which had been supported by these two columns remained, and not only did not collapse but, as stated in Mr. Hagarty's letter, did not even crack. I can assure Mr. Hagarty that we relied on no such miracle in removing column No. 21 from the first story of the Denver building, and that ample and proper supports were provided before it was touched.

Regarding the use of what Mr. Hagarty is pleased to term "mixed construction" of reinforced concrete and structural steel, it is well known that a great many buildings were built in the United States using cast-iron columns and steel or iron beams, the outer ends of the beams supported on concrete, brick or stone walls or piers, many years before structural steel-frame or reinforced-concrete frame buildings were built. Many of these old buildings are standing today in an excellent state of preservation and without showing any serious defects due to the mixing of these materials.

If there is any element of danger in supporting steel beams or girders on reinforced-concrete columns, or in supporting reinforced-concrete columns, floors and beams on steel girders, the engineering profession should certainly be educated without further delay, as this practice is being followed daily and has been pretty firmly established for years by common usage. In fact, when it becomes necessary in a reinforced-concrete building to carry several stories of columns and floors, supported on a clear span, the writer prefers to use structural-steel girders or trusses to save depth, and to fireproof them with concrete.

It is quite possible to calculate the deflection in the steel girder under maximum load and so design it that the deflection will not be excessive or detrimental to the rest of the structure. This is a matter which is up to the designer, whether the building is steel frame, reinforced concrete or "mixed construction."

It may not be amiss to call attention here to the fact that almost all steel-frame buildings are combination structures in that they have reinforced-concrete floors and fireproofing, or hollow tile arches and fireproofing, or brick arches and fireproofing.

It seems to the writer that the work on the Denver building has demonstrated what can be done in reconstruction of reinforced-concrete buildings and that it marks a very important step in the art, as it removes what has been made one of the most serious objections to reinforced-concrete construction in the minds of architects, engineers and owners; namely, the difficulty of making changes.

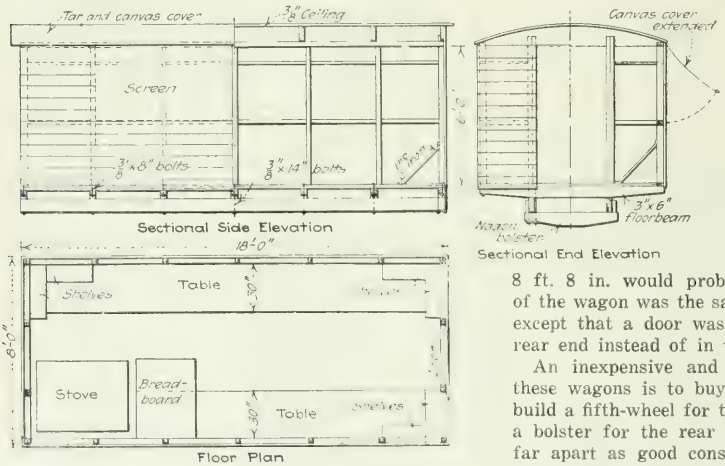
Walter H. Wheeler.
Minneapolis, June 2.

HINTS FOR THE CONTRACTOR

Mess- and Bunk-Houses on Wheels Make Mobile Construction Camp

By R. M. Adams
Civil Engineer, Montrose, Col.

CAMP units on wheels were the means of materially reducing the labor cost on canal repair work in Idaho, done last year under the direction of the writer. The plan was to have both mess- and bunk-houses always in readiness so that the entire camp could be moved on very short notice, and at the same time entail very little expense. This eliminated the greatest element of inefficiency in this class of work and also increased the morale of the camp by insuring regular, hot meals for the workmen who were often wet all day during the winter months. This item of small labor turnover would in a short time pay for the mess-wagon.



A MESS- AND COOK-WAGON OR BUNK-WAGON

The plan on which the wagon-camp units were constructed was to do as little framing as possible, and still be consistent with good workmanship and appearance, but not to save weight at the cost of sturdy construction. In the main the frames were built up of 2 x 4-in. studding with a canvas-covered roof. Wire screen was placed around the walls at windowsill height, which could be covered with canvas when desired. The construction of the cook-wagon is shown in the accompanying illustration.

The sides were built up of 7/8-in. flooring as that was the only material that could be had at the time. The 3/8-in. material used for the roof, or ceiling, it is believed, could replace the heavier material of the sides with considerable saving in weight. The roofing material consists of canvas tarred and sanded lightly. This kind of a covering will withstand the rubbing of low-hanging branches better than any other, and is just as waterproof and durable as any manufactured covering.

The form of rafter construction is such that there could be no eaves. It is therefore an advantage to have the roof covering continue on over the edge of the roof, and up under the blind-stop used as a fastener at the joint of the siding with the roofing boards, and from which the canvas hung loosely as constructed in the bunk-wagons, with a pole at the bottom edge. In the mess-wagons the canvas was attached at the line of the top of the windows; in both wagons the canvas came down to a point 6 in. lower than the window sill. It can be fastened down to keep out rain, snow, or dust, in windy weather, and will aid the cook in keeping the necessary temperature for culinary work. In hot weather it can be set out at an angle to form an awning.

On the work mentioned above one mess-wagon was provided for each camp and as many bunk-wagons as the work on the particular job in hand required. The number of men placed in one wagon varied principally with nationality. The bunk-wagons were made 9 ft. wide, and three bunks were built longitudinally at each end on the floor, or near it, leaving an open space in the center for tables, chairs, and stove. Access is provided by a door in the middle of the side. The cook's wagons were made 8 ft. wide, although a width of 8 ft. 8 in. would probably be better. The framing of the wagon was the same as that of the bunk-wagons except that a door was provided in the center of the rear end instead of in the side.

An inexpensive and satisfactory way to build up these wagons is to buy only wheels and axles and to build a fifth-wheel for the front end, a sand board and a bolster for the rear end, and to place the axles as far apart as good construction will allow, using iron braces to steady the rear axle, rather than a reach pole. On the work under the writer's direction all of the fifth-wheel was made in the blacksmith shop of the repair department except the plates which were purchased for $8 per set—cheaper than they could be made. It was found that three-point suspension greatly reduced strains on the wagon-body, and it is essential that the mess-wagons have fifth-wheels when used on canal banks, as it is possible to get the wagons to and from places that would otherwise be inaccessible; it is not impossible to turn one of these wagons on an 18-ft. canal bank.

The construction of these wagons is lighter than the car for somewhat similar purpose described in *Engineering News-Record*, Feb. 27, 1919, p. 444. The light construction makes it possible to handle them easily, and when hooked behind a tractor or to a truck, they are not likely to break in the running gear. For several reasons they would be very acceptable for highway work. Based on the prices in the northwest during 1919, one of these bunk-wagons costs nearly $175 and a cook-wagon $200.

NEWS OF THE WEEK

New York, June 9, 1921

Federation Receives Report on Waste in Industry

Committee Finds that Management Is Responsible for 50 Per Cent and Labor 25 Per Cent of Wastes

After a discussion during which it appeared, for a time, that the report of the committee on the elimination of waste in industry, charging that "over 50 per cent of the responsibility for these wastes can be placed at the door of management and less than 25 per cent at the door of labor," might be repudiated, the executive board of the American Engineering Council, the governing body of the Federated American Engineering Societies, at its meeting in St. Louis, June 3, unanimously approved the document on the condition that it be issued only as a signed committee report. An abstract of the report appears elsewhere in these columns.

Following a conference between Edwin S. Carman, representing the federation, and H. O. Garman and C. E. Drayer, president and secretary, respectively, of the American Association of Engineers, the executive board of the federation passed a resolution appointing a committee to consult with a similar committee of the American Association of Engineers with a view to establishing some basis of co-operation between the two organizations. It is understood that the appointment of such a committee by the American Association of Engineers has not as yet been authorized.

Committee Reports

The committee on licensing of engineers objected to Section 39-0 of the recently amended New York law, which states, in part, that "nothing herein shall apply to a corporation, partnership or joint stock association provided the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint stock associations shall be licensed engineers." It was pointed out that the revised section, from which the foregoing has been quoted, was an unsatisfactory attempt to meet the criticism of the Attorney General with regard to a former section (No. 14) which had been declared unconstitutional. The report was referred back to the licensing committee with instructions to prepare an additional report for the next meeting.

A motion was carried approving the Temple bill calling for appropriations to be used in the completion of the topographical survey of the United States.

The water power committee reported in favor of a "hands-off" policy with regard to the Federal Power Commission.

The committee on engineering research recommended that government appropriations for research be distributed among colleges suitably equipped for such work whether or not they be classified as land-grant institutions.

Bill in Congress Authorizing New York Port Compact

A bill authorizing the establishment of the Port of New York Authority and the port compact between the States of New York and New Jersey was introduced in the House of Representatives May 26, following the introduction of a similar bill in the Senate.

License Law for Pennsylvania

House bill 204 to regulate the practice of professional engineering and land surveying in Pennsylvania was signed by Gov. William C. Sproul May 26. The act becomes effective June 1, 1922.

The bill follows the model law of Engineering Council, with modifications to conform to local requirements. Corporations and co-partnerships are not exempted, as all practitioners come under the law. The section of the measure referring to corporation practice is as follows: "A firm or a copartnership or a corporation may only engage in the practice of the profession of engineering or land surveying in this commonwealth in the name of the person or persons connected with such firm or copartnership or corporation who is or are in responsible charge of the design or of the execution of the work which constitutes such practice each of whom is registered as a professional engineer or as a land surveyor."

The American Association of Engineers, mainly through the Harrisburg, Philadelphia and Pittsburgh chapters, were the main sponsors of the bill. Some minor opposition developed at the public hearings before the ways and means committee from engineers resident in southeastern Pennsylvania.

The bill had a turbulent voyage. Attempt was made to kill it in committee, but once on the floor it passed by a five to one vote. Next, through activities of officials of the state highway department, it was referred to the judiciary committee and was not brought to a vote until the closing hour of the session, when it was passed by the Senate. It was then held up by the Governor for two days less than one month.

Early Action on New Federal Aid Road Bill Probable

No Difficulty Expected in Harmonizing Differences Between Townsend and Dowell Measures

(Washington Correspondence)

Prospects favor the early enactment of federal highway legislation. A compromise measure will be fashioned from the Townsend and Dowell bills, which are being actively considered in Congress. Hearings on the Townsend bill were concluded by the Senate committee on post offices and post roads June 2. Hearings on the Dowell bill were still in progress before the House committee on roads on that date.

The Senate committee, in the light of the testimony which it has taken, will make several amendments to the Townsend bill, as introduced. One of these will make it clear that the selection of the roads is to be made in co-operation with the state highway commissions. The Dowell bill probably will be reported to the House in substantially its present form.

The Senate is expected to pass, without material change, the Townsend bill in much the same form that it will be presented by the committee. The House unquestionably will pass the Dowell bill. The differences in the two bills will be harmonized in conference. The indication is that no great amount of difficulty will be experienced by the conferees in blending the bills into a measure on which they can agree.

Philip Perlman, Secretary of State for Maryland, was one of the recent witnesses appearing before the Senate committee. He said, in part:

"One objection that we have to the Townsend bill is that the commission is to be given power to determine what roads are to form the interstate system. The states are given no choice in that selection. That is a very serious matter. The state commission should make the selection subject to the veto of the federal government, as has been the custom in the past. It also is a serious matter for us that the commission should have the power to make roads conform to a certain standard. All of our roads are not 20 ft. wide. We do not have the 66 ft. right of way in many instances. After we have spent our money on roads we should not be confronted with legislation of this kind. We would rather not have such standards put in the bill. What you are doing, and it may be unintentional, is forcing a bill that gives state aid to a federal project instead of federal aid to a state project."

(Continued on p. 1011)

Disastrous Colorado Floods Follow Great Rainstorm

Large Part of Pueblo Destroyed—Heavy Precipitation Causes Unprecedented Stages in Upper Arkansas and South Platte Rivers

EXTREME floods devasted the valley cities of central and southern Colorado east of the continental divide between June 4 and June 6. The worst damage was done in Pueblo, where the waters of the Arkansas River and its tributary, Fountain Creek, rose 15 ft. above the highest previous stage and submerged over 300 city blocks, destroying a great number of buildings and causing deaths estimated by hundreds. No dependable figures of damage have been compiled up to the present, but amounts reported from various points indicate a total of $20,000,000 to $25,000,000, of which nearly $15,000,000 represents the Pueblo loss.

Two rivers, the Arkansas and the South Platte, drain the region east of the continental divide, which passes north and south somewhat west of the middle of the state. Their drainage areas, embracing this region from Greeley and Fort Collins in the north to the New Mexico state line in the south, were covered by an abnormal, long-continued rainstorm beginning on June 2 but reaching its maximum on June 3 and 4 and in part continuing until June 5 and 6. J. M. Sherier, U. S. Weather Bureau district forecaster at Denver, in a telegram to *Engineering News-Record* describes the cause of the floods as torrential downpours on the eastern slope of the continental divide, of whose maximum intensity there is probably no record. Apparently the most intense rainfall affected the southerly half of the area described, forming the upper drainage area of the Arkansas, while somewhat less heavy but longer-continued rains fell over the South Platte drainage area. Pueblo, the chief city in the former region, was by far the worst sufferer, and damage to roads and bridges in this region is also reported the most serious. Denver and other cities in the northern region suffered relatively little, but extensive damage was done to agricultural lands and to bridges and the highways in the South Platte area also.

Heavy Rainfall for Several Days

Robert Follansbee, district engineer of the U. S. Geological Survey, reports that the Arkansas and South Platte Rivers reached their highest stages for many years as the result of unseasonable extreme rains occurring at a time of normal high water stages from melting snow in the mountains. Forecaster Sherier gives the precipitation in the night of June 3-4 at Pueblo as 2.88 in., but expresses the opinion that a much heavier precipitation occurred in the area just above the city. The Pueblo figure for June 3-6 is 6.18 in. The storm thus is closely comparable in intensity and extent with the Central States storm of March, 1913, while the steepness of the drainage area rendered the effects relatively more severe; the Arkansas River after emerging from the Royal Gorge in the neighborhood of Canyon City falls about 500 ft. in 35 miles to Pueblo. Flood stage at Pueblo is about 10 ft. The highest previous flood is reported as 14.3 ft., but the crest of the present flood reached 30 ft. (estimated).

No rainfall figures for the South Platte drainage area are as yet available. but J. E. Maloney, state highway commissioner, reports excessive rains over the entire drainage area for Ft. Collins to the southern divide at Palmer Lake.

Failure of several storage dams, among them three dams on Beaver Creek, a northern tributary of the Arkansas near Florence, is reported to have intensified the flood conditions on the morning of June 5. No definite account of the damage to these structures has been obtainable, however, up to the moment of going to press. The Skagway dam near Cripple Creek and some smaller dams in the mountains are said to have failed.

Little loss of life occurred along the South Platte and its tributaries. Large property damage was done here, however, according to Mr. Follansbee.

Much Agricultural and Highway Damage

Millions of dollars of damage to agricultural interests are reported in both the Arkansas and South Platte areas. Highway damage is extensive in both the northern and southern regions, according to J. E. Maloney. This latter figure is estimated at $1,000,000 for the Arkansas and probably almost as much for the South Platte. According to one report, every bridge over the Arkansas for many miles was washed out. Mr. Maloney reports a bridge at Hadley and a bridge at Las Animas washed out east of Pueblo, but others in that part of the state uninjured. A stone arch bridge over Fountain Creek at Buttes was destroyed and a temporary structure is under construction there now. In the South Platte region most of the county bridges on the tributaries are out, but none on the main river; the road damage in this region is very great, however.

By June 7 energetic efforts were being made to re-establish communication with Pueblo from east and north, including railroad service; communication from the south had not been badly disturbed. The state highway authorities were then at work repairing road damage and had already restored many of the main thoroughfares.

Belle Isle Bridge Contract Let on New Bids

As the result of receiving favorable bids on May 21, on the fourth advertisement for the construction of the Belle Isle bridge at Detroit, the city has let contracts for the structure to Greiling Bros., of Green Bay, Wis., and the Wisconsin Bridge & Iron Co., of North Milwaukee, Wis.

The total cost will be $2,365,830, which comes within the amount available, the balance of the $3,000,000 bridge fund voted in 1917. Construction of the bridge will be started within a month. The work has been under consideration since the old bridge burned, six years ago.

Greiling Bros. were awarded the contract for work in Groups A, C, and D, comprising all the work except the structural steel and bronze bearings. For the substructure work they bid $1,278,180, for concrete work in the superstructure $690,235, for waterproofing $23,280, and for handrailing and lamp posts $20,000. The one contract, covering the above items, totals $2,011,695. The Wisconsin Bridge and Iron Co. bid $354,135 on the structural steel and bronze bearings.

Twelve Firms Bid

Twelve firms bid on all or part of the work, and two companies bid on all groups to complete the bridge. Greiling Bros. and the Arundel Corporation, of Philadelphia, bid on all groups. Greiling Bros.'s bid on the structural steel and bronze bearings was $406,400, making that firm's bid for the complete structure $2,418,095. The Arundel Corporation's bid of $2,355,237.50 was informal in that it was not on the regular form and stipulated that the city should furnish an unloading dock for the construction material, and also that the city should furnish all cement to be used in the structure. Although the bid was first considered to be the low bid, the additional cost of the cement made it in excess of the funds available. The bid was rejected.

In recommending that the contracts be awarded, the Commissioner of Public Works cited that the combination of two firms' proposals in part makes the awarding of contract legal, in that the available balance remaining in the Belle Isle Bridge Fund is not exceeded, the Controller's records showing a credit balance of $2,370,653.28 in the fund.

The city council voted unanimously in favor of the contracts recommended by the Department of Public Works, and Mayor Couzens has signified his approval of the council's action. The bridge will be construced according to revised plans for a cantilever type bridge as prepared by Esselstyn, Murphy and Hanford, the engineers in charge of the design and supervision of construction. The subway approach under Jefferson Ave. at the north end of the bridge has already been completed, at a cost approximating $400,000.

State Sanitary Engineers Perfect Their Organization

The Conference of State Sanitary Engineers, which was tentatively formed at the New Orleans meeting of the American Public Health Association in 1919 and which met in Washington in 1920, perfected its organization by the adoption of a constitution at Boston last week. The constitution provides that the members of the conference shall consist of the chief sanitary engineers of state boards and departments of public health and similar officers of other state departments doing sanitary work, together with three sanitary engineers from the U. S. Public Health Service. Each state and also the U. S. Public Health Service will be entitled to but one vote. Besides the usual executive officers the sanitary engineer of the U. S. Public Health Service on duty at Washington headquarters—at present I. W. Mendelsohn, associate sanitary engineer—will serve as corresponding secretary.

NEW OFFICERS

Officers elected for the ensuing year are: Chairman, C. A. Emerson, Jr., engineer, Pennsylvania State Department of Health, Harrisburg; vice-president, W. H. Dittoe, engineer, Ohio State Board of Health, Columbus; secretary-treasurer, Theodore Horton, engineer, New York State Department of Health, Albany.

The Boston conference last week, which preceded the nineteenth annual conference of state and territorial health authorities with the U. S. Public Health Service, held two sessions each on June 1 and 2 with a full program of committee reports and papers and very active discussions on water supply, sewage disposal, mosquito control, pasteurization and other phases of public milk supplies, sanitation of swimming pools, rat proofing, and other lines of work conducted by the state and federal health departments.

A large part of the time of the conference was devoted to a consideration of the certification and the general supervision of water supplies for railways and vessels engaged in interstate commerce. This certification is by the U. S. Public Health Service (Treasury Department) acting in co-operation with state departments of health. The Public Health Service wishes the several state departments of health to agree upon a method of certification before the printing of new regulations. There was so much divergence of opinion regarding some of the points at issue that the matter was finally left to a committee for adjustment, with the expectancy that the committee would reach an early conclusion.

A comprehensive paper on "State Sanitation" was read by George C. Whipple, professor of sanitary engineering, Harvard University. Another paper which was listened to with great interest was on "The Typhoid Epidemic at Salem, Ohio," by W. H. Dittoe, engineer, Ohio State Board of Health. (See *Engineering News-Record*, Dec. 23, 1920, p. 1244, for a summary of this epidemic).

Notable reports, with recommendations as to rules to be established by or to be used for the guidance of state departments of health, were submitted as follows: Water Supply, W. H. Dittoe, chairman; Cross Connections and By-Passes on Water Supplies, S. Pincus, associate sanitary engineer, U. S. Public Health Service, New York City; Milk Supply, C. A. Emerson, Jr.; Stream Pollution and Sewage Disposal, E. H. Ehlers, engineer, Texas State Board of Health; Mosquito Control, R. Messer, engineer, Virginia Department of Health; Swimming Pools, S. DeM. Gage, chemist and sanitary engineer, Providence State Board of Health.

It is expected that the committee reports and papers will be printed by the U. S. Public Health Service.

Report on Industrial Wastes

Waste in industrial processes is causing enormous annual losses to the nation, it is declared in a report of the American Engineering Council's committee on elimination of waste in industry, made public at a meeting of the council's executive board at St. Louis, Mo., June 3. "Over 50 per cent of the responsibility for these wastes," the report says, "can be placed at the door of management and less than 25 per cent at the door of labor." The findings of the committee, which was appointed by Herbert Hoover, cover investigations of typical industries.

The investigation found that the margin of unemployment mounts to more than a million men, that billions of dollars are tied up in idle equipment, that high labor turnover is a rough index of one of the commonest wastes, and that the waste of time, energy and money through duplication of estimates and bids in the building trades runs into millions annually.

Both employer and employee restrict output, it was said. Both capital and labor are blamed for existing abuses, but the annual losses through waste by conflicts between them is much less than popularly supposed.

Between four and five million workers were idle during January and February of this year. In 1921 half a billion dollars will be lost in wages in the building trades, it is said. Nationwide machinery to obtain continuous information concerning unemployment conditions throughout the country is said to be necessary. Means for regularizing employment in the principal industries is also urged. An elaborate plan of nation-wide co-operation involving the government, the public, trade associations, the industries, labor, bankers and engineers, is outlined.

The waste inquiry was in charge of a committee of sixteen headed by J. Parke Channing, of New York, as chairman, and L. W. Wallace, of Washington, executive secretary of the American Engineering Council.

Pasadena Adopts City Manager Form of Government

The city manager form of government was put into effect in Pasadena, Cal., early in May and C. W. Koiner, former superintendent of the Pasadena municipal lighting and power department, was elected to the office of city manager. Press reports state that 64 candidates sought the position.

To Study Jersey Watershed

The New Jersey State Department of Conservation and Development has authorized an investigation by the firm of Hazen, Whipple & Fuller, consulting engineers, of New York, of the unappropriated watersheds of the state with particular reference to the needs of the metropolitan district. The study will show what waters in North Jersey are still available, their character, and the cost to transport them. The Conservation Department has also made a decision to establish upon all the principal streams in the state a series of gaging stations. In this undertaking the U. S. Geological Survey will co-operate.

Commission to Make Inquiry Into Panama Administration

Secretary of War Weeks has appointed a commission of four men, three of them engineers and the fourth an executive of a public utility corporation, to investigate conditions in the Panama Canal Zone with a view to determining reforms necessary to make the zone more efficient and less expensive as a government going concern. The chairman is Brig.-Gen. W. D. Connor, Corps of Engineers, U. S. A., who is in charge of the inland waterway service of the War Department and the other members are Albert Brooks Fry, supervising chief engineer, U. S. Public Buildings, Port of New York; Col. F. A. Molitor, consulting engineer, New York City and Harley T. Wilson, president, Western Power Corp., New York. The commission sails for Panama June 10.

Engineers Appointed on Columbus City Planning Commission

A city planning commission of four citizens and four ex-officio members has been appointed for Columbus, Ohio, under a state law passed some years ago and a city ordinance passed this year. The citizen members of the committee are Frank H. [illegible], professor of municipal engineering, Ohio State University, John F. [illegible], president of the Columbus Real Estate Board, Frank L. Packard, architect, and Robert E. [illegible], a newspaper publisher. The ex-officio members are Robert H. Simpson, city [illegible], and W. H. Duffy, service director. The commission has [illegible] power only to employ [illegible] and will be [illegible] by the [illegible] committee [illegible] [illegible] will be considered by the commission.

Railroad Security Owners Appoint Engineer Board

Announcement was made June 6 of the appointment by the National Association of Owners of Railroad Securities of a board of economics and engineering, consisting of six prominent engineers, headed by Col. F. A. Molitor as chairman. The board consists of John F. Stevens, late head of the American railway mission to Russia, who was previously chief engineer of the Panama Canal and chairman of the Isthmian Canal Commission for two years; Col. F. A. Molitor, who had charge of the reorganization, under the Director of Military Engineering and Engineer Supplies of the A.E.F., of distribution and receipt of supplies from principal bases and who was previously for three years supervising railroad expert for the government in the Philippine Islands; J. F. Wallace, chairman, Chicago Railway Terminal Commission, who was associated with Mr. Stevens in the Canal Zone; W. L. Darling, for many years chief engineer of the Northern Pacific Ry., who during the war was an associate member of the Naval Consulting Board and a member of the Russian Railway Mission; Lewis B. Stillwell, railroad electrification engineer, who was previously electrical director, Interborough Rapid Transit Co., New York City, and W. W. Colpitts, consulting engineer, who until 1913 was chief engineer of the Kansas City, Mexico & Orient Railway Co.

The daily press announced last Monday that the board would be headed by Mr. Stevens. Since Mr. Stevens is to return to Russia to resume his railroad work there, Col. Molitor has been named to head the board.

According to the announcement of the association, "the work to be performed by this board is regarded as an important step in the solution of the transportation problems now confronting the country." At the time of the appointments, S. Davies Warfield, president of the association said, "No member of the Board of Economics and Engineering is connected with any railroad company or any financial institution. This board is unhampered by ties of individual, railroad or financial identity or ownership, or by the influences of any particular security owning or banking group. It is free from the environment that attends governmental appointment. It can pursue its investigations and reach conclusions solely with the purpose of securing the substantial economies that can be made in the public interest."

Housing Division Recommended

The Committee on Commerce of the Senate has recommended favorably to the Senate the Calder bill, which has as its object the creation of a division of construction and housing in the Bureau of Standards of the Department of Commerce. The committee endorses the arguments of the Secretary of Commerce in favor of such a division.

Detroit-Windsor Bridge Companies Are Organized

Passage of the charter and franchise of the Canadian Transit Co. by the Canadian Parliament completes the legal preliminaries to prosecution of the Detroit-Windsor bridge work, it is reported. Congressional authority for building the bridge was granted to the American Transit Co. two months ago, and arrangements are being completed for joint action of the two companies. It is planned to appoint a board of consulting engineers, consisting of four bridge engineers of international prominence to co-operate with C. E. Fowler, chief engineer, in supervising the development of the detail design. Proposals for financing the undertaking have been received and are expected to be acted upon as soon as the directors of the joint corporation can meet. Mr. Fowler states that the structure is to be a wire-cable suspension bridge of about 1,800-ft. span, with two 28-ft. roadways, two 7-ft. sidewalks, and two electric railway tracks on the upper deck. A lower deck will provide for four railway tracks.

New Federal Power Regulations

The Federal Power Commission, meeting in a special session May 27, approved the amendments to the regulations, promulgated for the administration of the Waterpower Act, with the exception of the proposed multiple in the specified rate of return and the regulation dealing with the allocation of earnings. The commission affirmed the multiple 1.5 and approved a revised form of the existing regulation on allocation which allows permittees or licensees to propose a basis of allocation before the issuance of a permit of license, but subjects such a basis to review at not less than five-year intervals. The commission also approved an additional paragraph to regulation 20, which requires licensees to file copies with the commission of annual reports made to the state commissions or to their stockholders.

The application of the Arkansas Hydroelectric Co. was denied because the chief of engineers reports that the Little Red River is navigable at and above the site at which it is proposed to build the dam. Public lands also are involved.

Batchelder Killed in Plane Crash

A. G. Batchelder, chairman of the executive board of the American Automobile Association, Washington, D. C., was killed May 28 when an army airplane, on which he was a passenger, encountered a severe storm near Morganstown, Md., and crashed to earth. With Mr. Batchelder in the machine were one other civilian and five army officers, all of whom lost their lives. As an advocate of good roads Mr. Batchelder had a wide acquaintance among highway engineers and for years was a consistent attendant at the various road conventions.

Warehouse Association to Hold Meeting in Pittsburgh

Representatives of manufacturing companies, distributing their products through public merchandise warehouses, will meet in convention at the William Penn Hotel, Pittsburgh, June 16 and 17, 1921, under the auspices of the Shippers' Warehousing and Distributing Association, organized in Chicago a year ago for the general purpose of effecting standardization of practice in the warehouse industry. Kent B. Stiles, 239 West 39th St., New York City, is secretary of the association.

Chicago Meeting of A. S. M. E.

Changes in the organization of engineering societies to accord with the increasing importance of the position which the engineer is taking in our social economy were suggested by Morris L. Cooke, Philadelphia, Pa., in a paper read at the spring meeting of the American Society of Mechanical Engineers, held in Chicago on May 23 to 26. He argued particularly for more effective administrative control, for a secretary who is a manager with authority instead of being servant to a board of directors, and for larger development of the non-technical mind of the profession, so as to give voice to the engineering opinion of the nation.

Special sessions on the Chicago railway terminal association and on highway construction plant were unusual features of the meeting, and the relations between engineering education and engineering industries were discussed in a joint paper by Magnus W. Alexander, New York, and Dugald C. Jackson, Cambridge, Mass. Apart from these subjects the various sectional meetings were devoted mainly to such technical and mechanical matters as machine tool work, boilers and fuels, modern locomotive design and hydroelectric plants.

McClellan President of A. I. E. E.

At the annual business meeting of the American Institute of Electrical Engineers held in New York, May 20, William McClellan, of Philadelphia, Pa., was elected president. Dr. McClellan graduated from the University of Pennsylvania and has been prominent in electrical engineering for twenty years. He has served as engineer in charge of construction for the Philadelphia Rapid Transit Co., with the Westinghouse, Church, Kerr Co., particularly in connection with electrification on the Erie R.R., was chief engineer of the Public Service Commission, Second District of New York, assistant to the president of the Buffalo General Electric Co., dean of the Wharton School of Finance and Commerce of the University of Pennsylvania, and vice-president of the Cleveland Electric Illuminating Co. Since early this year he has been in independent consulting practice in Philadelphia.

California Convention Discusses Municipal Power Projects

Under the auspices of the California League of Municipalities a convention was held in Sacramento, Cal., on May 20, which was attended by over fifty mayors and other officers of California cities to discuss ways and means of aiding cities and organized rural districts in undertaking the development and ownership of hydro-electric power on a large scale. Prominent in the proceedings was the discussion of Senate Bill 18, which has recently become a law and which legalizes co-operative organizations of and between political subdivisions of the state which wish to join in certain undertakings. The sentiment of the convention was strongly opposed to private ownership of utilities and many speakers expressed the opinion that the power companies were not fair to the rights of the people and the industries of the state.

In addressing the meeting Governor Stephens stated that while fair returns for the honestly invested capital of privately owned public utilities should be protected, yet he hoped that districts, cities and counties would be able to develop hydro-electric power for their own uses. Charles H. Lee, president of the State Water Commission, stated that although there were about 9,500,000 hp. water power in California which could be developed 1,000,000 hp. had already been developed and applications were on file for an additional 7,000,000, among the latter being some claims which overlap and some sites which are not financially feasible to develop. Mr. Lee felt that the most probable result of the attempt by municipalities to get possession of the few available sites would be that the permitees would use increased diligence in developing the 7,000,000 hp. on which filings have already been made.

The convention decided to draft an agreement under the authority of Senate Bill No. 18 to form organizations for studying the hydro-electric situation looking toward power development by municipalities. The convention also resolved to redraft the Johnson act for presentation at a special session of the Legislature or, failing in that, at the next general election. The Johnson act, which was defeated in the Senate during the recently closed Legislature, was a measure supported by the league and designed to create a hydro-electric power commission modeled after the Ontario commission.

Tunnel Deadlock Ends

Agreement was reached June 7 by the New York and the New Jersey Tunnel commissions on plans for the Jersey entrance and exit of the Hudson River vehicular tubes, thus breaking a deadlock which has been delaying construction work for several months. Bids for the Jersey shaft will soon be called for.

Mechanical Engineers Discuss Road Building Machinery

Three papers and a brief general discussion on machinery for paved road construction occupied a session at the spring meeting at Chicago, May 23-26, of the American Society of Mechanical Engineers. The papers were: "Planning and Organizing a Road Job for Mechanical Handling of Material," by C. D. Curtis; "Road Construction Plants," by B. H. Piepmeier, and "Mechanical Needs in Highway Construction Machinery," by R. C. Marshall, Jr. An abstract of the first paper was published on p. 949 of last week's issue. The discussion was brief and turned largely on the economy of large and small plants, with the conclusion that the larger plant offered advantages where conditions were favorable for its use.

Federal-Aid Road Bill Hearings

(Continued from p. 1007)

Mr. Perlman's testimony was supplemented by that of John N. Mackall, chairman and chief engineer of the Maryland State Roads Commission, who said:

"We have co-operated with the Bureau of Public Roads in a most satisfactory manner. There never has been a serious disagreement between us. We believe that we can continue to co-operate with that bureau and build and maintain roads satisfactory to the federal government. The intent of this bill is very clear that the federal government, without regard to the state, shall select a federal system.

"The width of 66 ft. for the right of way would be unfortunate. There are many places where to acquire a right of way 66 ft. wide would actually cost more than to construct the surfacing 66 ft. wide.

"Roads in Maryland are costing an average of $33,000 a mile for concrete for roads 15 ft. wide, and $12,000 a mile additional for a 20-ft. road. Money is costing 5½ per cent. Interest on that additional $12,000 that you would invest would be $660 a year. That interest alone will maintain the road. You can let the interest compound above the cost of maintenance. If you need to widen a road in ten or twenty years you will have sufficient funds from the interest alone to do the work without impairing the principal. I think widening should be done from current receipts from automobile licenses.

"Co-operation in the selection of roads is an absolute necessity if federal aid is to be a success. We hope this Congress will commit itself to a policy of federal aid along lines that as all can follow and build and maintain our roads and not spend our time in Washington."

During the course of the hearing Senator Townsend made the following statement:

"There are probably not three states in the Union that would insist on taking out of the federal appropriation for road construction any money for the purposes of maintenance. Practically all the states insist that they want to maintain the roads and that they want all the money appropriated to be used in constructing roads.

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, was recalled to the stand for further cross-questioning. In the course of his answers he made the following statement:

"If into this law there could be written a regular procedure by which the state would select a system of roads, having regard to the service of the state, the population within the state, and the interstate traffic, they could be given certain specifications for the selection of the roads which could then be put up to the federal authority and examined to see if the roads selected meet those conditions. I do not believe that the federal government should go into local fights. If authority is assumed to arbitrate disputes as to which of two roads shall be followed, assuming that both roads meet the conditions set up in the law, I believe the federal government would have an endless number of disputes on its hands to settle —particularly disputes which have been disposed of once."

P. St. J. Wilson, chief engineer of the Bureau of Public Roads, testified that "there should be a reasonable system of through roads and federal money ought to be concentrated on that system. The more important sections could be improved first just as every state is doing and just as every county is doing."

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia. Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa. Annual Convention, New Haven, Conn., June 28-July 1.

The Engineering Council of Utah was addressed May 20 by H. C. Boyden, of the Portland Cement Association, on the fundamentals for obtaining good concrete.

The Engineers' Club of Philadelphia, Pa., at its luncheon meeting, June 14, will be addressed by Colonel Henry S. Spackman on "German Reparation—Its Economic Relation to the United States."

Personal Notes

Leslie H. Allen, recently with Fred T. Ley & Co., contractors, Springfield, Mass., as an industrial housing engineer and later as sales manager for the New England territory, has joined the staff of the Portland Cement Association, Chicago, Ill., as assistant manager of the cement products bureau.

Ernest McCullough has been engaged as associate editor, of the *American Architect*, New York. During the World War he spent 27 months in France. He resigned recently from the Army, where he had served in the Chemical Warfare Service with rank of lieutenant-colonel.

Albert O. True, until recently captain, Engineers, U. S. A., and in charge of government water supplies at Newport News, Va., and vicinity, has been retained by W. J. Sherman, consulting engineer of Toledo, Ohio, as resident engineer on the construction of a reservoir and filter plant for the town of Wauseon, Ohio.

I. H. Schram, superintendent of terminals, Erie R.R., at Marion, Ohio, has been appointed division engineer with headquarters at Marion.

F. L. Wheaton, formerly division engineer of the Delaware, Lackawanna & Western R.R., with headquarters at Binghamton, N. Y., has been transferred to Buffalo, where he will have jurisdiction over both the Buffalo and Scranton divisions.

J. Warren Mylchreest, of Mylchreest Brothers, general contractors, Middletown, Conn., has been appointed city engineer of Middletown.

Robert B. Fuller, formerly resident engineer on cotton mill construction with Lockwood, Greene & Co., engineers, Atlanta, Ga., is now a member of the firm Coate-Fuller Construction Co., Piqua, Ohio, general contractors on concrete and building construction.

Patrick Philip, of Vancouver, B. C., has been appointed chief provincial engineer for district 4 of the Dominion Department of Public Works.

Robert Colton, Jr., for some time engaged in special engineering projects in China, has joined the firm of Glenville & Collins, engineers, at Vancouver, B. C.

Bert C. Wells, formerly city manager, El Dorado, Kan., has been appointed city manager of Atchison, Kan.

J. T. Anderson, formerly with the Pennsylvania State Highway Department, is now general superintendent for N. M. Leigh, contractor, at Mannington, W. Va.

J. S. Bright, former district engineer for the U. S. Bureau of Public Roads at Denver, Col., has been transferred to San Francisco, where he will assist Dr. L. I. Hewes.

J. W. Ball, for the past seven years with the U. S. Bureau of Public Roads as engineer in charge of construction, has been assigned to regional headquarters at San Francisco under the direction of Dr. L. I. Hewes.

R. W. Parke, formerly resident engineer with the North Carolina State Highway Commission in the second division, has been appointed construction engineer for the new seventh district with headquarters at Elkin, N. C.

C. S. Currier, formerly location engineer for the North Carolina State Highway Commission, second division, is now district engineer, seventh district.

U. L. Fisher, formerly resident engineer, second division, North Carolina State Highway Commission, has been appointed maintenance engineer for the seventh district.

Major D. Q. McComb, formerly division engineer, has been appointed chief engineer of the Tennesse Highway Department. Major McComb is a mechanical engineer graduate, '00, of Colorado Agricultural College; a civil engineer graduate, '10, of University of Illinois, and a post-graduate in highway engineering of Columbia University in the City of New York. He is an engineer of over 13 years' experience, in the employ of the Philippine Bureau of Education; in the Philippine Bureau of Public Works as assistant and district engineer; with the Pittsburgh Testing Laboratory, Birmingham, Ala., as chemist; as highway engineer, U. S. Bureau of Public Roads, and as division engineer, Tennessee Highway Department.

Allan V. Garratt, formerly chief engineeer of the Lombard Governor Co., and more recently consulting hydraulic engineer to Lockwood, Greene & Co., engineers, has opened an office in Boston, Mass., for consultation and advisory work in hydraulic engineering.

William Couper, former assistant general manager of the Associated General Contractors of America, recently accepted an executive position with the Texas Co., New York, entering upon his new duties June 1.

Eugene Gedney, county assistant for the New York State Highway Department for ten years, and recently assistant engineer in the valuation department of the New York Central R.R. in Cleveland, is now engaged in the contracting business in Cleveland, specializing in reinforced concrete structures, streets, roads and pavements. He has been awarded the contract for the construction of ten bridges in Cuyahoga County.

C. E. Drayer, national secretary of the American Association of Engineers, was awarded the honorary degree of doctor of science by Ohio Northern University, his alma mater, on May 25 at the fiftieth anniversary of the founding of the university.

W. A. Bechthold, formerly assistant county highway commissioner of Racine County, Wis., has been appoined Racine County Highway Commissioner.

Obituary

A. O. Leach, engineer who served on the construction of the army base at Sewell's Point, Norfolk, Va., died May 8 in Norfolk. He was born in Ontario, Canada, in 1885 and was educated in civil engineering in Canadian colleges. He was for twelve years connected with the engineering department of the Great Northern Ry., his latest position being that of valuation engineer. In 1917 his services as a civilian were accepted by the United States Government and he was detailed for duty as supervising engineer in charge of the Camp Dodge cantonment at Des Moines, Iowa. In the same year he made investigations of the two proposed sites at Norfolk for the army base and recommended its construction on Sewell's Point.

J. Fremont Armstrong, secretary of the Minnesota Federation of Architectural and Engineering Societies and editor of its official publication, died at White Bear Lake, near St. Paul, Minn., May 10. He had varied experience as an engineer, a school teacher, newspaper editor and a publisher. He was also supervisor of allotting claims in the Bureau of Indian Affairs.

Edgar M. Graham, consulting engineer, of Muskogee, Okla., since 1910 died May 14. He was born in Buffalo, N. Y., in 1881. For more than ten years he was chief engineer of the Muskogee Electric Traction Co. He built 10 mi. of the Webbers Falls Ry. Co. In 1900 he was assistant to Guthrie & Diehl, consulting engineers, Buffalo, N. Y.; worked the following year with the New York Central and then for two years was with the Lackawanna Steel Co. In 1905 he became chief draftsman for the Buffalo & Susquehanna Ry. Co. and in 1907 was assistant chief engineer. He entered private practice in 1908 in Buffalo. Mr. Graham was active in engineering society affairs. At the time of his death he was president of the local chapter of the American Association of Engineers.

Karl G. Roebling, president of John A. Roebling's Sons Co., Roebling, N. J., died May 29, at Spring Lake, N. J. He was born in Trenton, N. J., in 1873 and was graduated from Princeton University in 1894. He was one of the directors of the Trenton Brass & Machine Co., the Otis Elevator Co. of New Jersey, the Standard Fire Insurance Co., the Woven Steel Hose & Rubber Co. and the Durable Wire Rope Co., of Boston, Mass.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Conditions in the Common Brick Industry

According to the June digest of the Common Brick Manufacturers' Association of America there has been an average price reduction from the peak of 33 per cent in brick. At the height of the demand for materials a year ago a composite price was taken from the reports of the membership of the association, representing 60 per cent of the country's production, which gave $24 per thousand as the average price. By Jan. 1 the price had settled to $20.05 per thousand and current reports as of May 1 show the figure to be $16.11. The lowest price quoted in any section of the country is from the southeast, where keen competition has even outdone Chicago, which, due to its favorable quality of clay and high plant efficiency, usually holds the record for minimum price. Some brick have been sold, says the digest, in Mississippi and Georgia for $9 per thousand.

Current reports show fewer plants closed, a slight reduction of stocks on hand, and indications of a little more business on the books. Orders on hand for May 1 totaled 114,875,000 brick, and today the figure is increased to 127,590,000. Of the 115 plants reporting to the association forty-nine are closed due to lack of orders. On May 1 there were eighty-four plants closed.

The digest continues: "A strange situation of a little demand producing lower prices rather than higher prices has arisen in some sections. Wherever a few orders have developed brick men have magnified the demand, resumed operations and produced a surplus which developed price-cutting competition."

Freight rates continue to be the greatest handicap in the way of construction, says the digest. Questionnaires taken by the association from its membership indicate that there have been increases in the freight rates on brick since 1915 between plants and principal markets of from 100 to over 500 per cent, the average increase being shown as 200 per cent. As a result a considerable percentage of the brick now being moved is forced to use trucks because the short-haul railroad rates are considered prohibitive.

Chicago Labor Leader with Fifteen Aids Indicted

"Mike" Boyle, Chicago labor leader, together with fifteen other business agents of various unions, was indicted May 26 by the special building grand jury on charges of conspiring to extort money. Amounts of money said to have been involved in the alleged extortions amount to about $30,000.

Southern Pine Orders Almost Double in Six Months

Orders on hand at Southern Pine lumber mills have almost doubled since the first of the year according to reports made to the Southern Pine Association by its subscribers. On Jan. 1 orders on hand averaged 607,590 ft.b.m. per mill, while on May 1 an average of 1,206,620 ft.b.m. was reported, representing an increase of 99 per cent. The average stocks held by Southern Pine subscribers uncovered by orders and available for shipment on the first of the year were 6,260,211 ft. b.m. Each month since has witnessed a gradual diminution, and on May 1 reports showed an average of 5,157,408 ft. b.m., a decrease of 18 per cent from the available stocks on Jan. 1.

Builders Paid High for Borrowing Privilege, Committee Hears

Testimony to the effect that builders paid large bonuses to banking institutions for the privilege of borrowing money, often having to buy undesirable real estate in order to make sure of securing it, was given last week before the Lockwood committee, investigating the building situation in New York City. One witness, a representative of a mortgage loan brokerage firm, told the committee that in negotiating a $210,000 loan for five years at 5½ per cent the borrowers paid to the insurance company's brokers a 3 per cent fee in addition to being forced to purchase a three-story brick house they did not want.

Another instance was cited wherein a builder was loaned $240,000 for five years at 6 per cent, the money being handed to the borrower in Liberty bonds at par, which at the time of the loan had a market value of about 95. In some instances it was testified only two-thirds of the loan was turned over to the borrower, the remainder being deducted as a bonus.

Some of the best known of the New York City banking houses, insurance companies and mortgage brokerage firms were said to subscribe to such practices.

New Immigration Law Goes Into Effect

The new immigration law, recently passed by Congress and which restricts immigration within a year to 3 per cent of any nationality already in the United States, went into effect June 3. The number of aliens that will be allowed to enter the United States within the year after the law becomes effective is 77,206. Provision is made, however, that as high as 20 per cent of the total may be allowed to enter during any one month.

Federal Reserve Board Notes Marked Building Activity

In the Federal Reserve Board's June 1 analysis of general business conditions the following reference is made to building operations:

District No. 1 (Boston) — Contracts awarded amounted to about $16,700,000 in April, as compared with $12,200,000 in March, an increase of 37 per cent. About $6,500,000 of the April total was for residential purposes, as compared with $4,300,000 in March.

District No. 2 (New York)—Contracts awarded during April had a total value of about $52,100,000, as compared with a value of $30,900,000 for March, an increase of 69 per cent. Residential building amounted to $18,100,000 in March and $28,600,000 in April.

District No. 3 (Philadelphia)—Contracts totaling $15,100,000, of which $6,300,000 were for residential purposes, were awarded during April, in comparison with March awards of $14,100,000, of which $6,000,000 were for residential purposes.

District No. 4 (Cleveland) — Contracts awarded during April totaled about $34,800,000, as compared with awards amounting to $32,760,000 in March. Of the April total only $9,100,000 was for residential purposes, as compared with $11,400,000 in March.

District No. 5 (Richmond)—Permits for new buildings in twenty-three cities totaled 1,638 in April as compared with 1,718 in March, the value of this new construction being $13,594,575, the highest monthly figure ever recorded for the group of cities. This was due to the inclusion of one industrial project which will cost $6,000,000.

District No. 7 (Chicago) — Contracts awarded during April totaled $53,700,000, of which $13,000,000 were for residences, as compared with a total of $37,400,000 during March, of which $9,300,000 were for residences.

District No. 8 (St. Louis)—In five cities there was an increase in number of permits during April, but their total was less than in March.

District No. 9 (Minneapolis)—Nine cities issued 2,868 permits, valued at $5,606,011 during April, as compared with 1,639 permits, valued at $2,621,591 during March. This increase in building activity is accounted for almost entirely by an increase in the permits issued for the construction of small buildings.

District No. 10 (Kansas City)—Reports from seventeen cities show a total of 2,668 permits issued in April, as compared with 2,778 in March.

District No. 11 (Dallas)—Nine cities report 2,588 permits, valued at $5,633,649, issued in April, as compared with 2,331 permits, valued at $5,190,191, issued in March.

District No. 12 (San Francisco)—The value of building permits in twenty cities amounted to $18,907,621 in April in comparison with $18,542,835 in March. In Southern California activity approaching a building boom is in progress.

Offer $1,000 for Lumber Saving Machinery or Method

A prize of $1,000 is offered by the National Lumber Manufacturers' Association, Washington, D. C., for the best new method, new machinery or new device which in practical application or use will result in an appreciable saving of labor, time, material and expense when applied to present manufacturing processes in the lumber industry. The purpose of the contest is to promote the reduction and elimination of preventable waste in the production of lumber, and to develop more efficient utilization of unpreventable waste in the lumber industry.

Bureau of Mines to Investigate Cement, Clay Products, Etc.

The Bureau of Mines will receive a supplemental appropriation of $35,000 for "scientific and technologic investigations concerning the mining, preparation, treatment and utilization of heavy clay products, cement, feldspar, slate and other non-metallics." The item was not seriously questioned in the House, but the Senate committee eliminated it from the bill. The committee was urged by Senators Pomerene, of Ohio; Underwood, of Alabama, and McNary, of Oregon, to allow this assistance to be extended to the non-metallic industries. The Secretary of the Interior, in a letter to the chairman of the Committee on Appropriations, urged that the appropriation be allowed.

In view of the very general demand for the character of the work to be undertaken with this appropriation the committee withdrew its objection, and the Senate approved the item as it passed the House, thus insuring its retention in the bill.

Government to Test Legality of Trade Association Activities

The attitude of the Federal administration toward the trade associations of the various industries has been made clear by the recent announcements of the Attorney General of the United States and the Secretary of Commerce. The Attorney General has given notice that he will push a test case against one of the open-price associations, and has indicated that there will be neither a drag net thrown over all the associations nor wholesale indictments. Secretary of Commerce Hoover has asserted that the purposes and actions of the vast majority of national associations are a constructive contribution to public welfare. "Their activity in promotion of better business practices, advancement of technical processes, simplification of production, standardization of quality, extension of foreign trade, commercial arbitration, etc.—all make for more efficient industry and business," said Secretary Hoover.

Philadelphia Has Brick Conference

Conforming to a resolution adopted at the New York Convention of the Common Brick Manufacturers' Association and the National Brick Manufacturers' Association, to inaugurate in each locality a movement for improving conditions in the brick industry, both as to the art of making and laying, architects, engineers, mason contractors, bricklayers, hodcarriers and building laborers and the manufacturers of brick and producers of other materials used in connection with brick work, met recently in Philadelphia. The meeting was presided over by Henry T. Shelley, chief engineer in charge of sewer construction with the Bureau of Surveys in Philadelphia.

Construction Articles in This Issue

Clam Shell Dredges of Large Size on the Sacramento Page 978

Precast Slabs Set on Submerged Concrete Piles Page 984

How Labor Union Working Rules Raise Building Costs Page 991

Gunite Used on Rack Supports for Hydro-Electric Plant Intake Page 1003

Construction Conferences Held In Many Cities

Following the national construction conference held in Chicago, March 2-3, the National Federation of Construction Industries, through its central direction committee, has been at work with various municipal, state and federal officials as well as construction associations and chambers of commerce, endeavoring to bring about local conferences of building construction interests, which will stimulate construction activity and look toward its reestablishment on a sound economic basis. Through the activities of the association many local conferences have already been held. Evidences of interest in the stabilization program have been received by the National Federation of Construction Industries from at least 69 different chambers of commerce, commercial clubs and boards of trade.

Unemployment in Britain Least in Building Trades

(London Correspondence)

The building were the only trades in which employment was fairly well maintained during April. The percentage of unemployment among all trade union members was 17.6 on April 30. The percentage of unemployed among 12,000,000 workers insured under the Unemployment Insurance Act rose from 11.3 on March 24 to 15 on April 29. Workers resigistered as unemployed on April 29 were 1,854,000, made up of 1,261,000 men, 448,000 women and the balance of unskilled girls and boys. Five hundred twenty-four thousand men and 553,000 women were on short time. Nine hundred thousand workers had their wages reduced on the sliding scale basis, including railway men, whose wages came down by 4s. Workers engaged on civil engineering constructional work had their wages reduced by 2d. to 4d. per hour.

Slight Increase in Unemployment

According to an estimate recently made by the U. S. Bureau of Labor Statistics there was an increase of unemployment in May over April of about one-half of one per cent.

Ohio Road Building to Await Lower Freight Rates

State Highway Commissioner Leon C. Herrick of Ohio has announced that no further awards of state road improvements will be made until the proposed readjustment of freight rates on road building materials is made. Mr. Herrick expects a reduction in such rates as the high freight rates are an impediment to road construction in the state. A letting which was scheduled for June 24 will be postponed indefinitely. He believes that contractors have the same idea that freight rates will decline as there was a reduction of approximately 11 per cent on the prices of contracts on the letting May 27 under the estimated cost made by the highway department engineers. The entire letting of May 27 called for $5,000,000 by the engineers' estimates, whereas the low bids aggregated $484,000 below the estimates.

Pennsylvania Soon to Open Bids on 84 Miles of Highway

The Pennsylvania State Highway Department will receive bids on June 21 and June 22 for the construction of 84 miles of highways of a durable type. Bids for the construction of 41½ miles will be received on June 21 and for 42½ miles on June 22. The mileage in each case is divided among sixteen projects. Specifications require that bids be submitted on one-course reinforced concrete on 53 miles of the total mileage.

Current Lumber Costs

Lumber costs are going down in some sections of the country at least, according to recent reports of the large associations. The Southern Pine mills report an average cost of $24.22 in February, the lowest since May, 1919. This is a considerable reduction from the peak month, December, 1920, when it was $37.27 per M. ft. b.m. Southern pine is selling now at an average of about $22.50 per thousand.

Cost of dressed lumber in North Carolina for March, 1921, is given as $31.02, compared with $35.88 in February. The average for 1920 was $44.22; for 1919, $38.13; for 1918, $33.95; for 1917, $23.56 and for 1916, $18.97.

Michigan and Wisconsin lumber mills do not, however, show such reductions at present, although during April in the northern woods, the heaviest declines were made in wages that have appeared during any one month. Average production costs in the northern woods as of May 1, 1921, are above $40 with lumber selling at from $41.50 to $42.50 per thousand.

On the West Coast the average total cost of manufacturing lumber in January was estimated as $25.75 per thousand feet, with total sales price averaging $25.56. Douglas fir is now selling at about $18 or $19.—*National Lumber Bulletin.*

Open-Shop Plan Gains in Building Industry

A decided tendency to adopt open shop methods of construction because of deadlocks following attempts at settlements in wage disputes, is noticed within the past few weeks. The decision of building trades employers to sign union agreements only upon condition that wage scales be reduced and an equally firm determination on the part of building trades mechanics not to accept reductions in wages, have made it apparent that a resumption of any considerable building is possible only through employment of non-union mechanics and labor.

Attempts at arbitrating the question have been tried in many cities both large and small, though as yet arbitration has apparently failed with a few notable exceptions.

The Illinois Society of Architects recently sent a communication to the contractors of Chicago urging the establishment of open shop in the building industry. The letter also emphasized the fact that before any wage agreement was signed between employers and employees in the building industry the public at large should have a voice in fixing the wage schedule and the working conditions.

An attempt is being made by the builders and union men of Newark to reach an amicable agreement, the mayor of that city, in the public interest, having taken a hand in the proceedings. Informal discussions of the situation have been held, but with no result so far. In Cleveland there is also a possibility of a conciliation board settling the wage situation, the board to consist of seven each of representatives of employers, labor, and the public. Judge J. J. Hahn has been selected as arbitrator of the wage situation at Providence, R. I., and is now hearing arguments of representatives of the master builders association and the bricklayers union. The carpenters and joiners union of Rockford, Ill., has also named an arbitrator and it is understood the employers' representative will soon be selected. In Kansas City, Alexander Maitland, president of the Kansas City Bridge Co., has been chosen chairman of the committee of arbitrators who will decide points in disagreement between representatives of union labor and building contractors. On the arbitration board are another engineer and a clergyman.

In Indianapolis a recent announcement was to the effect that all the building trade council members on strike with the exception of the steamfitters had returned to work, pursuant to a decision previously reached.

One of the most recent of the large strikes in the building industry to be noted is that in Pittsburgh, where on June 1 approximately 1,000 workmen in the building trades walked out. The craftsmen in eighteen unionized trades refused to work on the terms laid down by the building construction employers association, which included a reduction in wages and radical changes in working conditions.

In Davenport, Iowa, it has been reported that sheet metal workers settled their differences with employers and signed up a new agreement calling for a 90c an hour scale. Meetings between the allied building trades and the master builders are being held, and it is believed that an amicable adjustment can be made on a basis of between 85 and 90c. per hour.

O and S Dependable Is New Crawling Tread Crane

Among the latest crawling tread cranes is the O S Dependable, a crane of 7 and 12-ton capacities manufactured and sold by the Orton & Steinbrenner Co., Chicago and Huntington, Ind. The superstructure of the crane is proportionately identical with the O & S heavy standard-gage rail types, and the crawling tread is a development of the creeper used in military tanks. The tread links and sprockets are of cast steel and the chain idler rollers are bronze brushed with a patented pressure lubricating system. Each tread is supported between the drive sprockets and the idlers by four pair of idler rollers, each pair of which is carried in an equalizing strut backed by heavy coil springs. When crossing railroad tracks, or other obstacles, the rollers will tilt as much as 6 in. from the horizontal. The crane is able to climb a 30 per cent grade in soft ground. The tread links are reversible and so designed that the ends overlap, guarding against the entrance of foreign material.

O & S CRAWLING TREAD CRANE

Equipment for the crane may be varied to suit working conditions, and includes orange peel or clam shell bucket, electro-magnet, pile driving attachment, fall block for heavy loads, etc. The smaller of the two models is equipped with a ¾-yd. clam shell bucket, a 30-ft. boom and in excavating and material handling duties does its work easily within a 30-ft. radius. The 12-ton type has a boom of 25 ft., though in either size the boom may be lengthened.

Seek Reduction of Rail Rates on Construction Materials

Uncertainty as to railroad rates on road and building materials probably will be removed as a result of a conference held last week in Washington between railway traffic executives and representatives of these industries. The presentation was heard by George Ingalls, chairman of the traffic executives' committee for the Eastern territory; L. J. Spence, chairman of the committee for the Western territory and Lincoln Green, chairman of the committee for the Southern territory. It was argued that the railroads, as well as the industries, would benefit more by lower rates in that a much greater tonnage would be handled. Under present conditions, it was declared that substitution of local materials is going forward at a rapid rate, to the detriment of manufacturers, and carriers. Others concerned are affected, since these materials frequently are inferior, but their use is forced by the prohibitive transportation charges on better materials.

The representatives of the railroad executives gave no indication as to whether or not they would recommend a reduction in rates, but they promised to give the matter immediate consideration. They pointed out the seriousness of the question, since the commodities under discussion furnish 20 per cent of all railroad freight tonnage.

Hetch Hetchy Strike Ended

The strike of tunnel workers on the Hetch Hetchy project in California which has been in effect since last August, although the work has never been closed down, has been officially declared off by the Hetch Hetchy branch of the International Union of Mine, Mill and Smelter Workers. The understanding is that striking employees will be employed without discrimination but that contractors and superintendents will not be expected by the union to limit their employees to union men.

The work has been progressing of late at a good rate of speed and the records of advance made at the several headings are steadily increasing. There is every indication that the contracts will be completed within the time limit originally prescribed.

Titan Develops Two-Yard Sub-Grade Truck

To meet a demand for a motor truck of medium capacity to be used where haulage over subgrade is necessary in road construction work, the Titan Truck Co., Milwaukee, Wis., has developed what it calls a 2 yd. subgrade truck, the essential features of which are the short wheel-base and the use of large-size pneumatic tires. Makers of the truck claim that the distribution of the load is such that 80 lb per square inch is all the pressure exerted upon the subgrade. The cord tires are 36 x 6 in. in the front and 42 x 9 in. in the rear,

the total carrying capacity of the tires being 14,400 lb.

The body is made of steel throughout and in two compartments. It is fitted with either an underneath hydraulic hoist with a dumping angle of 45 deg., or a Titan patented mechanical hoist with a dumping angle of 55 deg.

Record Week in Contracts Let

The value of contracts let during the past week, as reported in *Engineering News-Record*, totalled $44,922,017, the record week of the year and 60 per cent in excess of the contracts let for the corresponding week of 1920.

Ohio Lets Road Contracts Worth $3,802,172

Construction of more than forty projects, to cost a total of $3,802,172, were authorized during the past week by the Ohio State Highway Department, practically all of the projects for the construction of which bids were received on June 2, being put under contract.

The contracts cover the construction or reconstruction of 113 miles of highways. The largest contract was for the construction of 3.02 miles of monolithic brick, the contract price being $458,953.

Wire Scratch Brush Used in Cleaning Building Stone

Five hundred and twenty square feet per day was the average in cleaning the face stone of the Hanna Building in Cleveland by the Haskins type H6 equipment, which is a wide scratch brush electrically driven, manufactured and distributed by the R. G. Haskins Co., Chicago. Four machines of this type were used on the building, each making the foregoing average. The contractor estimated that these machines were doing the work normally requiring 16 men. The same equipment is used for cleaning form marks on concrete.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.33	−$4 00	$4.50	$3.23	$3.51	$4.65	$4.35	−$4.90	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	—47½%	5%
Cast-iron pipe, 6 in. and over, ton	54 00	59.22	−65.00	−59.10	−62.80	70.00	85.90	—70.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80 (del.)	3.00	2.60	2.17	2.41	3.10	3.09	3.10	+3.48
Gravel, ¾ in., cu.yd	2.50	2.80	3.50	−2 25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	−2.25	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	−2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	40.00	50 00	55 00	−37.00	47.00	27.00	25.50@28.50	120.00
Lime, finishing, hydrated, ton	21.00	22.50	27.50	20.00	29.00	32.00	25.40	24.00	30 00
Lime common, lump, 200 lb. bbl	3.30	1.60	3.00	1.65	2 00	−3.10	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	−12.00	−14.50	12.00	−17 00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	− 092	.09	.12½	.11	.15
Hollow partition tile 4x12x12, block	....	.15	.13	.096	−.092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	+.72	.90	+.89	.91	.95	+.96	.79	+.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1 00	.50	.50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.35@ 45	.40@.50	.50	.37½@.50	.50@.55	.50	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5⅛ x 8 x 11⅛. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

There seems to be an impression in the steel industry that prices are coming down. Chicago re-sale interests are shading prices on structural shapes, bars and plates. We quote structurals in Atlanta at $4, instead of $4.25, and in San Francisco at $4.80 instead of $5. The price of cast-iron pipe is gradually going down. For example, although $62.80 is the formal quotation in Minneapolis large quantities are obtainable at $57.80, while St. Paul last week placed an order for 494 tons of 6-in. at $54.75 per ton, f.o.b. St. Paul.

Common brick is down 50c. in Atlanta, $1 in Minneapolis. Hollow tile is down in Minneapolis and Montreal. The rise in linseed oil continues in Montreal, Atlanta, Chicago and San Francisco.

The downward movement of wages in Montreal is shown by the following comparison of present hourly rates with those of a year ago: Bricklayers, 90c., last year $1; carpenters 65c., against 75c.; roofers 50c.; against 70c.; painters 60c. against 65c.; plasterers 75c., against 80c.; plumbers 60c., against 85c.; tilelayers 60c., against 70c.; laborers 35c., against 45c.

The employment situation in Seattle shows some improvement since the reopening of street and road work and the resumption of lumbering and logging activities. The strike in San Francisco building trades is still on, builders announcing that they will resume operations on June 13 on an open shop basis with wages reduced 7½ per cent from the former schedule. The Chicago controversy was submitted to arbitration on June 4.

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E. J. MEHREN Editor

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Night Work on Concrete Roads

GREATER speed is the governing reason for any night construction work; as a rule costs and construction difficulties are increased by it. There are no figures available on how these general principles apply to the Maricopa County road work described elsewhere in this issue, but there is reason to believe that in this particular job there may be benefits not usually thought of which may be worth considering elsewhere. These are the gain in labor efficiency in the cool of the night and the possible benefit to the concrete by being permitted to take its initial set before the heat of the day. Phoenix this time of the year is a hot place, especially during the height of the sun. Men ought to be able in the cooler night to work enough faster to make up for the inevitable slowing down due to the lack of daylight. The effect on the setting of the concrete of the sun and heat is being studied, as the article indicates, but it is reasonable to suppose that the retardation of the set will be beneficial in that it will permit a longer period in which to get the water on the new concrete.

The Tribute to Ridgway

IN THE lives of few men—engineers particularly—occurs so convincing a demonstration of the esteem in which they are held as the one accorded to Robert Ridgway last week on the occasion of his promotion to chief engineer of the New York Transit Commission. Some of those who went to the Pennsylvania Hotel expecting to find assembled there a score or two of the professional associates of the guest of honor were amazed to see a gathering of almost 800. But the mere volume of attendance, impressive as it was, was not the most significant thing about the banquet. The throng which turned out to honor Ridgway represented the rank and file of the metropolitan district's engineers and contractors. Consulting engineers and commissioners rubbed elbows with rodmen and inspectors, contractors and designers hobnobbed with draftsmen and time clerks, and men in the city's engineering service were grouped at tables with corporation executives and sales engineers. Ridgway is a good engineer and a good executive, combining courage with fairness in dealings with public officials, engineers and contractors, a man who inspires implicit confidence and loyalty among his superiors and subordinates alike, but these characteristics could never have won for him the place in the hearts of his fellows which he occupies. The answer to his popularity will probably be found in the distinctly human qualities of the man. Modest almost to a fault, without a trace of self-seeking in his make-up, Ridgway has a thorough and sympathetic understanding of the problems of others—especially the young engineer and contractor whose language he can talk and toward whom he has never been known to exhibit that patronizing manner sometimes affected by men who have reached the upper ranks of the profession.

To Study Building Costs

WITH organization preliminaries disposed of, the New York section of the National Congress of the Building and Construction Industries has turned its attention to the task for which it was formed—analyzing the industry with a view to pointing out actual conditions, and taking action to correct practices that need revision. Where to begin has been somewhat of an enigma, but it is believed the best start can be made in a series of informal meetings, each one to be given over to the discussion of a single commodity or material. For instance, it is proposed that all the essential facts about brick be discovered, every person who handles brick, from the manufacturer to the mason, taking part in the discussion. The investing public feels that brick work is too high and that it will go lower. The congress will endeavor to find out if the cost be high and, if found so, upon what factors further deflation rests. Other commodities will follow in order. As the congress is all inclusive every element, including the investing public, will have a voice in the discussions. It is needless to say the congress has a real opportunity if it gets all the essential facts. The public wants to know upon whom the responsibility rests for keeping prices so far above a pre-war level. It wants cold facts and unsensational statements. It lacks accurate information and as a result hesitates to invest. The congress can answer the question "What ails construction?" by a direct appeal to its membership. It has an opportunity to lend stability and character to its own business or to become atrophied and pass the way of legions of other investigatory bodies.

How Strong Should a Dam Be?

DAM loading is not man made or controlled, but is of the elements, whose occurrence and extent can only be guessed at and which at any time may produce conditions far in excess of any known record. The result is that whereas bridges and buildings rarely fail, except from obviously preventable causes, dam failures due to unexpected overload are always with us. Every flood like the recent one in Colorado raises some queries. How great a rainfall concentration is the engineer justified in expecting? How great an additional expense for spillway and strength against overtopping can reasonably be incurred? Is it better to risk the loss of the structure and downstream damage and loss of life or to provide insurance against the possible 50-year flood? These are questions that take dam designing out of the field of the structural expert into the realm of pure engineering judgment. Such judgment cannot be codified like law or reduced to fixed principles like science; its exercise must be special and different for each case to which it is applied. But it will help every engineer who already has—or hopes some day to have—judgmatic capabilities to put to himself for answer the question —"How strong should a dam be?"

Derailment on Curves

DERAILMENT of a locomotive on a curve, charged to excessive speed, is noted on p. 1024 of this issue, in an abstract of a report by the Bureau of Safety of the Interstate Commerce Commission. It is believed by the bureau that the speed of the train was great enough to have required an elevation of outer rail twice that provided, in order to meet A. R. E. A. recommended practice. The fact that the derailed—or overturned—locomotive came to rest on its left side, rounding a curve to the right, and the absence of wheel marks between the rails lends weight to the bureau's conclusion that actual overturning from excessive speed did occur. Moreover, it is pointed out that standing train orders permitted a speed greater than recommended by A. R. E. A. practice for the elevation of outer rail that existed. In justice to the railroad company and its engineering department, it must be recognized that exact superelevation of the outer rail—to balance overturning effect theoretically—is not the limiting factor of safety in railroad curve mechanics. The pressure of the wheel on the outer rail not only imparts holding power to the flanges, but also is probably the principal factor, rather than track fixtures, that holds the rail to the tie by friction and prevents shearing the spikes. In other words, the outer rail must guide the equipment around the curve and the greater the wheel pressure on it, the less the liability of flanges climbing and rail spreading. It is to be regretted that the Bureau of Safety of the Interstate Commerce Commission has not included a more enlightening discussion of the elements of curve mechanics in a report of this kind. The conclusions as given, without such comment, are likely to be misleading in their general application, regardless of the fact that the operating department of the railroad evidently permitted too great a speed over this line and that actual overturning evidently did occur. Moreover, such an accident emphasizes the necessity of more effective liaison between engineering and operating departments in matters so vital to both.

Progress at Philadelphia

FIRST place in the week's constructive developments must be accorded to the report of the board of engineers on the proposed Delaware River bridge to connect Philadelphia and Camden. It represents a definite step of progress in a great public improvement. The recommendations of the board pave the way for early beginning of construction work. Since the two states involved are committed to the improvement and anxious for its early realization, and since the studies of traffic, ground conditions, and structural requirements on which the report is based appear to be thorough and sane, the joint commissions of the states should not find it difficult to reach a decision. In the main point of contention, the location of the crossing, the engineers have found that the most advantageous solution is intermediate between the two that have been most strongly advocated, and it may therefore be expected that the contending parties will be more ready to accept the recommended location than they would be if an extreme location had been chosen. A large expenditure will be necessary, nearly $30,000,000 in fact; but the funds are available, and no one familiar with the situation can doubt that the bridge will make returns commensurate with its cost. The outstanding fact is that the Delaware, which now lacks a road bridge below Trenton, is one of the main stream barriers in the East. It separates the rich territories of New Jersey and Pennsylvania; and, almost equally important, it cuts across important communication routes leading from New England and New York to the West. Repeatedly attention has been called by *Engineering News-Record* to the restricting influence of the major stream barriers upon the development of highway transportation. The Camden-Philadelphia bridge will eliminate one of these barriers.

Concrete in Sea Water Once More

NO ONE can quarrel with the excellent rules for securing durable reinforced concrete in sea water laid down by Kenneth Allen in his report to the Board of Estimate of the City of New York, as recorded in this issue. It is probably a fact that if one assumes "strict compliance with these rules, reinforced concrete may be safely used in marine work." The crux of the problem lies in the words "strict compliance." Mr. Allen himself truly says that "to secure dependable work practically 100 per cent excellence is required." In this fallible world there is no such thing as practically 100 per cent excellence, and the degree by which perfection is not reached is the measure of failure of reinforced-concrete structures in sea water. Such failure has been so great in existing structures that it is remarkable that so many engineers continue to express confidence in their own ability to produce reinforced concrete that will stand up under marine exposure.

The issue has been greatly confused by past studies and by offhand opinions. There is little question today regarding the possibility of making plain concrete which will resist sea water attack. Chemical and electrical dangers are probably quite small so far as a dense concrete is concerned but a whole literature relating to these factors serves to divert emphasis from the fact that the serious danger is in reinforced-concrete frameworks, generally of slender members but always where the steel is reached by corrosive influences that cause failure due to localized rupture and not to general disintegration. A large percentage of such structures in sea water today are in a state of progressive failure in the space which is alternately wet and dry.

This is the serious problem and one which will not be solved merely by insisting that such concrete must be made 100 per cent perfect. Probably in most of these structures the concrete was none too good under present-day standards. At the same time there is little qualitative data which would demonstrate beyond doubt that the complete observance of all of the latest rules of reinforced-concrete manufacture will produce a structure which will not be attacked by the disintegrating force of the ocean.

What is needed in this subject more than anything else is an exhaustive study, such a study as was started by Messrs. Wig and Ferguson some years ago and which was reported partly in *Engineering News-Record*. Many of the data these two investigators obtained are buried in governmental archives. Some have been published in official documents, but what is available to most engineers are merely the conclusions. These studies should be supplemented now by some further similar investigations which will take up actual structures, their composition and their behavior, and not draw the conclusions from generalities. We want something definite on the effect of varying degrees of salinity, on the possibilities

in surface coatings such as paraffin, gunite, asphalt paint, etc., on the destructive power of salt spray, on the proper embedment of the steel and on the possible effect of vibration, always assuming the concrete itself to be of the best.

Such a study should be backed and furthered mostly by those who are interested in reinforced concrete and its constituent materials. Every ocean reinforced-concrete structure which is going to pieces—and many of them are in public places where they are seen by thousands of people—is a setback to the use of concrete everywhere. Even among engineers the difference between the problem of concrete and of reinforced concrete in sea water is generally overlooked. How much more is it to be expected that the layman will overlook the differences between ocean reinforced concrete and inland concrete? There is little good in continually maintaining that it is possible to build perfectly safe reinforced-concrete structures in and around the ocean and if such structures are not being built. Experience is a considerably better advertiser than prophecy.

Engineering Studies for Flood Protection

CONTROL of the weather is as yet beyond man's power. Fortunately or unfortunately, he has not been able to discover means for making the sun shine or the rains come down. And so long as this limitation shall continue, flood rains will deluge the earth from time to time, now in one region, now in another. The meteorologist cannot even predict them, much less prevent. Dependence for protection from floods must rest in the prevision and planning of engineers.

Of the possibilities of flood-producing rainfall, only a small part is known, despite vast amounts of study that have been given to the problem. In the past engineers have had to concern themselves mainly with two extreme phases of the question: the flood of the brook or rivulet, with a drainage area of a few square miles or at best a few hundred, caused by intense local showers; and the great flood of a river system, resulting from slow, long-continued rains. At every road or railway embankment the engineer encounters numberless culverts and small bridges whose waterways he must proportion for local freshets, and many observations have been compiled and many rules formulated for determining the greatest runoff per square mile from a small drainage area. Equally patient study, but of radically different kind, has been applied to the great trunk streams, as the Ohio and the Mississippi, in accordance with the fundamental difference in the conditions from which their floods result. Streams and drainage areas of intermediate size, however, have received almost no attention with respect to flood.

Because of this absence of knowledge the investigations consequent upon the Central States flood of 1913 had to go back to the original data of rainfall observations. It was a laborious research, but it yielded results of remarkable value. In the light of these results it was seen to be urgently necessary that similar studies of flood and protection possibilities be made in other river valleys throughout the country. Since that time, however, the importance of this work has been lost sight of, until now the Colorado floods bring it back abruptly to the general consciousness.

In these disastrous regional floods we are dealing with phenomena of extremely rare occurrence. The Miami investigations, just referred to, pointed to the inference that the 1913 flood conditions of southwestern Ohio would probably not recur oftener than once in a hundred or two hundred years in any single drainage basin of the Central States. But in the eight years since then, no similar regional flood has occurred throughout the length and breadth of the United States, and it may develop that the probabilities of extreme flood rainfalls of the kind in question are even more remote than the engineers concluded. It is probable that the Pueblo precipitation was not nearly as severe and widespread as that of 1913; yet its effects prove it to have been a rainfall of extremely rare occurrence.

The construction of engineering works to prevent floods or minimize their destruction is not something that can be taken in hand at a moment's notice. Not only must the works be planned with elaborate care, but the engineer cannot even tell what works are practicable, if any, until he has investigated in detail all the conditions involved; there is no fixed formula for flood protection. Protective works may prove to be too expensive; in this case, however, the engineer can minimize the danger by predetermining its amount and frequency, and by suggesting how the community may keep out of the flood path. In any event, nothing whatever can be done with respect to the flood menace, not even sound private or public planning, until the engineer has made his study.

Obviously the time for such study is before the flood arrives—and the flood comes unheralded. That is why the subject of flood studies is urgent despite the variety of great floods and why it is a matter of national concern. In the interests of conservation of our resources in human life as well as in property, flood studies should be initiated all over the country, in every meteorological zone and in every stream valley.

Half the required investigation, that comprising the purely meteorological studies, is obviously a national one, and through the Weather Bureau, the Geological Survey and similar offices it can be dealt with most capably. The other half, the local study of what works should be provided and can be provided to control floods, remains a local, that is a regional, responsibility. It should not prove impossible as a practical matter to divide and yet co-ordinate the local and national studies. Joint effort could produce quick results.

One vital point, well known though not always consciously perceived, is entitled to careful reflection: Flood protection is not wholly a matter of dollars and cents. Its importance lies as much in public morale, as affected by security from sweeping disaster. It may often be a fine point to decide whether the amount of damage done by a flood—even when it runs into as many millions as the Colorado damage—will warrant huge expenditures for protection, in view of the likelihood that many decades will elapse before the works can produce returns by preventing a repetition of the destruction. But the paralysis of human effort and initiative that results from a flood is a factor that can not be ignored.

Flood visitation places a blight on the spirit of the region affected that may for long time check its development and reduce its contribution to the nation's advance. To present the possibility, to inspire farmer, manufacturer, and business man with the confidence, is alone sufficient to justify large investments in engineering studies and flood-protection construction.

Filling High Viaducts on the Philadelphia & Reading Ry.

Maintenance Difficulties and Waste Disposal—Design of Culverts for 120-Ft. Embankment—Compression of Fill Deforms Viaduct Towers—How the Trouble Was Overcome

By Percival S. Baker
Engineer of Bridges and Buildings, Philadelphia & Reading Ry., Philadelphia

On the Catawissa branch of the Philadelphia & Reading Ry., which was constructed between the years 1835 and 1838, there were originally seven high wooden viaducts. These were renewed from time to time in timber, but finally in 1898 six of them were replaced by iron structures, while the seventh was replaced in 1901 by a steel structure. All the structures are now in course of replacement by earth fills. Certain difficulties experienced in the course of the replacement, and the expedients devised to deal with these difficulties are dealt with in the present article.

In general all of the viaducts were designed in accordance with the usual practice, being a series of 35-ft. tower spans and 85-ft. intermediate spans. The 85-ft. spans were deck riveted trusses, and the other spans were deck plate girders. Each tower was composed of two bents connected by longitudinal bracing, each bent being made up of two columns battered transversely connected by the usual transverse bracing. The columns were two 15-in. channels and the bracing two 3½-in. angles, both with single lacing. The six earlier viaducts were designed for a loading equivalent to approximately Cooper's E40, the seventh for a loading of approximately E50. These viaducts and the distances between them are:

	Length, Ft.	Height, Ft.
No. 1, Dark Run Viaduct, south of Ringtown, (2.1 mi.)	568	52
No. 2, Ringtown Viaduct, north of Ringtown, (8.2 mi.)	1,078	120
No. 3, Stranger Hollow Viaduct, north of Beaver Valley (1.4 mi.)	434	94
No. 4, Long Hollow Viaduct, south of Shumans, (3.2 mi.)	746	129
No. 5, Mine Gap Viaduct, north of McAuley, (0.4 mi.)	589	105
No. 7, Fisher's Viaduct, north of McAuley, (1.3 mi.)	757	120
No. 8, Mainville Viaduct, south of Mainville	723	101

The line on which these viaducts are located is single track and carries a very heavy southbound freight traffic, while passenger service is limited to two trains per day. It passes through a mountainous section for a considerable portion of its length and has a ruling grade against southbound traffic of approximately 0.7 per cent, which extends continuously for a distance of 35 miles. All the viaducts are located in this territory, and within a length of 16½ miles.

On account of the traffic and grade conditions the company was desirous of using heavier locomotives, but was unable to do so because of the viaducts. This fact and the availability of a large amount of filling material led to the decision to fill the viaducts. On a railroad like the Philadelphia & Reading, which serves a thickly settled portion of the country containing several highly developed industrial centers, there is offered almost continuously a large amount of industrial dirt for disposal. It is at times difficult to find suitable places to waste this dirt as well as the accumulation of railroad ashes. The filling of the viaducts therefore accomplished a double purpose.

FIG. 1. TYPICAL VIADUCT ON CATAWISSA BRANCH
Fishers Viaduct, or Bridge No. 7. Dumping has been begun at ends. Several bents are already encased, and forms are in place on another.

The ravines crossed by the viaducts contain relatively small streams, so that culverts of moderate size were sufficient for the flow. These culverts vary from a 4-ft. box to a 15-ft. arch. The arch under Fishers Viaduct is 12 ft. in span; its details are shown in the accompanying drawing, Fig. 3. The ring is designed to carry the entire load of the fill above it and is stable without the steel reinforcement, which was added to prevent temperature cracks.

Work was started on Dark Run Viaduct in 1916 and completed in June, 1917. The filling was made in the

usual manner; that is, a line of bottom-dump cars was run onto the viaduct and dumped through the floor, every third of fourth tie having previously been removed. No special care was taken, except the precaution to keep the filling approximately level across the ravine. All the metalwork including the girders was buried in the fill and the bridge ties were left in place carrying the track. No trouble of any kind was experienced, and traffic was not interrupted throughout the work.

Filling Disturbs Track Alignment—Immediately after the completion of this first fill, work was started on Stranger Hollow and carried forward in a manner similar to that employed at Dark Run. In this case the filling progressed satisfactorily until it had reached to within 10 ft. of the rail. Then, however, the track began to get out of line and surface, settling considerably at some points. The track was blocked up and the filling pushed to completion without causing any serious delays to traffic.

The next one to be filled was Long Hollow Viaduct. Filling was started in March, 1918, and for a time progressed rather slowly on account of the delay in the completion of the 15-ft. arch culvert to carry the stream. The same methods were adopted here as in the two preceding cases: A line of bottom-dump cars was run out onto the bridge and the material dumped through openings made between the ties; without any attempt to spread the material after it was dumped, although the unloading was so arranged that the top of the fill was maintained approximately level throughout the length of the viaduct. Various kinds of filling material were used, including waste from industrial plants, earth, clay, ashes and mine rock, but care was taken that no heavy masses struck the tower bracing.

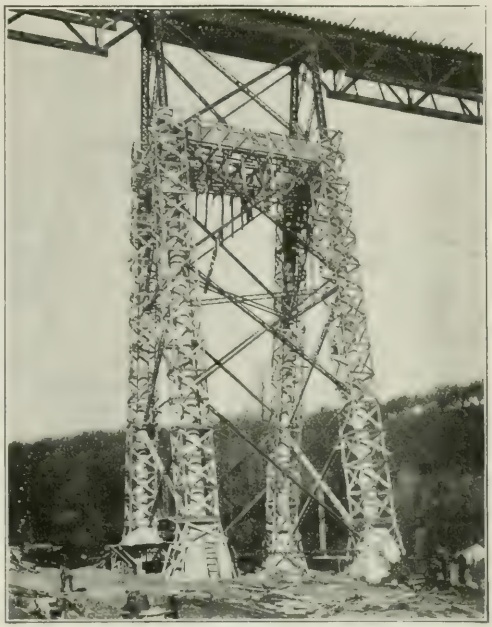


FIG. 2. PLANT FOR ENCASING COLUMNS TO STIFFEN THEM AGAINST DEFORMATION BY EARTH FILL

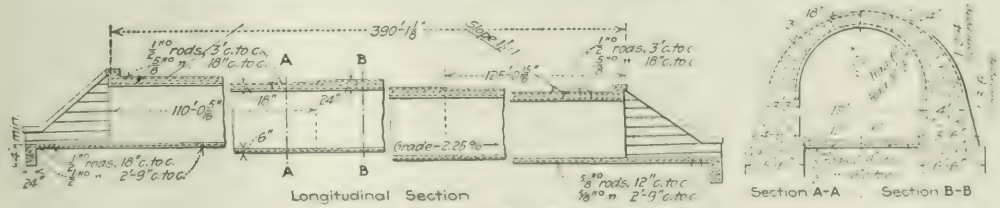


FIG. 3. CULVERT FOR VIADUCT NO. 7

High Tower Columns Distort—When the Long Hollow fill reached a height of about 50 ft., it was noticed that one column in a high tower was beginning to bend, causing the lattice bars to buckle at that point. This point was just below a connection with the longitudinal bracing, and a few feet above the line of the fill. On studying into the cause of this bend, it was conjectured that it was due to the load on the longitudinal bracing members bending them down and thus pulling the columns together. An attempt was then made to support the bracing with timber, but there was no solid foundation, and as the filling progressed it was found that this timbering was a failure.

As soon as the bend in the column was discovered traffic was reduced, and a timber bent was erected to carry the truss supported by this column. A few days later it was found that other columns were bending. Traffic was immediately abandoned over the bridge, and timber bents were erected to support the superstructure. Some of these bents were from 60 to 70 ft. high and were blocked on the fill already placed. Consequently considerable trouble was anticipated. Filling was continued as rapidly as possible. All through traffic was detoured by another route, the only traffic allowed on the structure being the local freight and two passenger trains, all hauled by light engines, and at times even these were forbidden to cross.

As the fill progressed the timber bents settled, owing to the compression of the material under them, in some cases as much as 6 ft. This settlement was not uniform, most of the bents moving to the right or left. Constant blocking and wedging was necessary to keep the superstructure up to a fairly even grade. In the meantime the iron bents were continuing to bend, and it was found that they were exerting a heavy pull on the superstructure, instead of being a support. The connections at the column caps were therefore cut, and there was immediately noticed a decided improvement, as much less difficulty was experienced in keeping the track to line. As soon as these connections were cut, the iron columns at once began to move rapidly and some column caps were soon 6 ft. from their former position.

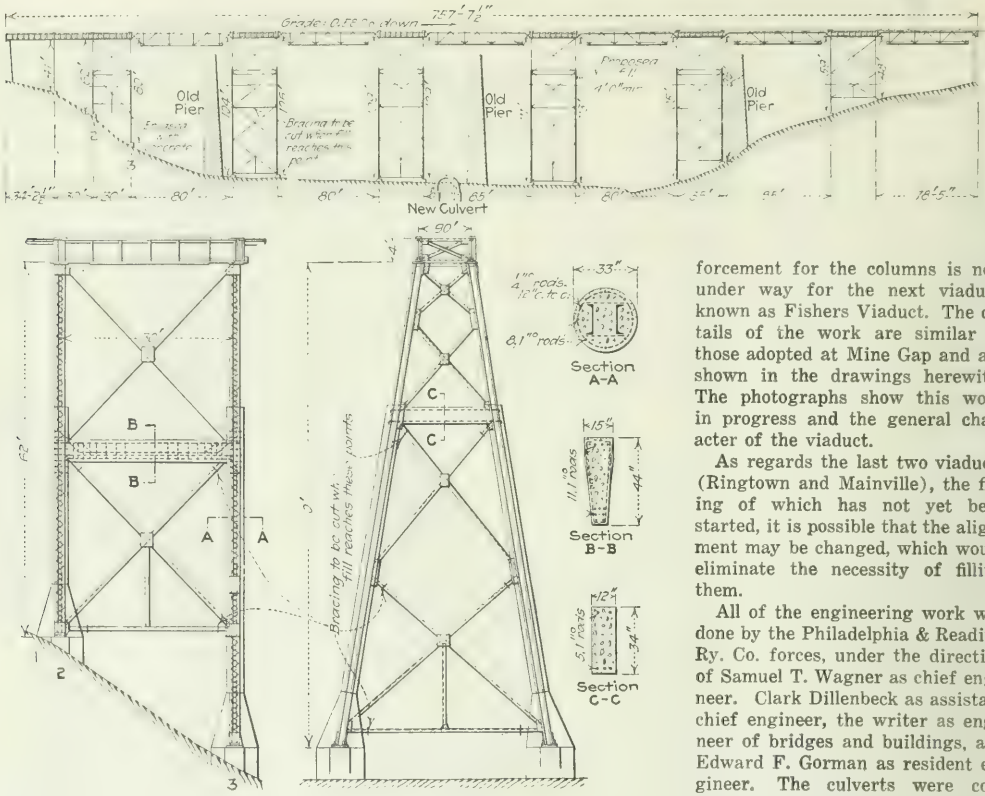


FIG. 4. STRUCTURAL PRECAUTIONS AND FILLING METHOD TO FORESTALL DEFORMATION OF TOWERS

Decide to Cut Bracing and Reinforce Columns—Owing to the difficulties experienced in filling Long Hollow Viaduct, a careful study was made before attempting to fill the next one, known as Mine Gap Viaduct. Several studies were made, based on two general principles, one being to support the bracing from the ground up, either by timber or concrete; the other, to reinforce the columns and cut the bracing as the fill progressed. The latter method was adopted.

In detail this method consisted in encasing each column in reinforced concrete, 33 in. in diameter, extending from the base to a point about 20 ft. below the cap. Reinforced-concrete struts were placed at these points in both the longitudinal and transverse planes, these struts being made strong enough to carry the load of the fill above them. In placing the fill, material was dumped only between the towers, and then shoveled into the towers in order that at all times the surface of the fill within the towers should be level for an area extending four feet beyond the lines of the columns. This was done to obtain, if possible, a vertical settlement of the fill and eliminate lateral pressures on the columns as much as possible. The filling of this viaduct has now been completed without any interference to traffic whatever.

Construction of the concrete culvert and the reinforcement for the columns is now under way for the next viaduct, known as Fishers Viaduct. The details of the work are similar to those adopted at Mine Gap and are shown in the drawings herewith. The photographs show this work in progress and the general character of the viaduct.

As regards the last two viaducts (Ringtown and Mainville), the filling of which has not yet been started, it is possible that the alignment may be changed, which would eliminate the necessity of filling them.

All of the engineering work was done by the Philadelphia & Reading Ry. Co. forces, under the direction of Samuel T. Wagner as chief engineer. Clark Dillenbeck as assistant chief engineer, the writer as engineer of bridges and buildings, and Edward F. Gorman as resident engineer. The culverts were constructed by contract, while the filling was carried out by the roadway forces of the railway. The reinforcing of the columns of Mine Gap Viaduct was done by the railway forces, but at Fishers Viaduct it was made a part of the culvert contract.

Truck Speed Rating and Standard Body Weight Allowances

At a recent general session of the motor truck members of the National Automobile Chamber of Commerce new standards for body weight allowances, gross weight, chassis, body and freight load, and new standards for speed were adopted. Under the new standard demonstration charges for commercial vehicles embodied in standards adopted in 1912 are eliminated. The standard speeds are now: for trucks, including gross weight, chassis, body and freight load, equipped with pneumatic tires, up to 28,000 lb. total weight, 25 miles per hour; solid rubber tires, up to 4,000 lb., 25 miles per hour; 8,000 lb., 20 miles per hour; 12,000 lb., 18 miles per hour; 16,000 lb. 16 miles per hour; 20,000 lb. and over, 15 miles per hour. These speed ratings are to be recognized by the manufacturers as the maximum and are not to be exceeded under any conditions. Body weight allowances adopted are: for 1- and 1½-ton trucks, 1,200 lb.; 2 and 2½ tons, 1,500 lb.; 3, 3½ and 4 tons, 2,000 lb.; 5 tons and over, 2,500 lb.

Plastic Gypsum Made Possible by a New Method

Public Patent Soon to Be Made Available Gratis Will Permit of Gypsum Being Used for Finish Coat of Plaster

By Warren E. Emley
Chemist, Bureau of Standards, Washington, D. C

A GOOD JOB of wall plaster is composed of three coats, which are known to the trade as "scratch," "brown," and "finish." The scratch coat is next to the lath, the brown coat in the middle, and the finish coat is applied to the exposed surface to give the plaster a pleasing appearance.

The quality requirements put upon material for the finish coat are peculiar. It must be very plastic in order that it can be spread in a thin layer (1/8 in.) over the brown coat, which has set and is partially dry; and it must be set in 20 or 30 minutes, in order that the plasterer may finish trowelling it without moving his scaffold.

The scratch and brown coats may be composed of either gypsum and sand or of lime and sand, but the finish coat must consist of both lime and gypsum. The lime is necessary to give the proper degree of plasticity, the gypsum to make the material set with sufficient speed. The weight of the finish coat is very small in comparison with the weights of the other two coats. If the specification calls for gypsum plaster, the contractor must provide enough gypsum for all three coats and a little lime to be mixed with some of the gypsum for the finish coat. Similarly, a small amount of gypsum must be provided to be mixed with the lime in the finish coat, when lime plaster is specified. The purchase of this small amount of a second material is an expensive nuisance, and is excusable only on the grounds of necessity. To add to the trouble, it seems impossible to get good results with a ready mixed lime gypsum finish. The lime must be soaked with water for at least 24 hours in order to develop its plasticity, and the gypsum cannot be soaked because it would set. This means that the materials must be prepared separately and mixed just before using, thereby requiring additional labor and equipment.

Would Decrease Cost

The superior plasticity of lime indicates also its superior sand carrying capacity. If lime and gypsum are selling at about the same price, the fact that lime may carry three parts of sand for scratch or brown coat work, while gypsum may carry only two, makes the lime plaster much cheaper. At the same time, the superior plasticity of the lime may reduce the labor cost of application of the plaster considerably below that of gypsum. This difference in sand carrying capacity is recognized by the prevalent custom of adding 10 to 15 per cent of hydrated lime to neat or sanded gypsum plasters by the gypsum manufacturers.

From the above statements, it will appear that if gypsum can be made as plastic as lime, (1) It will not be necessary to add any lime to the gypsum for use as a finish coat. (2) The differential in favor of lime, due to its greater sand carrying capacity, will be overcome. (3) It will not be necessary for the gypsum manufacturer to add lime or any other foreign material (except retarder) in the preparation of neat gypsum plaster. These results are greatly to be desired, not only by the gypsum industry, but also by the general public, because they would tend to decrease the cost of an important building material.

Accordingly, work was started on an attempt to make gypsum as plastic as lime. The first successful experiment was completed on Sept. 13, 1920, and since that date, sufficient work has been done to make sure of the practicability of the method. The problem may therefore be considered solved, insofar as it can be with laboratory equipment.

The first thought was that plasticity is in some way dependent upon extreme fineness, and that fine grinding might solve the problem. Fine grinding, however, is not new in the gypsum industry, and it would seem strange that any increase of plasticity due to this method of manufacture could have passed unnoticed. Further investigation showed that all attempts at severe grinding on a practical scale had been conducted in a buhr mill or a tube mill. It has long been known that gypsum can be decomposed by grinding: that the water of crystallization can be ground out of it. When gypsum is ground in either of the above types of mills, the current of air passing through the mill carries off the water as fast as it is liberated. If the grinding is sufficiently severe to liberate all of the water, the resultant product is known as "soluble anhydrite." This is a peculiar form of anhydrous calcium sulphate. It differs from the mineral anhydrite in its great affinity for water. So great is this affinity that a very short exposure to moist air is sufficient to change it back to "calcined gypsum," or plaster of paris. The result is that when gypsum is ground in the usual type of equipment, either the grinding is not sufficiently severe to liberate the water of crystallization, in which case the size of the grains is not greatly reduced, or, if the grinding is severe enough to liberate the water, the final product soon absorbs water from the air and goes right back to where it started from.

Effect of Grinding

When calcined gypsum is subjected to grinding under such circumstances that the water is liberated but is not permitted to escape from the system, an entirely new product results. No satisfactory explanation has yet been evolved, but the fact remains that the product is plastic. Up to a certain limit, the degree of plasticity seems to depend upon the duration of grinding. Fortunately this limit is well beyond the plasticity of the best lime putty, so that this process enables us to make calcined gypsum more plastic than lime.

The plasticimeter described in Bureau of Standards Technologic Paper No. 169 is not yet adapted to measure the plasticity of unretarded calcined gypsum: the material begins to set before the experiment can be completed. Use has therefore been made of the Carson blotter test, as described in the Transactions of the National Lime Manufacturers Association for 1916. This has proved quite satisfactory as a means of differentiating between the plasticities of finishing hydrate and masons hydrate. When tested by this method, this "plastic gypsum" proves to be more plastic than the best lime putty.

Besides improving the plasticity, the process also causes certain changes in other properties of the material. The increased fineness of the plastic gypsum naturally necessitates the use of more water to bring the paste to a given consistency. Yet, in spite of this excess

water, the set material will average about 20 per cent stronger than that made from ordinary calcined gypsum. The process slows down the setting reaction somewhat. The time of set of one sample was changed from 12 to 17 minutes by this kind of fine grinding. Commercial calcined gypsum usually deteriorates somewhat on storing. It tends to work "lean" and carry less sand. Samples of this plastic gypsum have been exposed to the air for four months without apparent deterioration of their plasticity.

The process has been applied with equal success to calcined gypsums from Nova Scotia, New York, and Virginia. It would seem, therefore, that the original quality of the material is of little importance.

The laboratory results have been accomplished by grinding the material after calcination, the grinding being conducted in a ball mill, so that the water could not escape. Commercial calcined gypsum is always ground during the course of manufacture, either before or after calcination, so that the grinding required to make plastic gypsum need not entail the installation of an extra process. It would seem, however, that the grinding should be done after calcination rather than before. An attempt to grind before calcination liberated so much water that the powder became damp and "balled up" in the mill.

It is probably not essential that a ball mill be used: a buhr mill or tube mill may be satisfactory if enough water is added to make up for that lost by evaporation during the grinding. The essential part is that the product as it leaves the mill shall contain approximately the same quantity of water as commercial calcined gypsum does: 9 parts by weight of water to 136 parts of calcium sulphate, or about 6.2 per cent water, if the material is pure.

Individual Manufacturing Problems

The duration of grinding required to make plastic gypsum depends upon the kind of equipment used, the fineness and hardness of the material, and the degree of plasticity desired. This problem must be worked out individually by each manufacturer for his particular equipment and material. It is a very simple matter to continue the grinding until the Carson blotter test shows the material to have the desired degree of plasticity. If the grinding equipment is continuous, arrangements can easily be made to pass the material through the mill more slowly. From the results of our laboratory experiments, it would seem that the output of any grinding equipment will be considerably reduced, perhaps cut in half, if the same equipment is used to make plastic gypsum.

As a summary of the above, it may be stated that a process has been developed whereby calcined gypsum can be made as plastic as lime. This does not necessarily require the installation of additional equipment, nor the introduction of any additional step in the usual process of manufacture. The chief item of cost lies in the possible decrease of output. The plasticity is not dependent upon the addition of any foreign material. The product is identical with commercial calcined gypsum in all its important properties, except plasticity, and can be retarded or accelerated in the usual way.

The new product, "plastic gypsum," was demonstrated at the annual meeting of the Gypsum Industries Association on December 15, 1920, but the process of manufacture was not divulged. A patent, covering both the process and the product, has been applied for, and, if granted, will be given to the public for the free use of anyone in the United States. This description of the process is being released at this time in order to give additional protection to the public interest.

Locomotive Overturned Rounding Curve

OPERATION at excessive speed on a curve of 8 deg. 38 min., with elevation of outer rail 4⅜ in., caused the overturning of a locomotive and the derailment of a passenger train near Bennington Station, Pa., on the Pennsylvania R.R., April 27, 1921, according to the conclusion drawn in the report of the accident recently issued by the chief of the Bureau of Safety of the Interstate Commerce Commission. While the statements of most of the witnesses did not indicate that the speed was much in excess of 25 or 35 miles an hour, it is believed by the bureau that the conductor's estimate of 40 to 45 miles an hour more nearly approaches the actual speed of the train at the time of the accident, and this view is supported by the condition of the wreckage and the absence of wheel marks of any kind on the ties at the point of derailment. The fireman and the engineer were killed and twenty passengers and one employee injured.

Approaching the point of accident from the west, the track is tangent for 2,167 ft., followed by a curve of 8 deg. 38 min. to the right, 1,285 ft. in length. The derailment occurred about 455 ft. from its western end, at which point the grade is 1.73 per cent descending for eastbound traffic. Track in the vicinity is laid with 130-lb. rail, 33 ft. in length, with eighteen oak ties to the rail length, tie plated, single spiked, and ballasted with a mixture of slag and cinders. Standing orders limit speed to 30 miles an hour within the territory.

According to the conductor, the train was traveling faster than usual just before the accident and he estimated the speed at the time of the accident to have been from 40 to 45 miles an hour. The engine came to rest on its left side about 300 ft. beyond the point of derailment, but all the coaches remained upright, although derailed. It was thought by the track supervisor who reached the scene of the accident shortly after its occurrence that it was due to excessive speed, since no wheel marks on the ties were found nor evidence of any obstruction on the track. Track walkers had covered this portion of the line less than two hours before the time of the accident. The engine was of the 4-6-2 type, having a total weight of 308,890 lb., a driving wheel base of 13 ft. 10 in., and a total length of 48 ft. 3 in.

The division engineer calculated that the equipment involved would overturn at the point of accident at a speed of 66.4 miles an hour, based on calculations not taking into account any slight shifting of the center of gravity of the locomotive due to lateral motion, slight irregularities in track, the effect of water in the boiler, etc. He expressed the opinion that a speed of from 50 to 55 miles an hour would have been unsafe. According to the recommended practice of the American Railway Engineering Association, on a curve of 8 deg. 38 min., an elevation of 5⅛ in. should be provided for a speed of 30 miles an hour; for a speed of 35 miles this elevation would be approximately 7 in., and for 40 miles, approximately 9⅛ in.

Economics of City Planning for Small Towns

Layout Designed Arbitrarily or to Meet Local Conditions—Street Width in Relation to Taxes and Buildings

GOOD and bad examples of city plans or street layouts are illustrated by the accompanying maps, reproduced from an article by A. G. Dalzell in *Town Planning and Conservation of Life*, published in Canada by the Commission of Conservation. The following is an abstract of the article:

The Loveland Farms development at Youngstown, Ohio, Fig. 1, is planned to fit the site, to have street widths suitable for their purpose, to reserve natural beauty spots for park purposes and to centralize business in a suitable location. Also, by enforcing building lines and restrictions, to insure that all buildings are placed properly on the land so that every property owner is assured of adequate light and air and a reasonable safeguard against the spread of fire.

On the other hand the plan, Fig. 2, of Ladysmith, B. C., a mining community on Vancouver Island, is the usual type of rectangular street development so common in the prairie sections of western Canada, but in this case the defects are greatly intensified because the plan is superimposed upon a hilly site. The axis seems to have been determined by the railway which forms the northern boundary of the city, but better street grades would have been secured if this axis had followed the cardinal points of the compass.

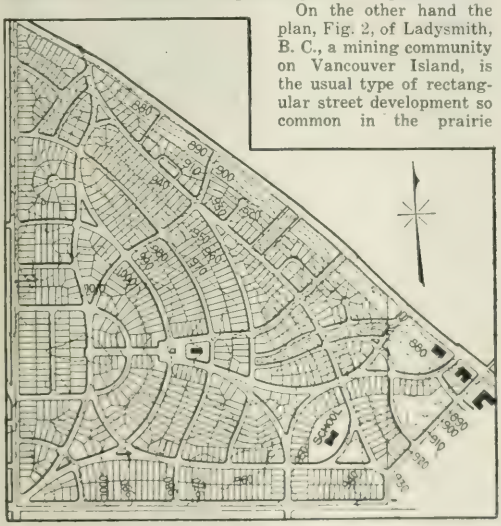


FIG. 1 CITY PLAN DESIGNED TO MEET CONDITIONS LOVELAND FARMS, OHIO

From the accompanying table showing the utilization of the area it will be seen that Loveland has the advantage of economy in street area and has more land available for communal enjoyment. Assuming that street costs are equally apportioned among lot owners in proportion to the area of the lot, and taking the standard of 800 sq.yd., as in Ladysmith, the lot owner in that city would be responsible for 693 sq.yd. of street while the owner of a similar lot in Loveland would be responsible for 271 sq.yd. only. At Loveland, by planning the streets to fit the site, economy in grading and drainage and general construction is assured, whereas in Ladysmith, topography not having been considered, the street grades run as high as 23 per cent and street construction is correspondingly expensive.

At Loveland, the business square and the community center are on a high level plateau, accessible from all directions by streets of easy grade. In Ladysmith, the so-called "market square" is useless both as a business and recreation center, the grade of the center line on the short axis being 14 per cent and the street leading to it from the railway station having an average grade of 7 per cent. In fact the square is not used for business.

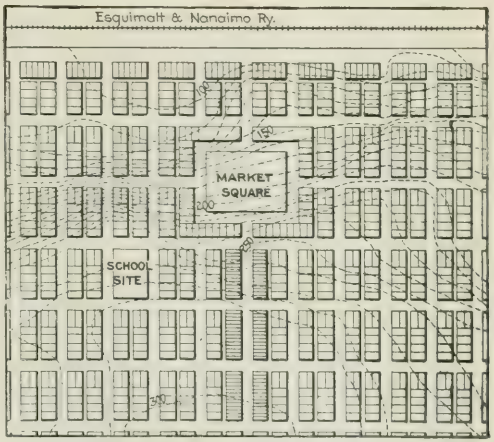


FIG. 2. CITY PLAN ADOPTED ARBITRARILY: LADYSMITH, B. C.

(Blocks, 360 x 260 ft.; streets, 80 ft.; contours, 10 ft.)

The subdivision of large lots into small ones on the central street is a modification of the original plan, but is witness to the fact that excessive street area tends to force the creation of narrow frontage lots. As there are no building-line restrictions, the tendency throughout has been the usual one of building as close to the frontage line as possible, so that in spite of the wide streets the general effect is that of overcrowding.

Economics of Street Widths—When a town has excessive street area in proportion to building area, the usual result is that street construction is temporary, with dirty roadways and dangerous ditches and sidewalks. If the citizens are determined to have improved roadways, with sidewalks and drainage, the burden of taxation may be out of all proportion to the value of the property benefited. In some cities this heavy taxation for street improvements has made it impossible for owners of vacant property to retain their holdings. Then the property has been allowed to go to tax sale, with the consequence that the holders of improved property have to carry an increased burden, and educational and social programs have been crippled because of excessive taxation for what are termed "local improvements."

DISTRIBUTION OF AREA IN CITY PLANS

	Loveland		Ladysmith	
	Acres	Per Cent	Acres	Per Cent
Building area	156	71	114.5	52.00
Park area	11	5	6.0	2.75
Street area	53	24	99.5	45.25
Total	220	100	220.00	100.00

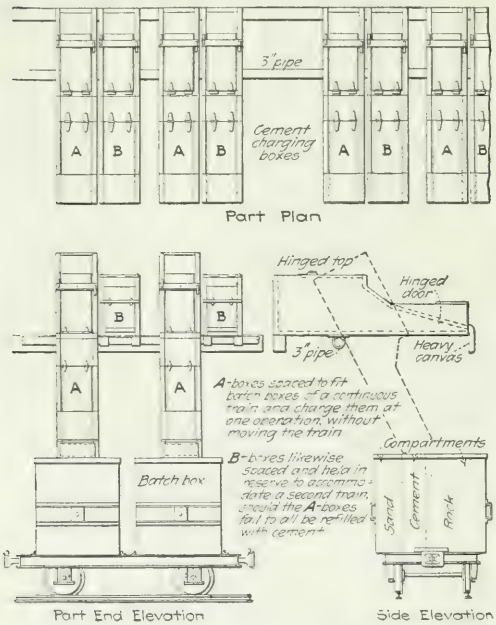
Excessive street area also adds to the cost of building land. If 20 per cent of the total area of land in a subdivision is devoted to streets, 25 per cent must be added to the original price of the land to make up for the loss of land not saleable. With 25 per cent in street area, 33 per cent must be added. It is thus common to find subdivisions with very wide streets having very narrow frontage lots, resulting in lateral overcrowding, which far outweighs any advantage that may result through the separation of buildings by the wide streets. To offset the high cost of land and street construction, the character of the building suffers, rooms being cramped or the sanitary essentials of a home sacrificed. It is not uncommon in such cases to find that more has been spent on the land and its development than on the buildings which are placed on the land.

Building the Maricopa County Concrete Roads

Field Methods Used in 141-Mile Road Contract Around Phoenix, Ariz. — Handling Cement, Operating Central Distributing Plant, Dispatching Material Trains, Scheduling Night Work

In the May 26, 1921, issue, p. 882, there was an article setting forth the outstanding features of the road program at Maricopa County, Ariz., where 141 miles of concrete paving is being placed under one contract and where over $8,000,000 has been voted for a 309-mile program. The job has recently been visited by a member of the editorial staff of this journal, as a result of which the following details of the construction operations have been prepared. The article should be read in connection with the earlier one noted.

THE sand and gravel washing plant which supplies the Maricopa County road job with aggregate for the concrete is located at Tempe, Ariz., about 10 miles from the center of the paving network under construction. It consists of two complete units which can be operated independently but which are built in the same timber structure. These units are exact duplicates even to having interchangeable parts, so as to reduce the danger of a complete shutdown of the plant. Rearrangement and additions to the washing system have been made



DETAIL OF DEVICE FOR CHARGING BATCH BOXES WITH CEMENT

from time to time in order to secure as many washings as possible.

As now operated, streams of water are directed against the incoming material (1) at the top of the bucket elevator whence the sand is washed through a sluice box to a screw conveyor, (2) in a series of streams on the inclined screw conveyor, (3) on the inside and (4) on top of the revolving screens where the rock is graded.

The efficiency of this washing system is high and it is claimed that only a negligible quantity of fines are left in the sand. Both the rock which goes through the crusher and the finer gravel consist largely of gneiss, quartzite and granite which have been worn down by river action until only the very hardest parts remain, thus affording materials of an exceptionally high grade. The proportioning of these materials has been worked out in accordance with the Abrams theory to obtain the maximum density and strength of concrete.

The plan is to have the washing plant keep about 10,000 cu.yd. of graded crushed rock in bunkers or storage piles ready for delivery. A minimum limit on sand has been unnecessary because thus far the material taken from the river bed has always produced 10 to 15 per cent more sand than gravel. In fact, if the present proportion continues the ultimate disposal of the sand surplus accumulating at the washing plant may become a problem. Sand and gravel are stored chiefly in piles near the plant whence a grab bucket operated by a locomotive crane loads the material into gondola cars. About 25,000 cu.yd. of sand and gravel were stored in bunkers and piles at the plant on May 11 and only one 8-hr. shift was working. When necessary the plant is operated two or three 8-hr. shifts daily until the desired storage is secured.

District Distributing Plant.—As first laid out the Maricopa County road system was planned for construction from three district distributing plants, work was to be carried on simultaneously at two while the third was being dismantled and set up at a new location. Construction began with two such plants in operation, one at Chandler and one at Fowler. Before the third plant had been built it was decided that greater economy and probably the same rate of progress, in the long run, could be made by working from only one distributing plant. The plant at Chandler was therefore shut down temporarily, and men and equipment were concentrated on that portion of the work that could be reached from Fowler. The third plant has not been built and will not be needed under the present program.

This rearrangement of the program did not radically change either the field forces, the number of mixers served or methods of handling materials, it merely routed materials through one central plant instead of two, and somewhat increased the length of maximum haul. With a maximum haul of 7 to 9 mi. it is believed that three locations for the distributing plants can serve advantageously the 150 mi. (approximately) of pavement which the bonds already sold ($4,000,000) will pay for. When some 22 miles more of pavement have been laid from the present plant at Fowler (this was written on May 11) men and equipment will be moved to Chandler to complete the work centering in that locality while the Fowler plant is being moved to Glendale, probably the last location under the present contract.

25,000-CU.YD. STORAGE PILES AT TEMPE CENTRAL MATERIALS PLANT
Sand piles at left and gravel at right

Materials from the washing plant are delivered in standard-gage trainloads to the district distributing plant. There a 4 per cent incline takes the cars onto a trestle whence they dump into the sand and gravel bunkers. Carloads of cement are taken up on the same trestle and by means of chutes from the car doors through openings in the roof of a cement house alongside, sacked cement is delivered by gravity direct to storage piles at a level above the industrial track on which materials are distributed.

The district distributing plant for aggregate and cement was shown in a sketch in the article in the issue of May 26. It is arranged for simultaneous loading of 12 cars which constitute a train, each car carrying two 4-sack batch boxes. Details of the cement charging boxes are shown in the drawing on p. 1026. In the cement storehouse the sacks are emptied into dump boxes balanced on a 3-in. pipe and so located above the track that when tilted down the cement runs through a closed section or spout into the cement compartment of batch boxes. The cover on the lower or chute portion of each dump box is hinged at its upper end so that it rests on the cement, thus eliminating an air space but swinging away freely when full opening for free passage of the cement is required. A piece of canvas or cement sack attached to the lower end of each spout serves as a curtain covering the batch box compartment into which the spout delivers. These two features were introduced to reduce the loss and nuisance occasioned by the escape of cement dust.

The air suction method of unloading bulk cement, which was used at first, had to be taken out of service frequently for repairs, the most persistently troublesome item being the excessive wear on the air locks or valves, caused, it is thought, by unground clinker in the cement. This clinker amounted to less than one-half of 1 per cent but this percentage was in large grains which scored the metal of the locks so that the vacuum could not be maintained. The suction unloader was altered several times and latterly a different air lock arrangement was tried. Meantime, to insure continuity of service, means for handling cement in sacks had to be maintained. Finally, decision was made to use sacked cement exclusively, and the suction unloader was taken out of service pending further development of the equipment.

Both sand and gravel bunkers deliver through chutes provided with an automatic cut-off or combination door and spout. This is a steel plate with edges curved upward, which is attached to the chute by a spring so that it can be sprung from closed to open position under pressure of the hand. Baffle boards of 1-in. lumber made up in sections about 12 ft. long and hinged longitudinally to the trestle timbers along the track are used to prevent the wasting of material from the spouts as the cars are being loaded. These baffles are hung so so that when swung on their hinges in toward the track they extend from the trestle timbers to the edge of the cars on a slope of about 45 degrees. When the spring gate is wide open there is no spillage, but during the short interval of opening or closing, the stream of material is directed over the edge of the car. When ready to either close or open the gate, the operator raises a baffle board section with one hand, thus catching the momentarily deflected stream and turning it into the proper compartment in the car. The batch boxes are placed on the cars with all sand compartments on one side and gravel compartments on the other. The spouts from the sand bunkers incline toward one side of the track and gravel spout to the other. Baffle boards are used only on the side of the track toward which the delivery spouts incline.

When the compartments do not fill evenly, the operator closes the gate to stop the flow of materials for a moment and using a small piece of board as a pusher, which he carries for this purpose, levels off the material in the car. The use of this pusher board has been insisted upon to insure accurate measurement of

materials. To clear any choking that may occur in the delivery spout a wooden plunger is hung from a hinge in such a position that by means of a conveniently placed wooden handle, it may be thrust vigorously into the chute.

When it is necessary to speed up train movements, all the sand compartments of a train can be loaded simultaneously and, with a single additional "spotting," further down the loading tunnel, all gravel compartments can be filled. As there are 24 compartments for each of these materials in a 12-car train, simultaneous loading of all cars would require a 12-man loading crew. However, only four to six men are ordinarily used in a crew, these men moving down the train as the cars are loaded. An inspector for the county watches the filling of all trains and is held responsible for the quantities of materials sent out in the batch-boxes.

Labor Schedule and Night Work

As the work is now arranged two 8-hr. shifts work on the mixer crews; 7 a.m. to 4 p.m. and 6 p.m. to 2 a.m. The schedule of the day shift includes an hour for lunch. The night shift is served a hot lunch about 10 p.m. but the men eat this in relays so as not to stop the work. At the district distributing plant three 8-hr. shifts are necessary to keep just a little ahead of requirements. The "grave-yard shift" uses only about 13 men as compared to the 18 men used on the other two, and in addition to filling and delivering to all the mixers one or more trains of material, it does all necessary cleaning up around the plant and any rearranging or repairing that would interfere with routine operation during the day. At first this shift only filled the cars and left the trains to be delivered first thing in the morning. This plan was given up in favor of immediate delivery to avoid the delays that might result from a blockade or other failure of the transportation system before the morning deliveries had been made.

After daylight hours each paving unit is lighted by acetylene lights of which about seven are used at each mixer. One of these is set to direct its light where it will be of most benefit to the men engaged in making the batch transfer, one is set to illuminate mixer operation, one for the special use of the men working with the finishing machine and the others are distributed along the sides of the roadway, wherever needed.

The mixer crews and all the men whose work has a direct bearing on the rate of progress in laying pavement, have an opportunity to earn a bonus. A bonus of 10 per cent of each man's wage is paid for every 50 ft. of pavement laid per day beyond the footage set as a standard. Effort is made to fix this standard with respect to the various conditions affecting each part of the job so as to give all an equal chance. As much as 30 per cent bonus has been earned on this basis at times. This makes a real inducement for teamwork and speed even in the case of common labor which is paid $3.85 per 8 hours.

Train Dispatching System.—After some experiments with telephone and other control systems, the best plan of dispatching concrete trains from the district distributing plant to the several mixers was found to be to eliminate all signal or train order methods and put the entire control of the train movements in the hands of a dispatcher equipped with a motor cycle. The locomotive engineers have standing orders to "hit the track" as soon as their trains are ready. It is the train dispatcher's duty to see that each train is given a destination soon enough to avoid any delay in waiting for orders. Orders are given verbally to each locomotive engineer usually very soon after he has started away from the central distributing plant.

The success of this method is due largely to the fact that for most of its length the construction railroad lies alongside finished pavement. All parts of the work are accessible on good roads and where necessary the dispatcher can ride his motor cycle between the rails of the construction track. He keeps in touch with conditions at all mixers and at the distributing plant and in case of shut-downs, train derailments or other delays, reroutes trains accordingly. This method of dispatching affords a flexibility which makes it possible to adjust the schedules to suit contingencies as they arise.

The dispatcher expects trains to make 6 miles per hour or more. Passing tracks are located every half mile. Only one man, the locomotive engineer, is assigned to each train. This man rarely has to leave his cab to throw a switch at the far end of the train. Such switching is infrequently required and when necessary is done by men connected with the work who are riding to and from the mixers a great deal of the time. Under ordinary conditions it takes the mixer crew about 40 minutes to use up a 12-car trainload of material.

With three mixer plants in operation and hauls from the central distributing plant of 2, 5 and 6½ miles respectively, which happened to be the situation when the job was visited recently, 14 gasoline locomotives were in use. Of these two were kept in reserve as spares, one was used for switching at the central plant and 11 were employed in actually making the train movements required. The requirements vary from two to four locomotives per mixer, according to the distance from the central distributing plant.

Repairing Facilities

Derailments due to broken axles have been more frequent than any other transportation trouble. The explanation of this offered by engineers on the work is that only axles containing an inferior grade of material have been available of late. Axles have been purchased from different factories without changing this condition.

Each locomotive carries re-railing frogs with which a derailed car in favorable position can be run back onto the track very quickly. The track itself, which is of 24-in. gage, is reported to have given no trouble whatever. It is laid in 15-ft. sections, has 20-lb. rails bolted to pressed steel ties with edges curved down all around to grip the roadbed. Adjoining sections are connected only by the slip joint at the end of each section, no bolt being used to fasten the sections together. The track is not kept in particularly good alignment, nor is the roadbed given much attention, yet even in collisions violent enough to buckle the steel frames of the car trucks, the track has not been shifted materially nor shown the need of special attention or more care in maintenance.

Four mixers are set up in the field for service from the district distributing plant, but crews are supplied for only three, the idea being to keep one in reserve so when a breakdown occurs the crew can go immediately to another mixer without loss of time. A fifth machine has recently been assigned to the Fowler plant to serve as a spare so there will be better opportunity to always maintain four mixer plants in the field.

Handling and Finishing Concrete.—The concrete is mixed in 4-sack batches in a 3-sack mixer. This causes some spillage and overflow, particularly in delivery from mixer to skip. As this overflow is on the subgrade and is covered in a very few minutes, it is not considered objectionable. The mix is placed as dry as is believed to be consistent with the elimination of air pockets. Maintenance work on the mixer has been simplified by keeping well greased all parts where spillage of concrete might occur. The oil used for this purpose is that drained from crank cases of gasoline engines used on the job. The steel header boards are also well greased with the same material just ahead of the mixer. A concrete spade is used vigorously in the concrete along each header board to insure the elimination of all "rat holes" and air pockets along the edge. On at least one of the mixing outfits, a weight of several hundred pounds has been added to the tamping machine to steady its operation and reduce the vibration. The operation of this machine is reported to be more satisfactory since it was weighted.

The finishing done by the belt attached to the tamping machine is supplemented by a hand-operated belting machine which is kept well back of the tamper. This second belting is done as late as consistent with the initial set of the cement and is regarded as an effective means of avoiding the tendency to form hair cracks. No hand roller is used in finishing the pavement; the mix is kept rather dry and, in a moisture-absorbing atmosphere, by the time the last belting is completed it is believed there would not be enough water in the surface to permit of the use of the roller. The use of a float is forbidden in the specifications, but its use is tolerated because it has been found desirable to have some means of smoothing up the surface here and there where the second belting has disturbed small rocks near the surface, smoothing out dog tracks in the fresh concrete, etc. An iron edging tool is used to round off the corner of the slab on a 1½-in. radius. This avoids the sharp corner or feather edge in the concrete at the header board. It is not expected that this pavement will later be widened.

A device which has been found particularly useful to the mixer crew is a tool-car built to run on the header boards as rails and which has a box for carrying supplies and miscellaneous spare parts for the mixer. This tool car is pushed ahead of the mixer and has frequently saved the delays incidental to going back to to the nearest base or sending a messenger for the parts and supplies necessary to make minor repairs.

Quick Setting Cement

Under weather conditions obtaining on this work the cement ordinarily takes its initial set about an hour quicker than at the cement mill in Riverside. In addition to this, when using water whose temperature is 100 deg. F., which is frequently the case during the summer weather when the water comes from a pipe laid on top of the ground, the cement sets an hour quicker that when water at 70 deg. is used. Thus during the hot weather this season, it is planned to ask the mill for cement with 4-hr. initial set in order that the desired condition of a 2-hr. initial set may be obtained on the work.

A comprehensive study is being undertaken to determine how and to what extent water temperature affects the rate of setting under conditions as they obtain on this work. In making the initial set tests on each car of cement, the practice is now to make these tests both with water at 100 deg. F. and at 70 deg. F., as it has been found that the former gives quicker results which check very closely with those made in the usual way. The 70-deg. tests are continued as a check.

Every precaution is taken to get water on the finished surface as soon as possible. Occasionally in order to flood it before the surface has hardened sufficiently to permit of shoveling earth upon it, dikes are built up along the headers and a transverse check of fines is carefully thrown across the pavement and the reservoir thus formed is filled with water. By the use of sand from which "fines" have been eliminated, late belting, and early flooding of the pavement, it has been possible to prevent the formation of hair cracks engineers on the work affirm, so the use of a burlap cover or sun shield, mentioned in the description of this work referred to at the beginning of this article, has not been found necessary and was discontinued.

Expansion Joints

Each shift places two expansion joints clear across the road. That is, they average one for every 4 hours' work of the mixer crew. At the outset these were made of an asphaltic compound ½ in. thick. In about 35 mi. of pavement laid in cold weather, expansion of the concrete closed the ½-in. joints, crushing the concrete and occasionally slightly buckling the slabs at a point. This movement of the pavement was ordinarily carried through several expansion joints and caused the buckling only at intervals of about a half-mile. Thus far the buckled pavement has always returned to its original position when the temperature lowered.

Some of the movements raised both of the abutting slabs but more often one slab was thrust up over the edge of the one adjoining. Where both slabs rose the danger was found to be in longitudinal cracks caused by heavy vehicles on the unsupported pavement; where only one slab rose there was a sharp-cornered ridge across the pavement sometimes 2 in. high, as well as occasional scaling off of the surface where excessive pressure was concentrated near the top of the slab. It is believed that while the paving laid in hot weather will not crush the ½-in. joints, it may shrink and cause contraction cracks in cold-weather. In order to correct the tendency to buckle in the cold-weather pavement, transverse cuts are being made near the joint where the buckling occurred and one or more additional expansion joints are inserted there. These cuts are made 10 to 15 ft. back of the joint to catch any longitudinal cracks that might have occurred while the slab was raised.

The width of construction joints is now being determined in the field by the engineer in charge of the paving units according to a table which gives the width of joint considered proper for every 10 deg. F. variation in temperature of the mixed concrete. On this work the maximum temperature of the pavement, due to direct rays of the sun, was taken to be 140 deg. F. and the minimum temperature 20 deg. F., giving a total variation of 120 deg. F. With construction joints placed every four hours the average slab length is 250 ft. The average width of the construction joints is 1¼ in. A maximum of 1½ in. is used.

The work is being done for Maricopa County under the general supervision of R. C. Perkins, county highway engineer. Twohy Brothers, for whom John F. Horan is engineer in charge, hold the contract for that part of the work to be done under the first bond issue.

Earth Fill Irrigation Dam Has Some Novel Details

Loose Rock Drains Lower Saturation Line—Air Vents Added to Sluiceways Permit Trapped Air To Escape

By Clair V. Mann
Civil Engineer, Rolla, Mo.

SOME of the details of the Apishapa Dam, recently completed near Fowler, Col., by the Apishapa Consolidated Irrigation Co., are sufficiently novel to make a record of its design worth while.

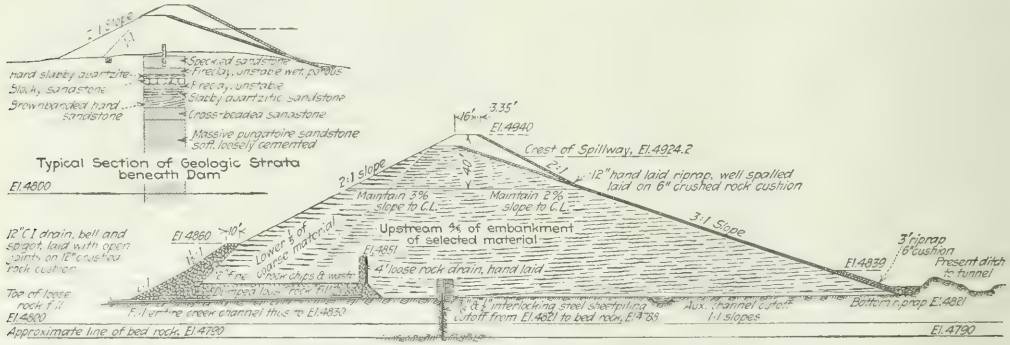
The dam, the completion of which is a triumph of enterprise for the small group of farmers who make up the irrigation company, is designed to form a storage reservoir of 26,000 acre-feet capacity to supplement the natural stream flow of Apishapa River, and thus irrigate 20,000 acres of fertile land in the famous Arkansas Valley region of Colorado. Irrigation from natural stream flow without storage had been carried on for some twenty years, but had proved inadequate for growing of successful crops. Storage from the dam will make this project the equal of any in the valley.

It is built across the bottom of the 200-ft. rock-walled canyon of Apishapa River, and consists essentially of a 318,000-cu.yd. earth embankment reinforced on the lower toe by a 11,000-cu.yd. rock fill toe. The water face is surfaced with broken stone riprap laid on a 6-in. crushed-rock cushion. Across the canyon, the dam is 586 ft. long on top and 300 ft. at the bottom. The dam crest as planned is 19.35 ft. wide over all, and the base of dam at maximum section is 594 ft. wide. As planned, the height above river bed is 120 ft., and this is 152 ft. above bedrock and bottom of cutoff wall. It is also 16 ft. above crest of spillway, which consists of a natural saddle one mile from the dam, large enough to pass any flood that may ever occur.

2:1 slope at the inner edge of this berm, the earth fill continues to its base on a 1:1 slope against which the rock-fill toe rests. From the outer edge of the berm, the slope of rock fill is 1½:1 for 30 ft. vertically, at which point its slope meets the original 2:1 slope from top of dam, which then continues to base of dam. The embankment built in 12-in. layers, placed in windrows across the canyon by means of dump wagons. Each layer was spread with a blade grader, sprinkled, and rolled twice with a corrugated wheeled roller weighing 250 lb. per lineal inch of tread. Successive layers were pitched toward center of dam 3 per cent from downstream and 2 per cent from upstream slopes.

The canyon is cut down through the massive Dakota sandstone and the alternating shale, clay, and sandstone beds under it to the massive, Purgatoire sandstone at the base of the Dakota formation. The canyon bottom at the dam site is covered with 50 ft. of intermixed adobe clay, fine river sand, and gravel, with an occasional boulder. The original plans contemplated a concrete cutoff wall extending down to bedrock, and up from stream bed a height of 50 ft. The construction of this wall would not have been within the company's means, so that a steel sheet-piling wall of ⅜ in. and ½ in. thickness, Carnegie and Lackawanna sections, was substituted. This wall is 8,000 sq.ft. in extent, and extends from 1 ft. above river bed to bedrock, or 33 ft. in depth. It is supplemented by a double-plank

SECTION OF CAST-IRON SLUICEWAY SHOWING AIR VENT

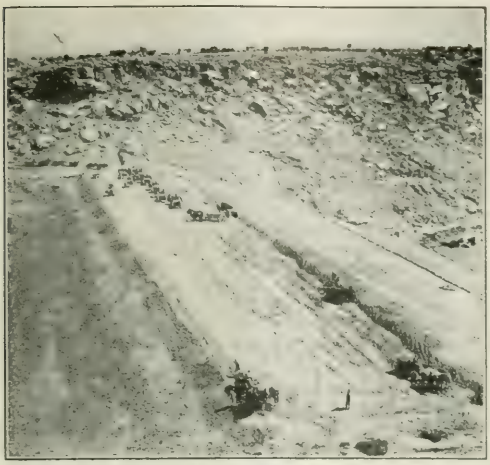


CROSS-SECTION AND SUB-SURFACE CONDITIONS AT APISHAPA DAM

The crest of dam as built is only 7.8 ft. above spillway crest, and the writer considers this insufficient margin for safety. Financial considerations led to the decision to restrict its height as indicated.

Both embankment slopes are 2:1 for the top 40 ft. of the section. From this point to base, the water slope is 3:1. The downstream face is 2:1 to a point 80 ft. below crest, where a 10-ft. horizontal berm is introduced at top of rock-fill toe. From the foot of the

wall 12 ft. high, bolted to the top of the steel wall, the joint being made water-tight with concrete. Both steel and wood walls are joined to the sides of the canyon by means of concrete walls built into notches in the faces of the cliffs, which walls extend down to bedrock and also encase each end of the steel and wood walls. By an extension of these walls up the cliff faces and out 10 ft. from them, a comparatively water-tight joint is made between earth embankment and



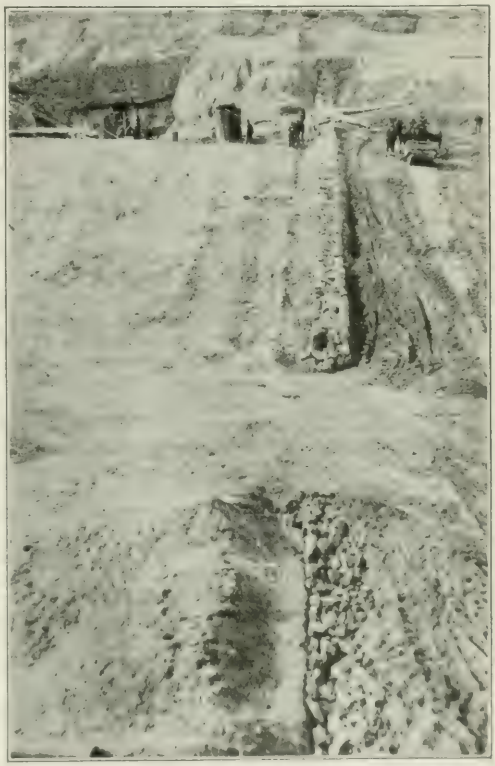
APISHAPA DAM NEARING COMPLETION

cliffs, and to this end the earth placed next to the walls was thoroughly puddled.

A novel feature is the construction of loose rock drains within the lower half of the embankment. This is designed to lower the line of saturation, and together with the rock-fill toe, will prevent the slipping off of the lower toe. The construction of the drains started with laying a 12-in. cast-iron pipe in the old stream bed, beginning 60 ft. downstream from axis of dam, running thence out beyond lower toe of dam. This pipe was surrounded with rock chips and crushed rock, and to it, at upper end, were joined two 8-in. cast pipes extending across the canyon to the cliffs, and up them through a notch. From the tops of the cliffs, clay tile instead of cast iron is used. Over all the pipes so laid and protected with crushed rock, a loose rock fill was placed to a depth of 10 ft. in the old stream bed and downstream from the 8-in. cross pipes. Directly over the 8-in. pipes a wall from cliff to cliff was built to a height of 30 ft. above the old stream bed and 4 ft. thick. This was constructed as an integral part of the earth embankment, and was covered on each side and over top with 1 ft. of loose rock chips and fine rock-waste to prevent entrance of earth fill. From the top of this wall, at its ends, the loose rock fill over the pipes was continued up the cliff faces and from them upward toward the ends of the dam, the section here being 4 x 4 ft., with waste covering additional. An accompanying view shows the cross-wall drain being built into the earth embankment.

The outlet is through a tunnel 10 x 10.75 ft. finished size, bored through the solid rock at one end of the dam. This tunnel was required to pass 2,000 sec.-ft. of water for prior rights down the river, so that portions of it passing through soft rock and shale pockets had to be concrete lined. The tunnel is approximately 700 ft. long. The cliff over its entrance was made vertical, and into it 20 ft. above river bed a chamber 12.5 ft. high, 37 ft. wide, was driven a distance of 17 ft. The inner 11 ft. was then sunk to the level of the tunnel and river bed. The inlet chamber was divided into five compartments by means of concrete piers and partitions, and the trash rack bars set on the chamber face in the plane of the vertical cliff. A scour gate was set at the level of the river bed and tunnel floor. Water entering the inlet pours over the inner edge of the inlet chamber floor and drops to the tunnel floor 20 ft. below. This arrangement was made to allow the silt to seal the reservoir floor in front of the dam, thus preventing seepage.

The outflow is controlled by two 42 x 72-in. and one 24 x 72-in. rectangular sluice gates installed in the tunnel 208 ft. from the head of inlet chamber. The gates are of very heavy, bronze-mounted pattern, designed to operate under 100 ft. head. The two larger gates are hydraulically operated. The smaller gate has a steel stem rising to the top of a gate tower built over the smaller gate. Hand-operating mechanisms



DRAIN WALL ACROSS CANYON CONSTRUCTED AS PART OF EARTH EMBANKMENT

and the oil tanks and pump are installed on the gate-house floor. The gates are placed at an angle in the tunnel, which at this point is enlarged to a finish width of 20.5 ft. The gates are set on the upper ends of three cast-iron sluiceways each 12 ft. long, 6 ft. high, and equal in width to the respective gates. These sluiceways discharge into a curved, concrete-lined chamber which connects with an 80-ft. section of concrete-lined tunnel.

To overcome the difficulties elsewhere experienced with gates of this type where set on concrete walls and sluices, an air-vent system was added to the cast-iron sluiceways. Eight-inch pipes enter each of the sluiceways at the top and just behind the gates, and

from thence are led to a vertical steel air pipe which extends up inside the gate tower to a point above high water and there passes through tower wall horizontally. An auxiliary outlet well 4 x 4 ft. in section rises from the lower end of the gate chamber just outside the gate tower, and to within 25 ft. of high-water line where a 30-in. gate valve controls the outflow through this well. A connection between this well and the air-vent pipe will permit any air trapped in the tunnel to rise and escape whenever the well itself is not discharging.

Two sets of plans were drawn up and abandoned before the final plans, prepared by the writer, were made up and the dam constructed. The writer was engineer in charge during construction and A. J. McCune, State Engineer of Colorado, was consulting engineer.

[A telegram from Mr. Mann dated June 9 says "Apishapa dam outside Pueblo cloudburst area, therefore safe with storage at El. 4865."—EDITOR.]

Recommend Concrete for Ocean Structures at New York

City Engineers Report That With Proper Precautions Reinforced Concrete Can Be Made Safe in Sea Water

THE City of New York is contemplating the construction of a boardwalk on the ocean front at Coney Island and at a more remote date a boulevard of the boardwalk type across a part of Jamaica Bay. Designs for these structures have been made of the usual pile and beam-and-girder type of reinforced concrete. Following an announcement regarding these structures a communication received by the Board of Estimate and Apportionment criticizing the use of reinforced concrete in or near sea water, led the Committee on Finance and Budget of the Board to order the chief engineer, Arthur S. Tuttle, to submit a report on the feasibility of this type of construction and material for sea-water exposure. Mr. Tuttle's report, including a detailed report by Kenneth Allen, engineer of the Board, has just been made public. It contains an extensive résumé of the literature of the subject, a symposium of opinions by various experts, and the conclusions of both Mr. Allen and Mr. Tuttle as to the availability of reinforced concrete for sea-water work. Briefly, both engineers are of the opinion that reinforced concrete may be safely used in or near sea water provided proper precautions as to type of structure methods and materials are taken.

The investigation was started by a criticism of Charles R. Ward, president of the Ward Engineering Corporation of Brooklyn, N. Y. Mr. Ward alleged that experiences with reinforced-concrete structures exposed to sea air and to sea water have demonstrated that salt water or salt air will penetrate the concrete, causing the steel reinforcement to rust and expand and the concrete to spall and crack, thereby gradually weakening the structure until it finally falls. In support of his contentions he quoted articles in *Engineering News-Record*, particularly those of March 25, 1920, and Jan. 20, 1921, describing the condition of reinforced-concrete pleasure piers on the Pacific Coast in southern California. He further refers to the dangerous condition of the reinforced-concrete municipal bath house at Coney Island, which is very near the proposed structure.

Mr. Tuttle reports on the municipal bath house as follows:

The municipal bath house at Coney Island is a reinforced-concrete structure built in 1911, designed originally to have a position back of and immediately adjoining the mean high water mark. It rests on a series of reinforced-concrete beams, those extending transversely being 8 x 15 in., while those having a longitudinal direction are 8 x 13 in., except under the side walls, where they are 14 x 13 in.; these in turn are supported on reinforced-concrete columns, arranged in 20 bents spaced about 20 ft. c. to c., each bent generally consisting of 5 columns spaced about 16 ft. apart, the outer and center lines of columns being 16 x 16 in. in cross section and the two remaining lines being 14 x 14 in. The floor slabs resting on the beams are about 8 x 20 ft. The columns have a length of a little less than 9 ft., and rest on spread foundations which in turn are carried by wooden piles; the base of the columns is approximately at the elevation of mean high water.

CONDITION OF MUNICIPAL BATH HOUSE

The specifications for beams, girders and columns provide that: "The reinforcements of all beams and girders shall have at least 1½ in. of concrete protection at the soffits and sides. The vertical reinforcements of the columns shall have at least 2 in. of concrete protection and shall be firmly secured together with ¼-in. wire ties every foot in height."

An inspection made by Engineer Kenneth Allen and Assistant Engineer Leicester Durham of this office on March 16, 1921, shows that in the six outshore bents small vertical cracks appear quite generally in the columns. These are usually short and vary in width from hair cracks up to 1/16-in., but in the case of two of the columns corners have spalled off for lengths of about 2 ft., here exposing the steel reinforcement. In this portion of the structure pronounced longitudinal cracks appear in the beams and girders along their underside and on the sides near the bottom, in a few cases exposing the steel, while in several places where no spalling or cracking has occurred the diagonal reinforcement is visible. Toward the northerly portion of this section the cracks are less pronounced. Through the remainder of the foundation of the substructure, and more particularly in the northerly portion, spalling was pronounced in the floor slabs, this generally being confined to small areas directly under the steel reinforcing rods which were exposed. In all cases the steel where exposed was rusted.

An examination of the remainder of the building disclosed no evidence of failure due to weakness of the foundations or to deterioration of the concrete.

The concrete appeared to be of good quality but there was evidence that the reinforcement in the sub-structure had been placed nearer the surface than provided under the specifications, and that in some of the floor slabs the steel was practically at the surface, while in the case of the columns where spalling was most pronounced the cover over the rods was originally only about 1¼ in., and in another case where the concrete was sound a vertical reinforcing rod projects near the foot of the column. It was the opinion of these engineers that there was no danger of the structure failing in the near future but that steps should be taken toward the necessary repairs at an opportune time. A later visit which I made to the structure confirmed the conclusions which had been reported by them.

A sample of the concrete used for the columns, which was tested in our laboratory, after thorough drying followed by 96 hours' immersion, showed a gain in weight of about 3.7 per cent, representing a porosity of about 9 per cent.

In my judgment, the damaged portions of the foundation can be satisfactorily repaired by stripping off all spalls or damaged concrete, cleaning the steel reinforcement where it can be reached, and sand-blasting the floor slabs, after which a thickness of from 1 in. to 1½ in. gunite can be applied to the columns, girders and beams over and above the amount required to restore the original sections, and a thickness of ⅜-in. to ½-in. to the floor slabs. The cost of this work, including the wire mesh with which the girders,

beams and columns should be wound before the gunite is applied, if limited to the sections where cracking or spalling has developed, would probably not exceed $5,000, while, if the same treatment is extended to the entire foundation, the expenditure would be a little less than double this amount.

I am informed that since the building was placed in commission no work has been done in the way of repairs to the portions of the structure to which criticism has been directed, and the small expenditure now required certainly does not represent a serious outlay when the exposed position of the building is considered.

Conclusions by Engineers

Mr. Tuttle then quotes several experts who feel that such failures as have occurred in reinforced concrete in sea water are due to poor material and methods, and says: "From the investigations made by Mr. Allen it would appear that reinforced concrete may be safely used in or near sea water provided that the following conditions are complied with: (1) Proper materials, mixing, workmanship, curing and handling must be rigidly insisted upon; (2) the surface of the concrete must be protected from abrasion; (3) the steel reinforcement in that portion of the structure above mean low water must be given a cover of at least 3 in. of concrete. . . . I see no reason why all of these requirements cannot be adequately met in the construction of the boardwalk and am of the opinion that this type of construction is best adapted to the service required."

He suggests further that an experiment proposed by the chemist of the Board, William P. Carpenter, be made. Mr. Carpenter suggests an investigation of the effect upon the bond between steel and concrete of a coating of a grout of 90 per cent portland cement and 10 per cent zinc yellow (a chromate paint pigment). He thinks that if this test proves satisfactory such coatings should be required on the reinforcement in the new work.

Mr. Allen's investigations include a number of interviews with engineers who nave built or observed reinforced-concrete structures in sea water. These interviews give widely divergent opinions, though in the main the engineers are optimistic to the extent that they believe that if proper methods and materials are used reinforced concrete will be safe in sea water. A number of them, however, cite many instances of reinforced-concrete pile structures which are in various stages of deterioration. These observations relate almost exclusively to slender pile frames of long, unbraced length, where the structure is subjected to the heavy battering of waves and to extreme vibration: such a situation as is common for the usual pleasure pier or boardwalk.

Mr. Allen's conclusions, briefly put, are as follows:

While there is a decided difference of opinion as to the reliability of concrete and especially reinforced concrete exposed to sea water, it seems to be acknowledged that the concrete must be of the best and the steel should be practically inacessible to the infiltration of sea water. Otherwise, we have in the case of plain concrete disintegration due to chemical reactions, or in the case of reinforced concrete, failure due to either electrolysis (which is not common) or to rusting of the steel.

Whether the admission of moist air alone to the steel is a serious cause of failure is a matter of opinion, but the action is probably greatest when the steel is alternately wet and dry. Although we speak of the "salt air," it is questionable whether salt is ever really conveyed in the air except as spray.

Aside from theoretical considerations, the fact remains that there have been numerous failures of concrete, both plain and reinforced, in sea water, but particularly in reinforced work. Although the preponderance of opinion quoted expresses confidence in these materials, exhaustive inspections by Wight, Wig and Ferguson leave us with no doubt as to the general failure to secure permanent construction with these materials in America. I believe that if all the facts were known these failures could always be traced either to improper design, improper material, or improper workmanship. To secure dependable work practically 100 per cent excellence is required in all these elements and if, for industrial reasons or incompetency on the part of those responsible for the work, this cannot be assured, there will always be certain risks in using these materials. There is sufficient testimony that it is practicable to secure reliable work under favorable conditions, and in comparing results with timber or steel structures it is to be remembered that these, too, are subject to deterioration or failure depending on their design, material and erection.

To insure reliable results in reinforced concrete in sea water the following rules are suggested:

Rules for Securing Durable Work

1. Use some well-known portland cement of good character, with clean, hard, graded sand and gravel not over ¾ in. or 1 in. in size.
2. Mix 1 part cement to not over 4½ parts aggregate with just enough fresh water so that it will settle in place and envelop the reinforcing rods with light tamping.
3. Complete the placing of concrete in each pile or unit in one operation so that there will be no construction seams.
4. To secure a dense smooth skin some mineral oil should be applied to the forms. If practicable a richer mortar than the average and about 3 in. thick may be applied next the forms, keeping the larger pieces of aggregate away from the surface, but if this is done the mortar face should be placed at the same time as the rest of the concrete.
5. Reinforcing material above the level of low water should be placed at least 3 in. from the face of the concrete. Below low-water level a protection of 2-in. cover will suffice.
6. Allow the work to become thoroughly hard before permitting exposure to sea water. In the case of precast members this should be not less than 30 days.
7. In precast piles or similar members particular care is necessary to prevent injury by flexure in handling. If not maintained in a vertical position the exact location of supports to avoid undue stress should be stipulated and adhered to.
8. The application of a coating of gunite ¾ in. to 1½ in. in thickness on surfaces exposed to the extreme range of spring tides is strongly recommended as an additional precaution.
9. Piles placed in very deep water should be so braced laterally as to prevent injury by flexure.
10. If the structure is to be exposed to the impact of vessels or abrasion from ice it should be further protected by sheathing, fender piles or a heavily galvanized iron casing.

Assuming strict compliance with these rules it is the conviction that reinforced concrete may be safely used in marine works with assurance of a durability that will compare favorably with that of other materials ordinarily employed in such construction.

Road "Lighthouses" in Britain

The Ministry of Transport is experimenting with an occulting light which flashes every 15 or 30 sec., according to its adjustment. These lights are destined for two purposes: The first which will probably take the form of a red lamp, is to be placed at dangerous corners and cross roads. The second, which is to be white, will be arranged to flash on the new standardized road signposts, focussing its light on the figures at intervals of 15 sec. The lamp is small and compact, the flash being generated by acetylene.

Tests of Dredge Pump Operation for Hydraulic Fill

Velocities and Power Consumption Decrease as Friction Head and Solids Show Increase

By Ivan E. Houk
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

IDEAL and actual operating conditions and their variations with the length of the delivery line are shown by the experiments at the Englewood dam by Professor S. M. Woodward, consulting engineer for the Miami Conservancy District, and the writer, in the summer of 1919. The observations also show the effects of variations in the character of the solids as well as the wide fluctuations in pumping characteristics which are continually occurring while handling large quantities of material. Briefly stated, the general conclusions which may be drawn from the tests are as follows:

1. The proportion of solids which may be safely carried decreases as the length of the delivery line increases.

2. In a 15-in. delivery line material is transported most efficiently at a velocity of about 12 ft. per second, the ideal velocity being the same regardless of the length of the line.

3. Wide fluctuations in vacuum, friction head, power consumption and velocity occur continually while pumping solids, even though the solids are fed to the pump as uniformly as possible. These fluctuations are caused by the unavoidable variations in the mixture being pumped.

4. During these fluctuations the velocity and power input to the motor decrease as the friction head and proportion of solids increase. The power consumption per cubic yard decreases with a decreasing velocity more rapidly than the total power input, since the increase in the proportion of solids causing the decrease in velocity more than compensates for the reduction in total discharge.

5. The friction head in the delivery line while pumping solids varies from one to several times the value for clear water, the actual amount for a constant velocity and a given material, increasing as the proportion of solids increases.

6. When the material being pumped is largely sand and gravel the friction head is considerably greater than when large proportions of clay and surface loam are being transported.

The original pump layout was in operation at the time the tests were made. (*Engineering News-Record*, Sept. 16, 1920, p. 547). Pumping units consisted of manganese steel dredge pumps having 15-in. suction and discharge openings and fitted with 46-in. impellers, direct connected to 500-hp. induction motors with variable speed control.

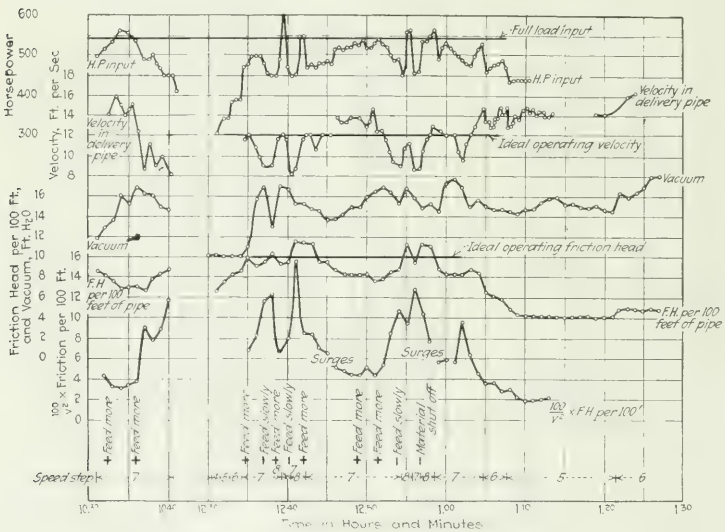


FIG. 1. OPERATION DIAGRAMS OF 15-IN. DREDGE PUMP, AUG. 28, 1919, WHILE DUMPING ABOUT 100 CU.YD. PER HOUR

(Static lift, 45 ft.; delivered line, 1,300 ft. long, including 7 lengths of riveted pipe, 68 lengths of welded pipe, 113 ft. of standard wrought-iron pipe with bolted screw flange joints, one flap valve, one 90 deg. bend; diameter of pipe, 15 in. inside; diameter of impeller, 46 in.)

Tests were made on May 22, Aug. 28 and Sept. 5. On May 22 about 125 cu.yd. per hour of a mixture containing a large proportion of black surface loam was being pumped through a delivery line about 760 ft. long. The output on that date was limited primarily by the length of the delivery line and by the danger of plugging in a long sag across the pool on top of the dam, it being necessary, of course, to reserve a certain amount of power for use in emergencies. On Aug. 28 about 100 cu.ft. per hour of a mixture of sand, gravel and clay with a preponderance of sand and gravel, was being pumped through a line about 1,300 ft. long. On this date also, the primary limitation was the length and profile of the delivery line. On Sept. 5 about 190 cu.yd. per hour of a mixture similar to that handled on the preceding date, was being pumped through a line about 395 ft. long. During this test plenty of reserve power was available and the output was limited entirely by the amount of material that could be worked into the sump by the monitor man.

Velocities and friction heads in the delivery pipe were the only quantities measured on May 22. However, on the latter dates the observations were more comprehensive. On Aug. 28 continuous measurements of pressure, vacuum, electrical current, velocity, motor speed step and feeding signals were secured by a corps of trained observers, through a period of about an hour. Similar data were taken on Sept. 5, throughout a period of about 1½ hr., except that ammeter readings were omitted and, instead, a few scattered power measurements were secured by observing the speed of rotation of the disk on the watt-hour meter.

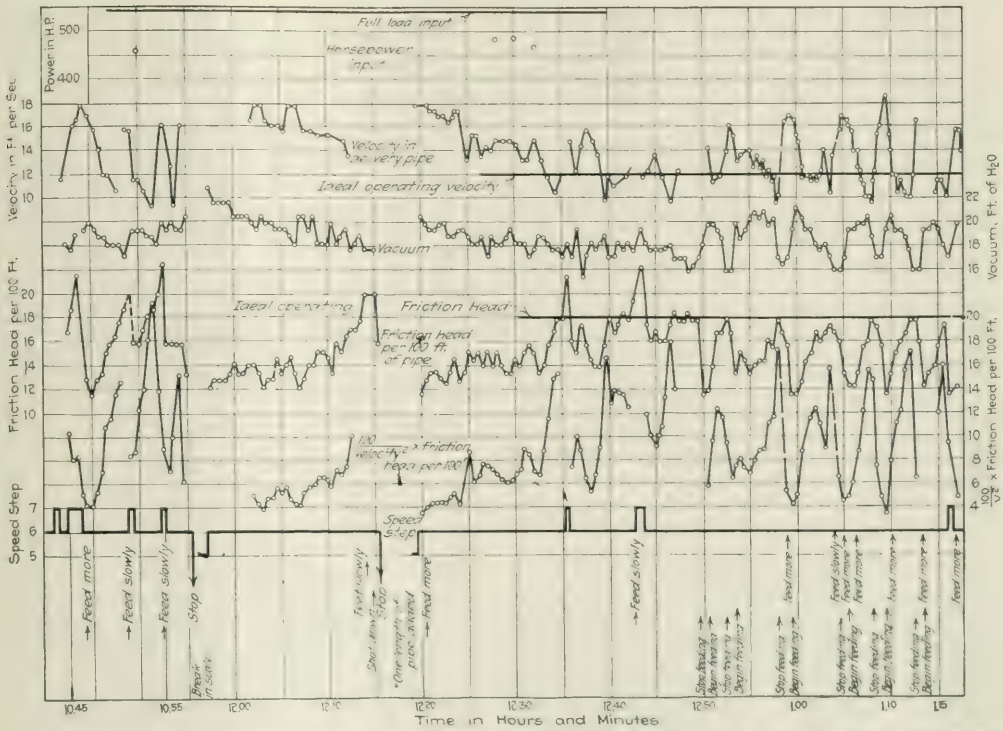


FIG. 2. OPERATION DIAGRAMS OF 15 IN. DREDGE PUMP, SEPT. 5, 1919, WHILE PUMPING ABOUT 190 CU.YD. PER HOUR

(Static lift, 49 ft.; delivery line, 395 ft. long, including 17 lengths of welded pipe, 1 length of riveted pipe, 102 ft. of standard wrought-iron pipe with bolted screw flange joints, one flap valve, and one 90-deg. bend; diameter of pipe, 15 in. inside; diameter of impeller, 46 in.)

Velocities were determined by measuring the curve of the jet at the end of the delivery pipe with the apparatus described in the *Engineering News-Record* of Jan. 6, 1920, p. 18. Since the vertical drop of the jet was kept constant and equal to 1.16 ft., the theoretical formula for reducing the observations would be

$$V = 3.72x$$

where V is the velocity in feet per second and x is the horizontal distance from the end of the pipe to the center of the disks. However, comparisons with pitot tube measurements, made while pumping clear water, showed that the coefficient should be raised to about 4.28, the pitot tube velocities being greater than those obtained from the jet measurements using the theoretical formula. In making these comparisons a rather crude pitot tube, made out of a piece of ½-in. pipe, was held at the center of the end of the delivery pipe, and the velocities obtained were reduced to mean pipe velocities by applying a coefficient of 0.9. Observations previously made with a standard Tulane tube on an 18-in. wood-stave line, carrying about 12 sec.-ft., showed this coefficient to be about 0.95. While the coefficient of 4.28 may be slightly in error it is believed that it is sufficiently accurate for the present purposes.

Results of the tests made on Aug. 28 and Sept. 5 are shown in Figs. 1 and 2, the various pumping characteristics being platted as ordinates against the times of observation as abscissas. Motor speed steps and feeding signals are shown just above the time scales. Feeding signals are self-explanatory. Speed steps were numbered consecutively from one to nine beginning with the slowest speed, number nine being the highest speed, 505 r.p.m. when full load is being carried. Detailed descriptions of pipe lines are noted under the diagrams.

The upper curve in Fig. 1 represents the horsepower consumed by the motor; that is, the power input, not the output. The rated output being 500 hp. and the efficiency 93 per cent, the rated input is, of course, about 540 hp. The horizontal line drawn on the figure at this value shows that the motor was operating at nearly full load the greater part of the time. The power curve was calculated from the ammeter readings using the relation determined from a comparison with the watt-hour meter when the motor was carrying full load. While the relation between power and current is not exactly constant, of course, where alternating current is being used, it was approximately so at the time the tests were made, owing to the comparatively small fluctuations in load.

The velocity curves show that the velocity varied from 8 to 16 ft. per second on Aug. 28, and from 9 to 18 ft. per second on Sept. 5. The fluctuations at a given motor speed were more pronounced as well as more frequent on the latter date when the proportion of solids was nearly doubled. This was also true in the case of the vacuum and friction heads, quantities varying somewhat synchronously in both tests.

The vacuum curves show the combined effect of changes in velocity head, entrance losses, and friction in the suction pipe, and in water level in the sump. On Aug. 28 the total vacuum head in feet of water varied from 10 to 18; on Sept. 5 it varied from 16 to 22. This comparatively high suction head was one of the undesirable features of the original pump layout which was remedied in the later installations.

The friction head curves show the actual variations in the friction head per 100 ft. of delivery pipe. The material being similar on these two dates, the variations were due entirely to variations in velocity and in proportion of solids. In an attempt to eliminate the effect of velocity changes the curve marked

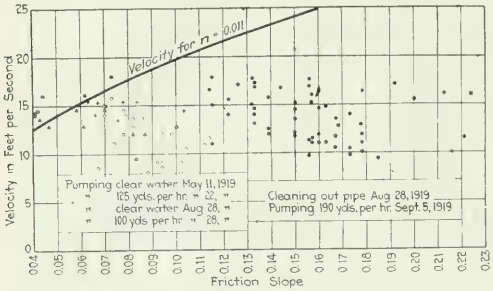


FIG. 3. DIAGRAM SHOWING FRICTION SLOPE AND VELOCITY IN DREDGE PIPE

(For descriptions of pipe lines on Aug. 28 and Sept. 5, 1919, see Figs. 1 and 2. On May 11, 1919, delivery line was 780 ft. long, including one flap valve, two 15-deg. bends, one long radius 90-deg. bend, 60 ft. of standard wrought-iron pipe, 20 lengths of riveted dredge pipe, and 26 lengths of welded dredge pipe. The alignment also contained some curvature made by a slight bending at consecutive pipe joints. On May 22, 1919, delivery line was 40 ft. long, including one flap valve, 75 ft. of standard wrought-iron pipe, one 15-deg. bend, one long radius 90-deg. bend, 20 lengths of riveted pipe and 21 lengths of welded pipe. The alignment also contained some curvature made by slight bending at the joints.)

$$\frac{100}{V^2} \times \text{F. H. per 100 ft.}$$

has been determined; in other words, this curve has been drawn to show what the friction head would have been if the velocity had been constant and equal to 10 ft. per second, assuming that the friction head varies as to the square of the velocity. This assumption, while practically correct for clear water, may, of course, be somewhat in error where solids are being carried.

It will be noticed that the irregularities in the curve of actual friction head are of less magnitude than those in the curve representing the friction head for a velocity of 10 ft. per second. This shows that the velocity decreases as the proportion of solids increases, thus keeping the friction head more nearly constant then it would be otherwise. This condition can easily be observed at any time by watching the jet at the end of the delivery pipe.

Fig. 1 shows that the actual power input to the motor increases or decreases as the velocity increases or decreases. However, the power consumption per cubic yard, which is the more pertinent quantity, decreases with a decreasing velocity more rapidly than the total motor input, since the increase in the proportion of solids accompanying the decreasing velocity more than compensates for the reduction in total discharge.

The ideal operating conditions are indicated on Figs. 1 and 2 by the horizontal lines cutting the velocity and friction head curves. On Fig. 1 the ideal friction head line has been placed at 16 ft. per 100 ft.; on Fig. 2 it has been placed at 18 ft. per 100 ft. The ideal velocity has been placed at 12 ft. per second on both diagrams. In other words, the velocity in the short line should be the same as in the long line while the proportion of solids should be higher. These lines represent approximately the conditions which the pump runners and monitor men try to maintain by the system of signals explained in *Engineering News-Record*, Sept. 16, 1920, p. 547. Actual velocities were generally below the ideal on Aug. 28 and above on Sept. 5; and the actual friction heads were generally lower than the ideal on both dates. The rather numerous signals shown in the lower right-hand corner of Fig. 2 were given by a somewhat panicky foreman, a bad plug having occurred a day or so before. He had been absent during the earlier part of the test; and better data would probably have been secured if he had been absent a little longer.

Fig. 1 shows that after the supply of material was shut off about seven minutes elapsed before the pipe was substantially free from material and about thirteen minutes before the friction was reduced to that corresponding to clear water.

Fig. 3, prepared by plotting velocities against actual friction slopes, shows in a somewhat different manner the great changes in friction head produced by variations in pumping mixture. The observations of May 22 and a few clear water observations made on May 11 have been shown in this figure, as well as the data taken on Aug. 28 and Sept. 5. A line has been drawn to show the velocities given by the Kutter formula with n equal to 0.011.

The observations of May 22, falling as they do, near the upper left-hand corner of the diagram, show that the friction head for a mixture containing large proportions of surface loam is somewhat less than where the material is mostly sand and gravel, the rate of pumping solids being greater on that date than on Aug. 28. The data for Sept. 5 falls considerably to the right of that for Aug. 28, owing to greater proportions of solids.

If the proportions and character of the solids could be kept constant and the velocity varied, the relation between friction slope and velocity would be represented by a curve, somewhat similar to the line shown, but located farther to the right. The distance to the right of the given line would increase as the proportion of solids increases. That is, there should be a family of curves for each experiment, each curve representing a fixed proportion of solids. The curve for a given proportion of solids would vary in location as the material changed, moving to the left as clay or loam replaces the sand and gravel and vice versa.

Although the variations in friction loss, shown on the diagrams, must have been due primarily to changes in pumping mixture, it is possible that some variations were also produced by material deposited in the bottom of the pipe when the velocities were comparatively low and the proportion of solids comparatively high. This filling may have been great enough at times to have caused an appreciable reduction in the effective cross-section so that the velocity within the pipe was different from that measured at the delivery end. However, there is no way to allow for such effects since the extent of the filling could not be determined.

The clear water observations of May 11, when the delivery line was practically the same as on May 22, compared with those of Aug. 28, show that for these dates differences in friction head due to differences in pipe alignment or in the pipe itself were unimportant.

Pumping conditions were much improved when sumps two and three were put into operation, due to the changes in pump layout, described in the *Engineering News-Record* article previously referred to, the power consumption being reduced from about 0.026 kw.-hr. per cubic yard per foot of head at sump one to about 0.010 kw.-hr. at sump three.

Arthur E. Morgan is chief engineer of The Miami Conservancy District, Charles H. Paul is the assistant chief engineer, and C. H. Locher is the construction manager. H. S. R. McCurdy is the division engineer in charge of the Englewood dam.

Capillary Moisture and Its Effect on Highway Subgrades

By W. W. McLaughlin
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An article appearing in the current issue of "Public Roads," the official publication of the U. S. Bureau of Public Roads.

One of the basic necessities in a pavement is a dry, well drained foundation or subgrade. The prevailing practice is to provide drainage by means of open ditches, covered drains, or both, for the removal of free surface or free ground water. Even where this precaution has been taken, many highway pavements have failed because of wet bases. In other instances, in the arid sections of the country, pavements have at least partially failed where drainage was not thought to be necessary, and these partial failures have resulted, as far as could be determined, because of moisture distribution in the subgrades.

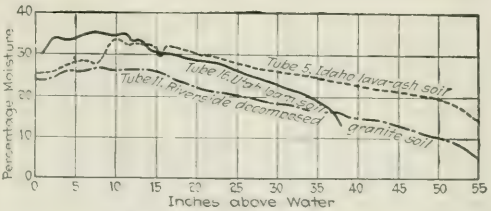
Why do these highways fail? Why do the foundations become wet and unstable in the face of accepted drainage methods? These are live questions bothering many highway engineers and now causing much concern in connection with highway pavement construction.

That capillary moisture may be the cause of some highway troubles and even failures has but recently been suspected. The writer's interest has been aroused in this question by investigations of the movement of soil moisture by capillarity by the division of irrigation investigations of the Bureau of Public Roads. It is the purpose of this article to present briefly a few of the data which may have a bearing upon the subject.

The force of capillarity acts equally in all directions, while the force of gravity acts only in a direction vertically downward. These two forces are at work all the time upon any moisture which may be within the soil. Capillarity is augmented by gravity when working in a direction downward from the horizontal and is reduced by that amount when working in a direction upward from the horizontal.

Table I shows clearly the effect of gravity on the capillary movement of soil moisture, both as to the distance the latter will reach in a given time and the total quantity of water moved. Expressed in round numbers and based upon the figures for the vertical column the moisture had moved downward at the end of 30 days two and one-half times as far in the soil column inclined downward at an angle of 15 deg. and two and three-fourths times as far in the soil inclined downward at an angle of 30 deg., as it had moved upward in the vertical column. At the end of 30 days three and one-fourth times as much water had moved down the 15 deg. incline and three and nine-tenths times as much water had moved down the 30 deg. incline as had climbed upward in the vertical column.

Table I also shows that the quantity of water per unit over the entire wetted length is greater for the columns



RELATION BETWEEN MOISTURE CONTENT AND HEIGHT ABOVE WATER

inclined downward than for the horizontal or vertical columns. That some idea may be obtained of the unit distribution of moisture in a vertical soil column and in a column inclined downward at an angle of 30 deg. Table II is given.

TABLE I. CAPILLARY MOVEMENT OF SOIL MOISTURE FROM A WATER SURFACE INTO A LAVA ASH SOIL COLUMN FOR VARIOUS PERIODS OF TIME, AND THE TOTAL QUANTITY OF WATER MOVED

	Time in Days	Direction Moisture Moved: Vertically Upward Inches	Horizontal Inches	Downward 15° from horizontal Inches	Downward 30° from horizontal Inches
Distance moved	1	16 25	22 9	24 80	26 20
	2	23 59	30 85	34 05	38 05
	3	27 67	37 55	41 70	42 35
	7	37 42	57 40	63 40	66 25
	15	46 92	81 45	95 25	99 70
	30	54 50	109 90	137.10	150 10
Water moved in acre-inches per acre	1	0 403	0.605	0 655	0 605
	2	0 554	0.806	0 907	0 857
	3	0 706	1 008	1 109	1 058
	7	0 907	1.562	1 764	1 764
	15	1 169	2 369	2 722	3 024
	30	1 320	3 58	4 334	5 141

In Table II the average percentage of moisture per inch in the inclined column is greater by 4½ per cent than that in the vertical column. The per cent of moisture in the end of the column away from the body of free water is 12 per cent greater in the inclined column than in the vertical column. This circumstance is of the greatest importance, because the supporting strength of the subgrade depends upon the percentage of water in the soil.

TABLE II. DISTRIBUTION OF MOISTURE IN SOIL COLUMNS BY 2-INCH SECTIONS FROM THE WATER SURFACE
(Yolo gravel-clay loam)

Distance from water surface	Percentage of Moisture in the Soil Column: Vertical Column Per Cent	Inclined Downward 30° Per Cent
2 inches	37 48	36 03
4 inches	36 72	35 92
6 inches	37 31	35 00
8 inches	37 68	34 39
10 inches	35 85	34 74
12 inches	32 35	34 28
14 inches	30 60	33 61
16 inches	28 20	32 30
18 inches	26 05	31 00
20 inches	23 25	29 94
22 inches	20 18	28 70
Average	31 45	33 99

The percentage of moisture found in a vertical soil column is not related directly to the height above the ground water except at the upper end, and then in only a very general way. The maximum percentage of moisture may be found and, in the clays and loams, usually is found several inches above the water surface. This point is illustrated by Fig. 1.

From the figure it is seen that in the Riverside soil the greatest per cent of moisture is found about 15 in. above the water surface. In the Idaho lava ash about one-half of the soil column is up to capillary saturation. In other words, there would be little difference from the standpoint of moisture content whether the pavement was 6 in. or 24 in. above the water surface.

Effect of Gravel Subbase—Stratified soils of different types are usually found in the alluvial areas and the relative percentage of moisture in the several strata is of interest. Several soil columns were made up of sand, loam, and clay in alternate layers, differently arranged. These columns after having stood for several days were analyzed for moisture. It was found that, at the same height, the several strata contained approximately the same percentage of moisture as a column of one type representing the various soils mingled. Table III gives the results of a typical instance. The made-up soil column has 6 in. of clay on the bottom, then 4 in. of river sand, and then a layer of clay, 6 in. thick, of the same type as the bottom layer. The second column of the table gives the percentage of moisture at various heights in a soil column made up as described above, and column 3 gives the percentage of moisture found at the corresponding heights in a uniform soil column of the type found in the made-up column at the respective heights.

TABLE III. DISTRIBUTION OF MOISTURE IN SOIL COLUMN OF UNIFORM TYPE AND IN A STRATIFIED COLUMN OF DIFFERENT SOIL TYPES

Distance Above the Water	Percentage of Moisture Made-Up Column. Per Cent	Percentage of Moisture Uniform Column. Per Cent
Average from 0 to 6 inches	44 39	47 95
6 to 10 inches	13 46	16 10
10 to 12 inches	43 52	40 78
12 to 14 inches	14 89	14 21
18 inches	13 72	12.19

In a soil column made up of 16 in. of clay on the bottom and sand on top, the moisture had not moved up into the sand more than 3 in. after standing 20 days. There was only 5 per cent of moisture in the sand, although there was 39 per cent in the top of the clay. Other similar tests indicated the advantage of a top layer of sand or gravel in keeping the moisture percentage low near the upper end of the soil column. The top layer of sand also seems to permit only slow movement of the moisture from the clay upward into the sand. Generally speaking, if the sand or gravel is placed at the bottom and a topping of clay or loam provided, the sand or gravel must be thick enough to prevent the rise of moisture to its upper edge to be effective. While the sand layer may transmit the moisture slowly, the clay or loam will readily take it up. Retardation of the movement within the limits of a few weeks is not of material importance or advantage in pavement work.

Extent of Capillary Movement—Questions often arise as to how far moisture will be brought up in different soils by capillarity from a body of free water, and at what rate the water will reach points at various heights above the water surface. Table IV gives some indication of the answers.

TABLE IV. RISE OF CAPILLARY MOISTURE IN SOILS FOR DIFFERENT PERIODS OF TIME AND RATE OF MOVEMENT OF THE MOISTURE

Distance above Water Surface	Light Clay Loam Time in days	Light Clay Loam Acre-Inches per day	Lava Ash Soil Time in day	Lava Ash Soil Acre-Inches per day	Sandy Loam Time in days	Sandy Loam Acre-Inches per day
12 inches	½	0.193	1	0.193	½	0.151
24 inches	6	0.0035	2	0.116	37	0.0001
36 inches	55	0.0018	6	0.035	.	None
48 inches	219	0.0001	17	0.009	..	.....
60 inches		None	50	0.005		.....
72 inches	...	.....	200	0.0001		.....

The table but emphasizes the fact that the finer the soil texture the greater its capillary power, and it also shows the fallacy of attempting to keep the subgrade dry by shallow drainage or the building of low fills over soil saturated with water or where the underground water table is nearer than 5 or 6 ft. to the surface, unless the soil be sandy. The table shows that in lava ash soil of the type used in the experiment there will be brought to the surface through 5 ft. of soil 1.8 acre-inches of water in a year, and through 4 ft. of this soil there would be brought to the surface in the same time 3.3 acre-inches. Five and one-half inches of water would be brought up through 1 ft. of sand, but through 2 ft. of sand only ½ acre-inch of water would be brought up in a year.

It is difficult to estimate the amount of the evaporation of moisture from below the midpoint of a paved highway. Near the outer edge of the pavement the rate of evaporation may be very rapid, but in the center the moisture would first have to move horizontally to a crack or through 8 or 10 ft. of soil to the outer edge of the pavement. On the deserts of the West the rate of evaporation from a wet soil may be ½ in. per day, and under some conditions even more. The rapid evaporation of the moisture near the outer edge of the pavement might, and sometimes does, result in a dry subgrade at and near the outer edge of the pavement and a wet subgrade in the center. In the heavier soils this would result in a subgrade of unequal supporting power and, through contraction and expansion resulting from unequal moisture content, leave an unsupported outer edge of the pavement or a mushy yielding subgrade center. According to Prof. William H. Burr, the safe bearing power of dry clay is 4 to 6 tons per square foot; that of moderately dry clay 2 to 4 tons; and that of soft, moist clay 1 to 2 tons. Hool and Johnson give as the safe-bearing power of quicksand ½ to 1 ton per square foot, gravel and coarse sand well cemented 8 to 10 tons, and clean dry sand 2 to 4 tons. These figures indicate the effect of moisture in the subgrade in its relation to load-bearing strength.

Where a highway is built through a country having a transverse slope of 15 deg. or more the movement of moisture down this slope by capillarity is relatively very rapid and extensive. If a sand or gravel stratum is present (especially if it be on top of a clay or other impervious or semi-impervious layer) then the capillary movement of moisture is much more rapid and will extend for great distances. Such soil conditions are not at all uncommon in an alluvial country and afford ideal conditions for the capillary siphoning of water.

The capillary movement of soil moisture from a free water surface is very rapid for the first 48 hr., and for that reason shallow side drain ditches are not effective in preventing the capillary movement of moisture into subgrades, especially if these ditches are at all near the pavement. Deep drains are not effective against capillary moisture unless placed below the limit of capillary rise of moisture in the soil under consideration.

That capillary moisture has caused soggy, wet subgrades is beyond question and unless effective preventive measures are taken it will continue to cause highway troubles.

The data outlined above were obtained from experiments conducted on the capillary movement of soil moisture where the source of the moisture was free water. The capillary movement of soil moisture from a wet soil to a soil containing a smaller percentage of water differs from what has been shown only in quantity. However, the rate and extent of movement of the moisture under the last named condition is relatively so little as to be almost negligible in highway pavements.

Seek Rail Routes to Canadian Oil Fields

Authority to construct railroads to the oil regions of northwest Canada has been sought by three companies. Two of these, the Slave River Co. and the Fort Smith Railway Co., ask charters for building lines across the portage from Smith Landing to Fort Smith on the Slave River to by-pass the rapids and shoals at this point. The government railway committee has asked the two companies to arrange a charter for a single line. The Edmonton & Mackenzie River Co. seeks a charter for a line from Fort McMurray, on the Athabasca River, to the junction of the Jackfish and Peace Rivers, and thence to the mouth of the Hay River at Great Slave Lake. Last year a charter was secured by a company backed by British financial interests for a line between Great Slave Lake and Hudson Bay at a point 1,000 miles north of Port Nelson and Fort Churchill.

Current Water-Works Problems and Practice

Abstracts of Papers and Technical Discussions Before the Cleveland Convention of the American Water Works Association—Comparative Costs of Pumping Plants and Reservoirs to Meet Excess Consumption Rates—Other Studies

The Small Plant Operator as Scientist

By Abel Wolman
Assistant Engineer, Maryland State Department of Health

All plant operators may be divided into three classes: (1) Those who feel that they are scientific but hesitate to present their observations because of inherent modesty; (2) the practical, who observe but do not report because of a supposed lack of scientific language; (3) those who neither observe nor report. It is to the first two classes that one must look for real development in water treatment, since they are the first to encounter new problems and the first to try out new solutions. A scientific hypothesis is useless if it is not in accord with the facts everywhere. A scientific solution is worthless if it does not solve our problems. Both the hypothesis and the solution must be tested by the plant operator.

When we speak of a problem in water treatment we are prone to emphasize its simplicity rather than its complexity. We find it easy to fall into the error of considering "water" as a definite thing, a simple compound, instead of regarding it always as a most variable substance, delicately fluctuating with atmospheric, geographic, and geologic influences. When water is considered in this sense each water filtration plant becomes a laboratory, a scientific structure, a research bureau, where facts and opinions may and should be tested out upon the peculiar and rare fluid there being handled. When a new hypothesis is announced each plant operator has the opportunity to make a real contribution to science and to practice by determining whether it tallies with the phenomena experienced with his own rarity, the little stream used in his plant. Likewise, he has the continual advantage of learning whether older theories account for the present observations and whether older methods are adequate. Each small plant stands, therefore, in the position of a special research laboratory upon the director of which there has been placed the duty of watching and interpreting a continuous series of experiments performed under conditions common to no other laboratory. I emphasize the distinctiveness of each plant, since even on the same stream, a few miles apart, the water has undergone profound change which converts it into a new substance, with new, though possibly slightly varied, attributes.

If we accept the concept of each plant as a true specialized investigative bureau and of water as a variable and not a constant substance what operator has the right to say that he is not or should not be a scientific observer? His duty, whether he likes it or not, has been enlarged from that of valve-operator to investigator. His responsibility is greater than to his immediate community. It is national and even international, for the plant operator is now a research worker, and the fruits of research are limited only by the infinite.

Sanitary Survey of Lake Erie Opposite Cleveland, Ohio

By J. W. Ellms
Engineer Water Purification, Cleveland Water Department

In connection with extensive studies made by the Division of Water for the purpose of preparing plans for the present and future expansion of the water-works of Cleveland, it seemed desirable to undertake a sanitary survey of Lake Erie opposite the city and its suburbs. The principal object in view was to discover, if possible, areas of least pollution in which might be located new water-works intakes. The work was done in 1920.

The area of lake studied covered about 250 square miles. Sampling stations were located at various points by a system of intersecting lines running parallel with or perpendicular to the shore. Some 1,800 samples of water were collected from the surface and from various depths. These samples were examined principally by bacteriological methods.

The conclusions reached were that the average quality of the water four to five miles from the shore along the entire thirty-two miles investigated was suitable for water supply purposes; that a better quality of water could be found nearer the shore west of the mouth of the Cuyahoga River than east of it; and that in general there were wide fluctuations in quality due to the effect of winds and storms setting up currents in the lake, which carried the sewage polluted shore water out into the lake.

Investigation of Tastes and Odors in the Cleveland Water Supply

By J. W. Ellms
Engineer Water Purification
and
W. C. Lawrence
Chemical Engineer, Cleveland Water Department

A long investigation undertaken to locate the source of the so-called "carbolic acid" taste which occurs at times in the Cleveland water supply showed that the cause of this foul taste was waste liquors from byproduct coke oven plants. It was found that very small quantities of phenol (carbolic acid) contained in these trade wastes were capable of producing the obnoxious taste complained of by water consumers, when the polluted water was chlorinated. In consequence, the "taste or odor" test, produced by chlorinating a large number of samples of water from the Cuyahoga River from the lake between the mouth of the river and the water-works intakes and from the intakes themselves, was employed. Many samples from sewers and from a great variety of industrial plants were also collected and tested.

The conclusion reached was that the cause for the taste was attributable principally to the waste liquors from the ammonia stills of byproduct coke oven plants, and that the phenol, although in minute quantities in these liquors, was quite sufficient to produce a foul tasting and smelling compound if the waste entered water-works intakes and came in contact with chlorine applied to the water for disinfection purposes. Fortunately very direct evidence was obtained of the diffusion of the waste as it emerged from the mouth of the Cuyahoga River, and of its path in reaching the intakes. Several large byproduct coke oven plants are located on the Cuyahoga River.

The Rate of Solution of Sulphate of Aluminum

By J. W. Ellms, A. G. Levy and L. A. Marshall
Cleveland Water Department

A study of the rate of dissolution of alum in water under certain conditions was undertaken to discover the factors influencing the rate of solution in order that the proper size of solution and storage tanks should be selected for the large filter plant now being designed for the city of Cleveland. Upward flow solution tanks were experimented with and sulphate of alumina of various sizes used in determining the rate of solution. Rates of flow from 2.5 to 10 in. vertical rise per minute were employed, and alum as dust or in pieces from ¼ in. to 3 in. in diameter were tried. The effect of the temperature of the water upon the rate was also studied.

The general conclusion reached was "that for all practical purposes, provided the point of saturation is not reached

by the water in passing through the alum in upward flow tanks within the limits of these experiments; namely, 2.5 to 10 in. vertical rise per minute, the length of time required to dissolve alum in any given condition of subdivision of the solid, is a factor only of the temperature of the water and of the size of the pieces of alum, and is independent of the total weight of alum to be dissolved."

Water Main Cleaning in Kansas City, Mo.

By Charles S. Foreman
First Assistant Engineer, Water Department, Kansas City, Mo.

The author believes that a summary of his experiences in the line of water main cleaning in Kansas City during the past three years will be of value to other waterworks superintendents desirous of instituting similar work in the system under their jurisdiction and that the following essential facts based upon his experiences will help to answer some of the questions which are usually asked:

(1) Cleaning can be so arranged that a main need not be out of service longer than twelve hours for cleaning. (2) The cleaning process is not injurious to the mains. (3) An increase in carrying capacity of from 60 to 85 per cent was obtained in large mains and the carrying capacity of such mains was restored to that of new pipe. (4) The saving in coal costs alone, derived from cleaning, will pay the entire cost of cleaning within from one to three years. (5) Laying of additional mains to obtain increased capacity can be postponed until the consumption demands are equal to the maximum capacity of the old main on the basis of new pipe. (6) When taking as credits such items as coal saving and postponement of obligatory laying of new mains the entire cost of cleaning is saved within from six months to a year.

For two or three years prior to the summer of 1918 there was always a lack of adequate pressure in the north and east portions of Kansas City. This district is fed from the Turkey Creek Pumping Station through one 20-in. and one 30-in. cast-iron water main. The question of laying additional feeder mains into these districts was abandoned because of the exceedingly high prices of material and the lack of funds.

Tests were run on about 6,000 ft. of 30-in. high pressure discharge line to determine the interior condition and carrying capacity of this pipe—laid in 1886. Taps were made exactly 1,000 ft. apart upon a straight length of the main, there being no services or connections to the main between gaging points. At each of these points 1-in. corporation cocks were installed for inserting pitometers and additional corporation cocks for pressure lines. A 2-in. pipe was connected to each of these taps and 1,000 ft. of this pipe laid along the surface of the ground bringing the two together so that a U-tube could be connected in to measure the differential pressure between the two points. The 30-in. pipe was double traversed at each pit and the average traverse co-efficient obtained. A pitometer was then set at each pit for checking quantities flowing through the 30-in. main.

The scale on the differential U-tube was graduated in 0.01 divisions and by using a liquid of specific gravity of 2 in this tube the readings obtained were in feet loss of head per thousand feet.

The advantages inherent in this method are that it is not necessary to obtain the difference in elevation between the two points, and that it eliminates the use of spring gages. Piezometers could not be used because of the high pressure, 125 to 150 lb. The test extended over a 24-hour period so that both maximum and minimum velocities in the pipe could be obtained.

The average pipe co-efficient, as computed by the Williams & Hazen formula, was 69.69, this being lower than that in the Williams & Hazen tables for pipe forty years old. From these tests it was evident that the 30-in. line was far below the carrying capacity of new cast-iron pipe. A contract was awarded to the National Water Main Cleaning Co. for the cleaning of 6,000 ft. of this 30-in. pipe.

Similar tests run after the pipe had been cleaned showed that the average pipe co-efficient was brought up to 116, and at low velocities as high as 120, the carrying capacity of this pipe having been restored to nearly that of new pipe.

The cleaning of the 30-in. pipe gave such excellent results that contract was let to the same company for the cleaning of additional 30- to 16-in. feeder mains into the northeast section of the city. Similar tests were run on each of these pipe lines both before and after cleaning. In all of these cases the pipe after being cleaned was restored to carrying capacity and corresponding loss of head as indicated in Williams & Hazen tables under co-efficient 120.

The contractor's price for cleaning ranged from 26c. per foot for 16-in. pipe to 45c. per foot for 36-in. pipe and the total cost, including all expenses for operating valves, cutting and repairing pipe and for all necessary sleeves and material was $22,046 for 43,837 lin.ft. of pipe cleaned, or 50.3c. per lineal foot for all sizes. The total cost of cleaning the various sizes including pavement repairs and operation of valves, etc., was as follows:

Length, Ft.	Size, In.	Total Cost	Cost Per Lineal Foot, Cents
7,202	16	$2,472.52	34.3
7,280	20	$3,056.80	41.9
2,371	24	$1,813.56	53.5
8,981	30	$5,604.93	62.3
17,000	36	$9,098.28	53.5

The accompanying table shows the length of time in service, the annual operating cost for coal before and after cleaning of the various sizes cleaned, the investment required and the annual interest thereon to obtain the increased capacity by laying new mains, and the total annual saving all being based on 5,000 ft. of each size and on the normal flow through the pipe at time tests were made.

Service Years	Size In.	M.G.D. Normal Flow	Loss of Head per 5,000 Ft. Uncleaned	Loss of Head per 5,000 Ft. Cleaned	Annual Coal Cost to Operate Line Uncleaned	Annual Coal Cost to Operate Line Cleaned	Annual Coal Saving	Size Required to Obtain Increase in Capacity If Not Cleaned In.	Estimated Cost 5,000 Ft.	Interest on Expenditure 5 Per Cent	Total Annual Saving	Total Cost of Cleaning
41	16	2.4	24.00	7.50	$462.53	$144.53	$318.00	12	$27,200	$1,360	$1,778.00	$1,715
42	20	3.4	23.50	5.60	641.60	152.89	488.71	16	33,100	1,655	2,143.7	2,095
28	24	5.0	12.60	5.25	505.90	210.79	295.11	16	33,100	1,655	1,950.11	2,675
33	30	12.0	23.50	9.00	2,264.46	867.24	1,397.22	24	70,000	3,500	4,897.22	3,115
33	36	16.0	15.25	6.00	3,740.52	1,471.68	2,268.84	30	73,500*	3,675	9,618.84	2,675

Annual cost for fuel to pump one million gallons 1 foot high at Quindaro = $0.042.
Annual cost for fuel to pump one million gallons 1 foot high at Turkey Creek = $0.022.
* No pavement or rock. Surface supply Missouri River water

State Versus Local Viewpoint on Filter Plant Control

By Robert B. Morse
Chief Engineer, Maryland State Department of Health
Chief Engineer, Washington Suburban Sanitary District

Within recent years the writer has found himself in the peculiar position of having the responsibility both of supervising the operation of water purification works for the state and of operating such works for a sanitary district. During this period the opportunity has arisen to study the contrasting mental attitudes which differences in function create in the same or different persons.

The duties of operator and state representative may be differentiated psychologically by remembering that in the first case emphasis is placed upon the means and the economy of producing a good water, while in the second the end product is all-important.

Owing to comparatively recent development of the scheme of water supply control by the state, it has come

about that a large proportion of state representatives, particularly those in the field, are young men; older men are not available in many instances because state budgets are still exceedingly lean. We then have before us at the start "youth" and its possible accompaniments—inexperience, lack of tact, impatience, and often self-importance—all qualities which, of course, older men are supposed to have eliminated or else to have learned to conceal.

If the state representative, regardless of his lawful powers, will approach the plant operator in a spirit of helpfulness and with an open mind, if he will study carefully each plant before arriving at conclusions regarding improvements in construction and operation, if he will consult with, rather than rail at, the plant operator in the realization that the good will of the latter is essential before any fruitful changes in control will be possible, if he will keep before him the desire to help and behind him the desire to order, then he will disintegrate his part of the barrier.

The task for the operator is a more difficult one, since it is that of converting suspicion into co-operation, where the fruits of co-operation are not at first apparent. The state official should find it easy to forget his badge, because by so doing the development of his plan becomes less arduous. The operator, however, has a greater difficulty in visualizing the benefits which accrue to him by accepting the offering of the upstart. He feels that somehow he gives more than he receives, that he knows his own plant better than anyone else can, that his dignity suffers by permitting any interference or suggestion. If he may be brought to conceive, however, that youth may gather experience quickly through the continuous co-ordination of study of a number of purification works and may obtain an actual maturity of judgment through contact with varied problems at a series of plants, and that daily routine may have prevented him from keeping pace with developments in his field, then the operator may see the advantage of co-operation. Suspicion will almost always succumb to the helpful presentation of new ideas. Where views are continually changing and where new methods are appearing the possibility of gaining knowledge of these through state assistance will do much to remove the antagonism of the operator.

Tastes and Odors From Chlorination

By Walter A. Sperry
Chief Chemist

Loyd C. Billings
First Assistant Chemist, Filtration Plant, Grand Rapids, Mich.

As we view this whole problem the most practical suggestions as to the feeding and control of chlorine has come from the writings of Abel Wolman, of the Maryland State Board of Health. (See *Journal Industrial Chemistry*, March, 1919; also *Engineering News-Record*, April 14, 1921, p. 639.)

Chlorine has been at once the operator's great benefactor and sore trial as he has sought to preserve public health and avoid public condemnation through its use. All have felt the constant need of such methods of control as would assure a safe water without the constant danger of tastes.

Wolman's chlorine absorption method of test, along with his residual chlorine test, appears to meet this dual problem. At Grand Rapids we have followed, for the most part, a plan of "invariable dosage." We have always felt its inadequacy. Tastes have developed when none were looked for and conversely. Disinfection has not always been satisfyingly complete. Limiting quantities producing tastes have been variable and puzzling.

For the past two years daily studies as to the chlorine absorption values of our raw, settled and tap water along with their oxygen consumed values have been made in the hopes of finding a more logical control than what we were making use of. They have lead us to believe more and more in the final fitness of the methods cited to this end.

Conclusions drawn from daily [illegible] results and also from experiments at Grand Rapids are:

Grand Rapids experience shows that comparatively large doses of chlorine are necessary to disinfect because of large amounts of organic present capable of absorbing chlorines.

Where the plan of invariable dosage is followed there is great danger of running into taste difficulties. Chlorine absorption studies show the range between the necessary amount of chlorine for disinfection and the amount to give taste to be small.

Some method of controlling chlorine feed is shown to be necessary as without such method the results at Grand Rapids show danger of running into taste difficulties and insufficient disinfection.

The chlorine absorption method as outlined by Mr. Wolman is consistent and accurate. Sixteen months' experience with testing method shows its practicability. It is the only quick method by which the chlorine demand of a water may be determined with accuracy. So far as this experience goes to show, chlorine demand, as indicated by this method, can be satisfied and enough more added as excess to disinfect and yet keep away from taste.

While such factors as turbidity and oxygen consumed show only a general relationship they all point to a consistency existing between them and the chlorine absorption values. This consistency argues well for confidence in the point of view taken by writers.

We believe the whole problem of tastes as applied to filtration plant practice is related to improperly proportioned dosages.

Coagulation and Sedimentation with Chemicals

By J. W. Ellms
Engineer Water Purification, Cleveland, Ohio

Like all new developments in science, colloidal chemistry has been seized upon to explain many phenomena which are complex, and which will eventually be found to require the formulation of entirely new and unrelated principles. If investigators will bear in mind, that from the mass of facts concerning the colloidal state of matter, principles and laws are slowly being developed, and by use of which explanations of some of the obscure phenomena in coagulation, sedimentation and filtration of water may be found, there may be a real advance in the art of water purification.

Licensing Water Purification Plant Operators in New Jersey

By Charles H. Capen, Jr.
Assistant Sanitary Engineer, State Department of Health, Trenton, N. J.

Acting under chapter 23 of the New Jersey Laws of 1918 the State Department of Health licenses operators of water purification plants. The act provides that every purification plant must have a licensed operator, but that licenses should be issued to all operators holding their positions prior to the time of the passage of the act upon proper certification by the municipal officer, corporation or individual, under whom the operator works. The department is given the authority to revoke a license, when upon the operator being given a hearing he shall be judged incompetent to manage the plant in his charge, or shall have been wilfully negligent in his duty, or shall have disregarded or disobeyed the rules or regulations of the department. There is provided a penalty of $10 for each day on which the violation occurs. It is further provided under the act that either before or after the institution of penal proceedings the department may proceed to prohibit such violations by injunction, and to obtain such other or further relief as the court may direct.

An abstract of rules and regulations issued by the department to govern licensing follows:

[illegible]

treatment works, including the following processes: Sedimentation, coagulation, filtration, and disinfection; and for making the standard tests, both chemical and bacteriological, necessary for testing and controlling the efficiency of all the various processes used in water treatment works; and informed in general as to the mechanical equipment and devices used in water treatment works.

A Second Class Operator's License shall be issued only to those persons having the qualifications and knowledge required in order to satisfactorily operate or control one or more of the processes required for a Superintendent's License; and having knowledge sufficient for the making of the routine standard test, both chemical and bacteriological, for testing and controlling the efficiency of the various processes utilized in water treatment works which he expects to operate.

A Third Class Operator's License shall be issued only to those persons having the qualications and knowledge required in order to satisfactorily operate or control one or more of the processes not covered in the First Class License and the Second Class License. This class applies only to those operators having charge of a plant at which the removal of iron or disinfection is the only process of treatment.

As provided by this act there were sixty-five licenses issued without examination, and fourteen licenses have been issued upon examination.

In each case possible representatives of the department have spent from one to four days at the plant with the applicants for examination, and have drilled them in the routine fundamentals as well as in some of the more involved chemical and bacteriological tests. In other cases the applicants have come to the offices of the department and have spent one or two days going over the operation of the plant from every standpoint possible without actually being at the plant in question.

Application of Colloid Chemistry to Sludge Pressing

By John Arthur Wilson, Wm. R. Copeland and Henry M. Heisig
Sewage Testing Station, Milwaukee, Wis.

The viewpoint of modern colloid chemistry is the logical one from which to attack the basic problems of sewage disposal because the solid organic matter of sewage consists chiefly of an agglomeration of extremely complex substances in the colloidal state. The sludge from the activated sludge process at the Milwaukee sewage testing station is not in the best condition for filter-pressing. By adding sulphuric acid to give the sludge its optimum active acidity (hydrogen ion concentration), the rate of filter pressing can be increased by as much as 400 per cent. By adding chromium or aluminum sulphate in proper amount and then the amount of sulphuric acid necessary to bring the sludge to its optimum acidity, the rate of filter pressing can be increased by as much as 900 per cent. Iron sulphate, or copperas, is no more effective than acid alone. The per cent of water in the sludge has a marked effect upon the increase in efficiency brought about by treating and should be regulated. Putrefaction of the sludge undoes the effect of aëration. The rate of filter pressing decreases with time and can be expressed quantitatively as a function of the time.

SLUDGE PRESSING TESTS ON ADDING ACID

Gallons pressed	2,871	2,673	3,193	3,228
P. value	7.1	7.7	7.4	7.6
Acid added, c.c. per gal.	.....	2.50	1.04	2.63
Hours required for pressing	23.8	6.0	5.3	6.4
Cake obtained, lb.	1,407	1,118	1,275	1,240

Shorter Abstracts and Discussions

The Romance of Water Storage—A plea for filtration and chlorination rather than placing dependence upon the sanitary protection of water supplies and upon the beneficial effect of water storage was presented by George A. Johnson, New York City, under the caption given above. In conclusion, the author advocated the use of all four lines of defense while still emphasizing his main thesis. Written discussions, based on advance copies of the paper, Mr. Johnson said, showed agreement with his arguments by a dozen state boards of health and sanitary engineers. In the oral discussion, R. S. Weston, Boston, said that he was in general agreement with Mr. Johnson's contentions but that the same general line of argument could be applied to filtration and chlorination as to sanitary protection and storage — for instance, the filter operator may sleep at his post.

Water Rates—A paper on Water Rates was presented by Nicholas S. Hill, Jr., New York City, and one on Municipal Rates by E. E. Bankson, associated with J. N. Chester, Pittsburgh, and C. A. Finley, chief Bureau of Water, Pittsburgh. Mr. Hill maintained that the basic rate making principles should be the same for private and public plants, including the distribution of the cost of water between the consumer and the taxpayer. The authors of the other paper urged that in the case of municipal-owned works the rates should vary with "the ownership of the works"—or according to capital contributions to meet first cost, whether from consumers or taxpayers. In each paper a rate structure theory was elaborated. After considerable general discussion it appeared that there was general agreement between the authors of the two papers; also that neither they nor most of those who discussed the papers believed that municipal plants should collect rates to pay capital charges on cancelled bonds.

Filtration from the Operator's Standpoint—Seven short papers on this topic were presented in succession and then discussed together. In a paper on filter loads, H. W. Streeter said that a water filter may be considered as presenting a series of barriers, the efficiency of which depends on efficient design and operation. Ohio River water studies indicated that the Public Health Service standard of 500 B. Coli per c.c. might be increased to permit 650 in unfiltered water and still give only the standard 2 coli in the treated water.

In a paper by L. O. Bernhagen, assistant engineer, Texas state Board of Health, the two-weeks school for filter plant operators conducted jointly by the Board and the University of Texas was described and a proposed legislative act providing for licensing filter plant operators was outlined.

Most of the discussion on this group of papers centered on tastes and odors due to chlorination and on the alleged tendency of the day to accept low filter efficiency and rely over much on chlorination. A number gave data and opinion to the effect that chlorination tastes always come from phenol in industrial wastes or else overdoses of chlorine. Instances were given of tastes attributed to the action of chlorine on phenol from coal tar paint in water tanks. Stress was laid on value of the Wolman chlorine absorption and excess or residual chlorine tests.

Arguments pro and con as to the efficiency of filters alone, before chlorination came into use, and as to whether water standards are higher now, led to renewals of the dictum that chlorination should be regarded as a supplement rather than a substitute for filtration, and finally to assertions by Allen Hazen that in the old days it was not claimed that filtration removed *all* disease germs and stopped all deaths from them and that bacterial standards are undoubtedly higher now than twenty years ago.

Superintendents' Day—Two sessions were given over to the superintendents. A half dozen papers were presented and an opportunity given for topical discussions on a variety of subjects. Fred B. Nelson, New York City, described the use of logarithmic straight-line diagrams for determining by one flow test of a meter its capacity at all pressure losses.

Tapping Large Steel Mains—Underlying principles essential for the successful tapping of large steel water mains were outlined by D. F. O'Brien, East Orange, N. J. Because of the large variations in the cross sectional contours of steel pipe, a cylindrical sleeve would require too great a thickness of lead at some points for calking. Accordingly, a ring is used to get the pipe contour so the sleeve may be properly fitted to the pipe. In pouring and calking sleeve joints more care is necessary on steel than on cast iron pipe. Finally, in cutting out the steel a light constant feed should be used.

Use of Machines in Distribution Construction — Papers describing various machines used extensively for pipe trenching, laying, calking, etc., at Detroit, and employed on a smaller scale at Baltimore, were read by W. Montgomery Mitchell and V. Bernard Siems, of Detroit and Baltimore, respectively. Detroit owns numerous machines and has done much toward standardizing them. Comparative tables and curves for hand and machine work at Baltimore showed large savings by the use of machines. The use of machines by

both cities has been forced of late by high labor costs for hand work and at Detroit by the large mileage of mains laid—over 450 miles in the last six years, and 135 miles in 1920 alone. Besides the machines already named, both cities use cranes for handling pipe and pneumatic hammers for calking.

Water Works for Erie, Pa.—The history and improvement of these works since the typhoid outbreak of 1911 was presented by J. N. Chester, Pittsburgh. The paper included a summary of four-day working tests of the reciprocating and the centrifugal pumps in use, with estimates of cost of pumping water based on coal at different prices, all showing lower cost for the centrifugal than for the reciprocating pumps.

Animalculae at the Dallas Filters—Filter stoppage by growths of small "flies" at Dallas, Texas, and prevention of the trouble by applying chlorine to the water before filtration were described by Helman Rosenthal, chemist of the filtration plant.

Concrete Tower Built To Support Revolving Crane

A reinforced-concrete tower was recently built in the center of the clinker storage yard of the Riverside Portland Cement Co. near Riverside, Cal., to support a cantilever crane which is used to pile clinker or to deliver it to a continuous belt conveyor. The crane proper is built of structural steel, but the tower was made of concrete because concrete was cheaper, would be effected less by hot clinker piled around it and would require less maintenance.

CIRCULAR TOWER SUPPORTS 140-TON REVOLVING CRANE

The tower is circular in section, 55 ft. high, and has an inside diameter of 30 ft. The walls are 2 ft. in thickness except at the parapet where the thickness increases to 3 ft. The foundation extends 4½ ft. below the ground level and has a diameter 4 ft. greater than the superstructure. A 6-in. diaphragm or floor supported on beams is located 7 ft. below the top of the tower.

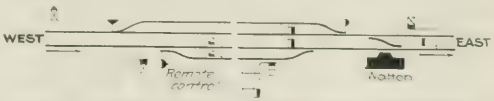
The revolving element, which weighs 140 tons, is supported on a track laid on ties placed radially around the parapet. The two crane arms are each 110 ft. long and operate 50-cu.ft. grab buckets. When operating both buckets, the capacity of the crane is 6,000 bbl. per 10-hr. shift. The seven motors on the crane, ranging in capacity up to 40 hp., are said to cause no vibration.

Chicago Engineer Reinstated

The Chicago Civil Service Commission has reinstated Thomas G. Pihlfeldt, city bridge engineer, who was dismissed last year on charges which led to a protest by the American Association of Engineers against the charges themselves and the manner of trying the case. (*See Engineering News-Record* May 13, 1920, p. 937, and Aug. 12, 1920, p. 334.) The reinstatement is said to have been made on the recommendation of the commissioner of public works.

Remote Control for Railway Switches

ECONOMY and efficiency in railway operation require the elimination of checks to the movement of trains between regular stopping places, as the resulting delays and cost are very serious in the aggregate, especially with heavy trains. A frequent cause of such checks is the use of hand-operated switches at sidings, yard entrances and other outlying points, where a train using the switch must stop while a brakeman goes ahead to operate it.



SIDING SWITCH CONTROLLED FROM DISTANT STATION

With these switches operated from stations, block towers or other convenient points the necessity of stopping trains can in many cases be avoided, with small expense for the installation. In the electric system, a motor-operated mechanism at the switch is controlled readily from almost any distance. As a rule the distance is too great for mechanical operation, the limit for which is taken usually at about 1,200 ft. The apparatus is interlocked with the block and switch signals.

A typical siding installation is that on the Atchison, Topeka & Santa Fe Ry., at Walton, Kan., where local conditions required the eastbound passing siding to be placed west of the station, so that its "heading-in" switch is about 5,000 ft. distant. Frequent delays occurred due to trains being required to stop for hand operation of the switch before they could enter the siding, these delays being especially troublesome from the fact that at time there is a congestion of eastbound traffic. By operating the switch electrically from the station the delay in taking the siding is eliminated, thus facilitating traffic and relieving congestion.

Two eastbound tracks, for fast and slow traffic, converging into one track, constitute a similar case on the Philadelphia & Reading R.R. near Palmyra, Pa. The switch, over 4,400 ft. distant, has been put under the control of the operator at the station, thus eliminating the delays due to hand operation by brakemen to let their trains out of the slow track. When these trains have a clear signal they now pass onto the fast track at about 20 m.p.h.

Remote control of a main line junction from the tower at an interlocked grade crossing about 3,000 ft. distant is a case of a different kind at Glen Jean, Ohio. The Chesapeake & Ohio Northern Ry. wished to connect with the main line of the Norfolk & Western Ry. about half a mile east of the crossing of the latter road and the Detroit, Toledo & Ironton Ry., at which crossing the Norfolk & Western Ry. had a mechanical interlocking plant. It was decided that the best plan would be to add an electro-mechanical attachment to the existing plant and to operate the switches and signals of the junction from the Glen Jean tower rather than to install a separate tower and interlocking plant at the junction.

On account of the distance, with the first switch about 2,800 ft. from the tower, the cost of the new equipment was nearly three times that of a separate mechanical plant. But the latter would have required the services of three operators, and the saving in labor cost by operating both plants by one set of men warranted the additional first cost.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Rainfall and Runoff Experiments

Reviewed by ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

RAINFALL AND RUNOFF IN THE MIAMI VALLEY—By Ivan E. Houk, District Hydrographer; Assoc. M. Am. Soc. C. E. Technical Reports, Part VIII, Miami Conservancy District. Dayton, Ohio: The District. Paper; 6 x 9 in.; pp. 234; illustrated. 75c.

As stated in the Introduction, the purpose of this report is to present to the engineering profession the results of rainfall and runoff investigations carried on in connection with the Miami Flood Control Project. The most significant feature of the report is the presentation in detail, of experimental laboratory researches on infiltration of rainfall.

In these experiments, natural soil plats 5 ft. square were selected, each surrounded by an impervious metal wall, and provision made for catching the surface runoff. Four experimental plats were used, two on flat and two on sloping ground, one in each condition being bare and the other grass-covered. In addition to records of rainfall and surface runoff, soil moisture determinations were made in the first two feet depth of soil at frequent intervals. The results are expressed graphically and in tabular form, and tables are presented showing maximum rates of evaporation, of transpiration, and also soil absorption and surface runoff for different typical periods, including one to five days' storms.

In order to check the result obtained for these experiments and secure additional data without waiting the comparatively long time required for the accumulation of such records from natural rainfall, a series of accelerated experiments was carried out by artificial sprinkling of the soil plats. For this purpose, four additional plats were established. The results obtained by sprinkling the different plats at different rates, and for different durations, are presented in tabular and graphical form, graphs being drawn showing the average relations between the rate of sprinkling or rainfall and resulting runoff rate, both with soil initially saturated and not saturated. These two series of observations of experimental studies represent an important contribution to the science of engineering hydrology.

Very little experimental work along these lines has hitherto been done, although its importance has been pointed out in the columns of this journal (*Engineering News-Record*, March 27, 1919, pp. 614, 661). About all that is hitherto available showing material infiltration rates is comprised in the experimental studies of runoff by Wollny, which covered a somewhat wider scope than the Miami experiments, in that the effect of variation in soil character, slope, orientation and vegetation, were all investigated. As regards studies similar to those where artificial rainfall or sprinkling was utilized, there is little else in print than the limited experiments of O'Meara.

In going through this portion of Mr. Houk's report, one finds little to criticize, as the data are fully presented, the discussion is unusually clear and rational, and the conclusions appear to be well confirmed by the experiments. It is to be regretted that a recording rain gage was not utilized in the experiments on natural runoff, since without it, it is impossible to obtain as complete information regarding the effect of rainfall duration and intensity on the various factors as would otherwise be available.

In view of the excellent character of the work done, engineers having to do with problems of flood causation and control will undoubtedly regret that more elaborate experiments, covering wider varieties of character of soil, and different slopes and types of vegetation cover, were not undertaken. As it is, some very important points are still left obscure, for example the exact cause of the persistent increase in infiltration with rainfall rate for all the rainfall rates experimented upon, and the fact that the soil was never found to be completely saturated, even after the heaviest rain.

The latter half of the book is devoted mainly to presentation and discussion of actual rainfall and runoff results obtained at 15 gaging stations maintained by or in co-operation with the Miami Conservancy District throughout various periods of years, and these results are interpreted in the light of the experimental data referred to, and form an important contribution to hydrology. Here, however, it is unfortunate that the physical characteristics of the various drainage basins, notably their average elevations, surface slopes, percentages of culture distribution, soil characteristics and the like, are not given. Such data would facilitate the interpretation of the variations in yield from areas with similar amounts of rainfall, which will be noted in the tables.

The report is accompanied by an excellent bibliography, and is one which should be read by all persons interested in the new and rapidly advancing science of hydrology. It is to be hoped that it will lead to further investigations by others, along similar lines.

Works for Transportation by Water

REVIEWED BY ALLEN HAZEN
Consulting Engineer, New York City

HANDBUCH DES WASSERBAUES: Für das Studium und die Praxis—Von Hubert Engels. Vol. I and II. Leipzig, Germany: Wilhelm Engelmann. Cloth; 7 x 10 in.; pp. 1614; illustrated. Paper; 260m.; bound; 292m.

The first edition of this monumental work was reviewed at length [by Mr. Hazen—EDITOR] in *Engineering News*, Jan. 21, 1915, p. 116. The book, in two large volumes, deals with hydrology, river courses and their improvement, canals, locks, harbors, shipping, ship canals, removable weirs for river improvement, and permanent weirs for storage. It also deals with water power, with protection of land from erosion by water, and with the agricultural relations of water. It does not extend to public water supplies and sewerage systems. The treatment is mainly from the standpoint of the designer; and the author in the preface to the second edition, referring to this, states that one does not learn how to build engineering works by reading books, but only by personal experience in actual construction under competent leadership. Free use has been made of technical publications of all kinds, domestic and foreign, and the text has been revised in many

places because of new material. The number of pages is increased from 1,499 to 1,614, the additions being mainly in the sections relating to weirs, dams, water power, river improvements, and locks.

The treatment is simple but clear and adequate. It deals with fundamentals rather than details. Many useful lessons may be learned from these volumes for application in other fields of engineering. For one who wishes to understand European methods of improving rivers for navigation, and all the allied arts, Professor Engels' work may be accepted as a clear and authoritative statement.

Location, Grading and Drainage of Highways

REVIEWED BY C. J. BENNETT
State Highway Commission, Hartford, Conn.

THE LOCATION, GRADING AND DRAINAGE OF HIGHWAYS: A Concise Discussion of General Principles Illustrated by Current and Recommended Practice—By Wilson G. Harger, C.E., Engineer N. Y. State Dept. of Highways; Former Senior Highway Engineer, U. S. Office of Roads, Author of "Highway Engineers' Handbook," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 294; illustrated. $3.50.

The writer of this book announces in his preface that this is one of four volumes presenting the road problem from the standpoint of the constructing engineer and is intended for the use of students and practicing engineers. A careful perusal convinces the reviewer that this is not an elementary text book on highway engineering, but is a book adapted to the use of engineers engaged in highway construction.

The author apparently makes an earnest effort to state the general problem of the highway engineer, and to attempt its solution. Mentioning first some of the high lights in the picture, the author cautions engineers of the danger of extravagance in the expenditure of public funds, especially when large sums are available. He sounds a note of warning regarding the use of standards which in effect he says are apt to be too closely followed to the detriment of the local problem.

Some features of the present condition in certain of the states are passed by, apparently because these conditions are not thoroughly understood. Most of the discussion regarding the grading and surfacing of highways has to do with localities where new roads are to be built which makes this work of more value for the engineer carrying on new construction than he who carries on reconstruction.

It is perhaps unfortunate that most of the detailed examples of highway construction are taken from New York State. It is not true, however, that the work is entirely based on New York State practice, but is particularly adaptable in certain instances to the solution of the general highway problem.

The book is divided into six chapters and an appendix. Chapter I takes up the general principles of economic highway design. In this chapter, the author, in pointing out the duty of the engineer to the community which he serves, sounds the usual note against politics, but brings out several new thoughts regarding the standing of the engineering profession in the community.

As to general principles, he stresses the need for highway mileage, but his conclusions may be questioned. In certain sections where traffic has developed in concentrated form, it seems impossible to lay down a rule for, or to determine the value of, road service. His statement that it is not necessary to worry about future traffic should be carefully considered in connection with the other matter in the book and not accepted alone. The paragraph on the demands of traffic is well founded on the principle that we should not build highways to carry a certain selected small number of vehicles. He lays down in this chapter eleven principles that point out the difficulties with which highway engineers are faced.

In the second chapter, which treats of proportion and economy in design, the author calls attention to several things necessary in the design of highways and highway structures which are not ordinarily considered by the engineer. He divides the subject between solutions for pioneer districts and those for more settled districts, which is a correct method of division. He also calls attention to the necessity for small savings which in the aggregate will reach large sums in a long period of time.

Chapter III, covering classification, routes and general engineering location, is quite unusual in its method of approach to the subject. The author appears to be sound in his conception of the value of traffic censuses, and also conservative in pointing out the necessity for making all possible modifications in results secured from traffic censuses on account of special causes, either for increase or decrease of traffic.

The author's discussion of highway financing, including the appendix, is valuable and should be in the mind of every engineer. The three principles of the distribution of tax burden are excellent. His chapter on this subject is generally sound. His treatment of selection of route is well done, and the chapter on general engineering location is a valuable addition to the literature on this subject. It seems unfortunate that the writer found it necessary to state that this work would not be of much interest to most of the younger engineers. It is exactly what the younger engineers need.

In the chapter on grades and alignment, which is, without doubt, the best portion of the book, the author goes into the selection of grades and the discussion of maxima and minima at length and with great care. It may be that a little too much consideration is given to the question of horse-drawn traffic, particularly for those sections where motor traffic is heavy.

The discussion upon selection of grades for motor truck traffic, while theoretical and to some extent beyond the power of the engineer to prove, opens up a new line of thought and will probably give rise to formulas which will be more possible of demonstration. The author has been courageous and in advance of his time in making up the tables of capitalization cost and the different grades illustrating these tables. His selection of examples to illustrate his argument is good. The few words on minimum grades are well selected, and what he says of alignment and sight distance is complete.

Chapter V on cross sections of rural roads is a compilation of information regarding road cross sections which is exceedingly full and complete. The discussion of the different features of this particular topic is admirable, and the collection of plates and tables showing the practices in different localities is valuable.

Chapter VI on drainage design does not seem as complete or satisfactory as the other chapters of the book. The discussion of rainfall, run-off and culvert area is good, though that upon values of different types of culverts is not as complete as one would like to have it.

The summary at the end of the chapter on drainage should have been enlarged to cover principles in the same manner as those on grades and alignment and cross sections of rural roads.

Concluding, the review of this book indicates that it is, as a whole, an excellent piece of work, and used with intelligence should do much to help the highway engineers of the different states in solving their great problems. The author is to be congratulated on his careful and painstaking consideration of the different topics involved. It is far easier to review and criticize than it is to write and complete a work of this kind. In the opinion of the writer this volume is an excellent piece of work attempting to bring the discussion of highway engineering up to the minute. The further volumes will be awaited with interest.

Walker's Building Estimator's Reference Book

THE BUILDING ESTIMATOR'S REFERENCE BOOK: A Practical and Thoroughly Reliable Book for Contractors and Estimators Engaged in Estimating the Cost of and Constructing all Classes of Modern Buildings, etc.—By Frank R. Walker, Assoc. M. Am. Soc. C.E., Author of "Practical Cost Keeping for Contractors". Fourth Edition. Chicago, Ill.: Frank R. Walker Co. Leatherette; 5 x 7 in.; pp. 2931; illustrated. $10.

The fact that this book has now gone into its fourth edition proves that it is having wide use. The latest edition is brought up to March 1, 1921, and contains matter of recent interest. The past three or four years, as the author well states, have played havoc with all cost estimates so that it is more than ever necessary to have revisions of such works as this. It is doubtful whether any revision could fully take care of the revolution in prices we have just gone through, but as Mr. Walker has in most cases included base rates the figures which he gives still have great use.

Omission of Author's Name

Unfortunately the signature of Joseph Kieran Costello, Detroit, Mich., was omitted from the letter entitled "Little Known Biographies of Engineers," appearing in this section, May 19, p. 863.

PUBLICATIONS RECEIVED

COLLECTION AND DISPOSAL OF MUNICIPAL REFUSE—By Rudolph Hering, D.Sc., New York City, Past President of American Public Health Association and of Engineers Club of Philadelphia; Past Vice-President Am. Soc. C. E.; M.A.S.M.E., etc., and Samuel A. Greeley, Chicago, Ill., M. of American Public Health Association, M. Am. Soc. C. E., Western Society of Civil Engineers, M.A.A.E., etc. New York and London: McGraw-Hill Book Co., Inc. Paper; 6 x 9 in.; pp. 653; illustrated. $7.

CONNECTICUT INDUSTRIAL WASTE BOARD: Report 1918-20. Reprint from the Report of the State Department of Health, June 30, 1920—Hartford, Conn.: Department of Health. Paper; 6 x 9 in.; pp. 72.

DEVELOPMENT OF A SYSTEM OF FEDERAL GRANTS-IN-AID—By Paul H. Douglas. Reprinted from Political Science Quarterly, Dec., 1920. New York: Academy of Political Science. Paper; 6 x 9 in.; pp. 293.
Takes up aids for agriculture, post roads, vocational education, etc., and closes with an "evaluation" of the Federal aid system.

THE EFFICIENCY OF FUMES AND EJECTORS—By E. C. Bowden-Smith, M. I. Mech. E., Late Egyptian Civil Service, Author of "Oil Firing for Kitchen Ranges and Steam Boilers," etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 205; illustrated. $5.

ENGINEERING CONSTRUCTION IN MASONRY AND CONCRETE. Part II—William Henry Warren, LL.D., Whitworth Scholar; M. Am. Soc. C. E., Challis Professor of Engineering and Dean of the Faculty of Engineering, University of Sydney, New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 498; illustrated. $12.

ENGINEERING INSTRUMENTS AND METERS—By Edgar A. Griffiths. New York: D. Van Nostrand Co. Cloth; 7 x 10 in.; pp. 360; illustrated. $7.50.

FACTS AND FIGURES OF THE AUTOMOBILE INDUSTRY: Statistics of Production, Registration, Export and Use of Motor Cars and Motor Trucks, 1921—New York: National Automobile Chamber of Commerce, Inc. Paper; 6 x 9 in.; pp. 96; illustrated.

THE GROUNDWORK OF ARCHITECTURE: Or the Study of How Architectural Styles Are Affected by Structural Engineering—By Emil G. Perrot, Registered Architect, M. Am. Soc. C. E., M. A.S.M.E., Philadelphia, Pa.: The Author. Paper; 7 x 10 in.; pp. 34; illustrated.

HOUSING BY EMPLOYERS IN THE UNITED STATES—By Leifur Magnusson. Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 283; illustrated. 65c. from Superintendent of Documents.
Based on a country-wide survey, including various industries, made in 1916. Contains many valuable data.

THE LAY-OUT OF SMALL WATER MAINS: Notes and Tables Dealing with Various Problems in Simple, Compound, Double and Ring Mains—By H. H. Hellins, M.Inst.C.E. New York and London: Isaac Pitman & Sons. Cloth; 6 x 9 in.; pp. 45; illustrated. $3.

THE LUMBER INSPECTION RULES: Containing Rules Governing the Manufacture and Inspection of the Different Kinds of Lumber, Weights of Lumber, Comparative Strength of Building Timbers and other Information Useful to the Buyer and Consumer of Lumber—Compiled by Lumber Inspection Rules. Fourth Edition. New York: Lumber Inspection Rules, 280 Madison Ave. Leatherette; 4 x 6 in.; pp. 341; illustrated.

MAINTENANCE OF WAY CYCLOPEDIA: A Reference Book Covering Definitions, Descriptions, Illustrations and Methods of Use of the Materials, Equipment and Devices Employed in the Maintenance of the Tracks, Bridges, Buildings, Water Stations, Signals and Other Fixed Properties of Railways—Compiled and Edited by E. T. Howson, Western Editor of the *Railway Age*, and Editor of the *Railway Maintenance Engineer*, E. R. Lewis, Formerly Chief of the Duluth, South Shore & Atlantic, and K. E. Kellenberger (Signal Section), Editor of the *Railway Signal Engineer*, Assisted by Homer Hughes, Associate Editor, Formerly Assistant Field Engineer, Interstate Commerce Commission. In co-operation with the American Railway Engineering Association. New York: Simmons-Boardman Publishing Co. Cloth; 9 x 12 in.; pp. 860; illustrated. Cloth, $10; leather, $15.

NEW SOUTH WALES DEPARTMENT OF PUBLIC WORKS: Report, 1920—Sydney, New South Wales: The Department. Paper; 8 x 13 in.; pp. 101; illustrated.

NEW YORK STATE BARGE CANAL: Book of Plans Issued as a Supplement to the Annual Report of the Department of the State Engineer and Surveyor, Frank M. Williams, 1920—Albany, N. Y.: New York State Barge Canal, Department of State Engineer and Surveyor. Cloth; 19 x 13 in.; pp. 156; illustrated.

POPULATION DATA OF THE UNITED STATES: 1920 Census—Boston, Mass.: Arthur Perry & Co. Paper; 3 x 6 in.; pp. 44.
Gives 1920 and 1910 ppopulations of the 110 cities having over 65,000 population by 1920 Census, arranged from greatest to least; also populations for last four censuses, with increase by decades, for all places above 10,000 in 1920, arranged alphabetically, with ranking number.

POSITIONS IN THE CLASSIFIED SERVICE OF THE CITY OF PHILADELPHIA: Classification with Schedule of Compensation. Clinton Rogers Woodruff, Commissioner—Philadelphia, Pa.: Civil Service Commission. Paper; 6 x 9 in.; pp. 455.
Proposed classification under provisions of new charter, prepared by Griffenhagen and associates and approved by Philadelphia Civil Service Commission (but apparently not yet adopted by City Council). Contains specifications for various classes or grades of position, with titles and compensation.

RAINFALL AND RUNOFF IN THE MIAMI VALLEY—By Ivan E. Houk, District Hydrographer; Assoc. M. Am. Soc. C. E. Technical Reports, Part VIII, Miami Conservancy District. Dayton, Ohio: The District. Paper; 6 x 9 in.; pp. 234; illustrated. 75c.

RETAIL PRICES: 1913 to Dec., 1919—Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 497; illustrated.

SANITATION IN COUNTRY PLACES: The Theory and Practice Including the Bacteriolytic Tank System—By W. Ramsay Smith, M.D., DSc., F.R.S. (Edin.). Permanent Head of the Department of Public Health of South Australia; Fellow of the Royal Institute of Public Health of Great Britain, etc. Sixth Edition. Adelaide, Australia: The Author. Paper; 6 x 9 in.; pp. 40; illustrated.
The fifth edition was noted in these columns March 17, 1921, p. 477. Some new and later matter has been inserted in the present edition.

SHOP HANDBOOK ON ALLOY STEELS: A Technical Subject Treated in a Non-technical Way. By G. Van Dyke, Manager, Special Steel Dept., Joseph T. Ryersson & Son. New York and Chicago: Joseph T. Ryerson & Son. Paper; 5 x 8 in.; pp. 95; illustrated.
Users of high-carbon and alloy steels will find this booklet interesting and instructive. The story of the production and manipulation of such steels is told in an easily understandable way, and in small compass a surprising amount of information on the make-up and peculiarities of special steel is imparted. There are also numerous tables of value for reference.

SIERRA LEONE RAILWAY: General Manager's Report on the Accounts and Working, 1919—Freetown, (Province of Sierra Leone) Africa: Railway Dept. Paper; 8 x 13 in.; pp. 48.

SOME ASPECTS OF THE GAUGE QUESTION—By F. G. Royal-Dawson, M. Inst. C. E., Chief Engineer with the Railway Board, Simla, India: Paper; 8 x 13 in.; pp. 36. 12 as.

STUDIES IN FRENCH FORESTRY—By Theodore S. Woolsey, Jr., Consulting Forester, Author of French Forests and Forestry (Tunisia, Algeria Corsica), and Executive Member Interallied War Timber Committee, Paris, 1917-19; with Two Chapters by William B. Greeley, Forester, U. S. Forest Service, and formerly Chief, Forestry Section C. and F., S. O. S., American Expeditionary Forces. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 550; illustrated. $6, postpaid.

WHOLESALE PRICES, 1890-1919. Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 205; illustrated. 50c. from Superintendent of Documents.

Letters to the Editor

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Hay as Filter for Boiler Water

Sir—In your issue of May 19, p. 869, appeared an interesting item concerning the "hay" filter used at Dayton, Ohio.

The writer, visiting a small water-works plant in Kansas some twenty-five years ago, saw a curious, cylindrical, orange-colored mass, somewhat suggestive of a mixture of macaroni, coral and calves brains. Upon inquiry it was found to be a bunch of hay that for some weeks had served in the plant's hot water heater for boiler supply.

It had been found to be an effective filter and depositary for calcareous contents of a very hard and sediment-carrying water. It was used until a more costly filtration plant restored hay to its normal use as an animal food.

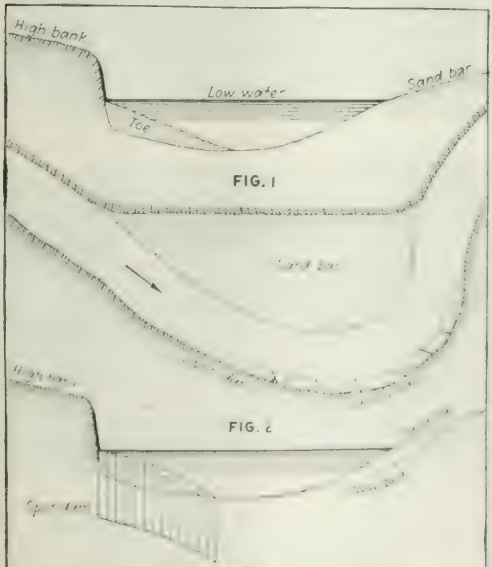
New York City, May 27. LOUIS L. TRIBUS,
Tribus & Massa, Consulting Engineers.

Protection of River Banks with Spur Dikes

Sir—The letter of Enrique Ramirez, *Engineering News-Record*, May 26, 1921, p. 909, in regard to spur dike river bank protection, recalls the installation that the writer saw several years ago in the Red River, Louisiana.

The caving banks of alluvial streams in this country have destroyed untold millions of dollars worth of property. A typical cross section of such a stream is shown in Fig. 1. The high bank with the nearly vertical face and the toe of loose material result from a cavein and which has not yet been washed away. To stop caving this toe below the low water line must be held in place and protected from high bank to channel center.

It has been found that any pile dike, built up to about the low water line and projecting at right angles to the stream or pointing down stream will usually cause a heavy scour around the outer end and along the upstream side, resulting in failure. It will also be a menace to navigation. Mattresses, rock fills, etc., laid on the toe soon break up or settle in the silt and are very expensive.



Accordingly the following method was employed. Spur dams were constructed as shown in Figs. 2 and 3. They pointed upstream at an angle of about 45 deg. They were made of a special dovetailed, interlocking sheet-piling built up of wood and concrete combined and jetted in place by a special marine piledriver. They extend from the low water line, projecting slightly above the toe, to the center of the channel where the top of the last piling is flush with the bed of the river.

By this method a substantial permanent structure is made and scour along the upper side and around the ends of the dams is prevented and navigation is not menaced. Bodies of dead water or very slow eddies are formed above, below and between the dams, causing the stream to drop its silt and further build up the toe. This dead water acts as a cushion, pushing the swift water path away from the caving bank.

In this type of construction it was found necessary to space the spur dams a distance apart equal to about one-fifth the radius of curvature of the river at that point. Piles must be non-buoyant or will work loose and float to the surface. Piling size and length vary under different conditions. The writer has seen interlocking piles 6 in. x 12 in. x 24 ft. placed with the tops flush with the river bed in 22 ft. of water and a five-mile current. This method is covered by patents in the United States.

Chicago, June 4. C. P. CHESTER.

Loose Anchor Bolts and Chimney Theory

Sir—Some time ago I examined a self-supporting steel chimney for a client who desired to purchase it. I noticed the top move what seemed to me 4 to 6 in. when the wind blew; its velocity that day was at times 45 miles an hour. The chimney was in a very exposed position. Imagine my surprise to find that the nuts on the anchor bolts had been loosened so that those I examined were ⅜ to ½ in. clear of the top of the bracket or lug which was riveted to the bell base of the chimney.

Why all the mathematical calculations of the necessary size and number of bolts, weight of foundation masonry, etc.? Here was a chimney 5 ft. in diameter and 118½ ft. high, resting upon a cast-iron base, and adjusting itself to as many new, nearly vertical positions as there were directions of the wind. The six 2¼-in. anchor bolts were set on a 10-ft. diameter pitch circle. Doubtless the designer thought necessary a 6-bolt anchorage, each bolt having some work to do, in fact one bolt at a time was doing all of the supporting or anchorage of the chimney.

This is another of the curious things one finds occasionally in the day's work. W. WALLACE CHRISTIE,
Ridgewood, N. J., June 4. Consulting Engineer.

Expressways for New York Traffic

Sir—I have been reading with a great deal of interest the discussion of Charles W. Leavitt's paper on "Expressways for New York Traffic" (see isue of March 31, p. 547) which has been going on in *Engineering News-Record*, particularly the comment by W. H. Breithaupt. I do not agree with him that it is necessary to put the expressways up so high above the street level, particularly as such a height would necessitate taking up too much room for the ramp approaches, whether they be spiral or otherwise.

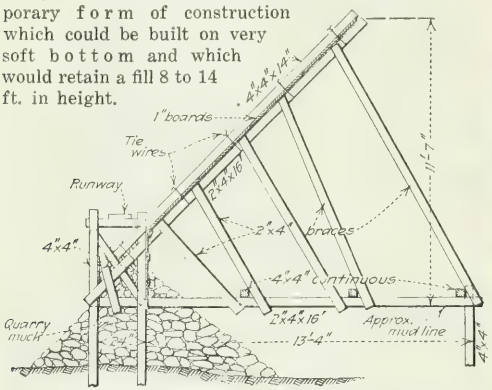
However, I have been wondering if you have considered the practicability of taking a strip of property, say 100 ft. wide, the entire length of the expressway, and using the space above, as well as below, for offices and apartments. Since the expressway itself need not be over 60 to 80 ft. wide, the remaining width could be used for corridors, elevator shafts and stairways to provide communication between the portions of the buildings below the expressway and the portions above it. CHARLES F. DINGMAN.

Palmer, Mass, May 28.

HINTS FOR THE CONTRACTOR

Effective Design for Wood Bulkhead To Hold Fill on Soft Bottom

A LIGHT timber bulkhead has been used successfully to retain a hydraulic fill in Los Angles harbor where several other types of retaining wall considered were found to be impracticable or too expensive. The fill is located on the north and west sides of the west basin. As a permanent wharf is to be built around this fill later, it was desirable to find some inexpensive temporary form of construction which could be built on very soft bottom and which would retain a fill 8 to 14 ft. in height.



CROSS-SECTION OF SEMI-FLEXIBLE BULKHEAD

The pair of 4 x 4-in. posts at the toe of the slope, as well as the single line at the opposite end of the structure, were pushed down about 6 ft. into the soft mud of the bottom by hand, or where firmer soil was encountered were driven with a hand maul, the workmen using a boat part of the time and near shore working in ship boots at low tide. After the posts and main timbers were put in and the facing of 1-in. boards had been placed, barges of "quarry muck" were landed at high tide alongside the plank runway, the rock being taken in wheelbarrows 100 ft. each way from the barge and dumped to form a solid toe. Care was taken to use battens on all cracks between the 1-in. board facing.

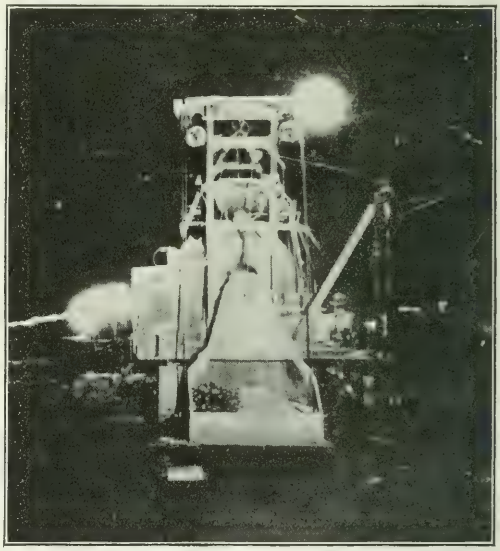
Bents, such as that shown in the cross-section, were placed every 4 ft. and thus boards whose lengths were any multiple of 4 could be used for the facing. The 45-deg. slope on the face was maintained throughout and the number of braces varied according to the height. The maximum height required was 14 ft. above the lower chord or horizontal 2 x 4 timber which was set on the surface of the mud.

This type of bulkhead was developed to meet the conditions imposed by the extreme instability of the soil. The idea was to obtain a bulkhead which could move laterally or vertically and still perform its function of impounding the discharge from a suction dredge. The rock toe is expected to prevent undercutting, the three longitudinal and continuous 4 x 4-in. anchors increase in effectiveness as the fill arises, and the shape of the structure is such that there is no tendency to overturn. In the softest places the bulkhead moved horizontally as much as 4 ft., at the same time settling more than 1½ ft., which, it is believed, would have destroyed most types of bulkhead.

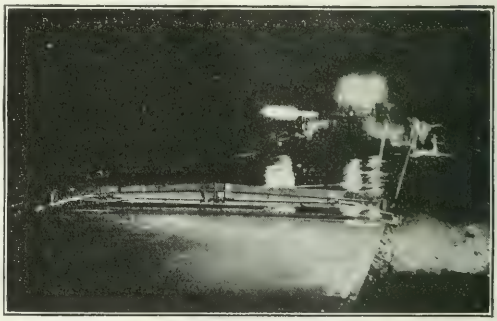
This design was prepared by J. Wyman Ludlow, assistant harbor engineer, Port of Los Angeles.

Night Lighting on Road Job

AS STATED in the article on the Maricopa County, Ariz., roads on p. 1026 of this issue, the concrete pavements there are being placed in two shifts, the latter of which runs from 6 p.m. to 2 a.m. After dark the



MIXER LIGHTED BY STORAGE BATTERY LAMPS



CONCRETE TAMPING MACHINE FLOOD LIGHTED

job is lighted by acetylene lamps of the Carbic variety, placed at intervals along the road and by electric lighting, from storage batteries, on the mixer. The accompanying views show the flood lighting of a finishing machine and the illumination of the mixer.

NEWS OF THE WEEK

New York, June 16, 1921

To Standardize Water-Works Methods and Materials

Fifteen Committees Named at Cleveland Convention, Am. W. W. Assoc. —Bartow the New President

Fifteen committees to standardize water-works methods, materials, records and rules were announced by the council on standardization of the American Water Works Association at the forty-first annual convention held last week in Cleveland. The council, which was created a year ago and consists of George W. Fuller, chairman, Frank A. Barbour, Edward Bartow, George A. Johnson and George C. Whipple, has selected as secretary Malcom Pirnie, of Hazen, Whipple & Fuller, New York. The 1921-22 budget of the association includes an appropriation of $2,000 for the work of the council.

The attendance at the convention was unusually large; about 400 active members, besides many associates and guests, were registered. Nine papers descriptive of the Cleveland water-works were presented. There were two sessions for superintendents and one each for filter plant operators and for supply men. The chemical and bacterial section held two sessions.

In his valedictory, President Beekman C. Little, Rochester, N. Y., spoke for balanced membership, ranging from superintendents of the smallest works to the topmost engineers in the country. Besides having diverse knowledge the water-works manager must be a politician—of the better sort. He should conduct publicity and educational work. The association, President Little said, finds it impossible to meet its financial needs from dues alone and needs contributions.

New Officers

A canvass of the letter ballot showed the following officers for 1921-22: President, Prof. Edward Bartow, Ames, Iowa; vice-president, W. S. Cramer, Lexington, Ky.; treasurer, W. W. Brush, New York City; trustees, G. C. Gensheimer, Erie, Pa., and J. C. Jensen, Council Bluffs, Iowa. There was no opposition ticket.

(Continued on p. 105[illegible])

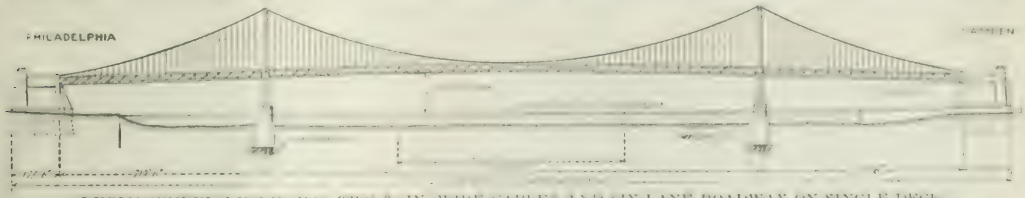
Delaware River Bridge To Be Suspension Structure

Board of Engineers Selects Location At Franklin Square—Bridge To Cost $29,000,000

Basing on studies continued for nearly nine months, the Board of Engineers on the Delaware River bridge reported to the joint interstate bridge commissions of New Jersey and Pennsylvania on June 9 on best location, type of structure, and cost of a highway connection between Philadelphia and Camden. It recommends a location about half a mile north of Market St., Philadelphia, extending from a western terminus at Franklin Square on Sixth St. between Race and Vine Sts., southeasterly at right angles to the river to an eastern terminus near Fifth and Linden Sts. in Camden. A suspension bridge with single highway deck and elevated footwalks was found to be the most desirable type of structure. The bridge will have a main span of 1,750 ft. and [illegible] spans of 719 ft., flanked by viaduct and filled approaches. Its clearance height will be 135 ft. above

ARCHITECT'S SKETCH OF BRIDGE TOWER

(Continued on p. 105[illegible])



RECOMMENDED DESIGN HAS TWO 30-IN. WIRE CABLES AND SIX-LANE ROADWAY ON SINGLE DECK

Pueblo Flood Intensified by Dam Failure

Earth Dam on Beaver Creek Washed Out—Levees Overtopped—Bridge Damage Not General

Reports on the effects of the Pueblo flood sent by a special correspondent of *Engineering News-Record* after a most difficult tour of several days through the flood district indicate that the destruction and damage in Pueblo is not as serious as first reports indicated, and that bridge and road washouts in the river valleys are not general and can be repaired for temporary service in a very short time.

Typical views of the flooded portions of Pueblo are shown on the opposite page. The greater part of the damage in the city appears to be chargeable to submergence and the attendant influx of mud and debris. Failure of the levees at several points and diversion of the river flow through parts of its original winding channel, straightened thirty or forty years ago, are responsible for more destructive local effects.

Bridge destruction was far from general. The old street bridges in the center of the city (see views) were not washed out, whereas in the downstream part of the city one railroad bridge was washed out, together with a highway bridge close alongside, while another railroad bridge paralleling the first remained standing. On Fountain Creek also one railroad bridge was destroyed. All the failures observed were caused by abutment or pier washouts, and no material amount of destruction by impact of current and floating debris was noticed.

The unprecedented height of the flood at Pueblo was due to the combined effect of a series of cloudburst-like rainfalls above the city and the washing out of the Schaefer dam of the Beaver Park Land & Irrigation Co. on Beaver Creek, about 40 miles northwest. This occurred at the peak of the rainfall flood, on the morning of June 5. The location of the city on the low ground at the junction of the Arkansas River and Fountain Creek was an essential factor in ponding the water. The Arkansas River flows southeasterly

through Pueblo in a valley one-quarter to one-half mile wide and originally meandering through the valley bottom. Fountain Creek joins it from the north just below the city. In the heart of Pueblo most of the bottom land is south of the river, being bounded by an abrupt slope to a bench or mesa on which much of the newer residential portion of the city is located. The destruction was confined to the low area, including the extensive railroad yards of the Santa Fe, the Denver & Rio Grande and Missouri Pacific lines, the Union Station, business and industrial districts and the like.

Early in the rise of the Arkansas the river overflowed the levees of lead-smelter slag blocks and granite facing that confined the rectified channel, and swept in a fan out into the business and downtown districts, which it ultimately flooded 15 ft. deep. Washing out of the levees occurred at a few points, as at the south end of the Santa Fe bridge —the K-truss structure shown in two of the views—whence the water flowed in a southerly loop along a part of the original river channel.

By the submergence and the current through the city, wooden houses were floated and smashed against more resistant structures, in turn causing many of the more substantial buildings to collapse. Fire that started in the lumber yards added to the danger at the height of the flood, but it was brought under control largely with the aid of the continuing rain. As has already been reported by press dispatches substantially correctly, about 350 city blocks have been wholly or partly ruined, and more than 50 large business buildings damaged by water or fire. Generally speaking frame buildings were utterly destroyed, while substantial brick wall construction of 13-in. thickness resisted in gratifying manner. A big concrete grain elevator, which for a day or two stood in a sea of mud and water, proved to be undamaged when the flood receded.

Breakage of water mains and local blocking of the sewers added to the difficulties of existence in the flooded district. Gas and electric light remained in service, partly at least, in residential districts above flood level.

Two strenuous attempts made by the correspondent to reach the washed-out Schaefer dam failed, passage being effectively blocked by bridge destruction. According to an eye-witness at Beaver, the flood wave which rushed down the canyon on failure of the dam formed a bore 20 ft. high and 600 ft. wide, in which rocks up to a cubic yard in size were carried along. Cottonwood trees were marked 30 ft. high with debris.

However, the Schaefer dam and a few very small earth dams are the only failures of this class of structure in the Colorado storm district, in spite of the general distribution of the flood rainfall over a large part of the Eastern Slope. The Skagway dam, previously reported to have failed, is still in place; its steel-plate-faced rock-fill structure seems to have resisted the flood effects successfully.

The Schaefer dam, 90 ft. high, was originally designed as a hydraulic-fill structure, under O. K. Parker. Subsequently team and scraper fill construction was advised by the late T. O. Jaycox, then state engineer. A study of its destruction has not been possible, as indicated, but the probabilities are that inadequate spillway capacity and cutting of the downstream slope by overflow were responsible for the washout.

Dowell Bill Strengthened by House Committee's Action

(Washington Correspondence)

Friends of the Dowell road bill are much elated over the strategy practised by the committee on roads of the House in attaching the Dowell bill, as amended, to the Phipps bill. The Phipps bill, which provides for an extension of time to the states that have been unable to absorb all the federal-aid money during the current year, already has passed the Senate. This has the effect of throwing the Phipps bill, with the Dowell rider, into conference, once that the measure has passed the House. While Senator Townsend may devise some means of delaying action, it is admitted that a very decided advantage has been gained by the proponents of the Dowell bill. Great pressure in favor of the Phipps bill will be brought by the states that have not absorbed their quota of federal funds, for if the Phipps bill does not become a law before July 1 the unabsorbed portion of the fund will be returned to the Treasury.

The present plan is for the House to bring up the Phipps bill on June 20. To do so will require a suspension of the rules, which calls for a two-thirds vote.

Minor Amendments Only

The only major amendment made to the Dowell bill by the House committee was in the provision regarding roads in the forest reserves. The amendment provides that 50 per cent of funds thus expended must be used in connecting main roads. The notice as to maintenance was increased from 60 to 100 days.

Hearings on the Dowell bill before the House committee covered much the same ground as did the hearings before the Senate committee. Witnesses appearing before the committee were unanimous that a prompt determination of the federal government's policy is necessary to the effective carrying forward of the state and county programs.

Thomas H. MacDonald, Chief of the Bureau of Public Roads, urged among other things that the bill should give authority for the federal government to train men for highway work. His suggestion is that this training should be confined to graduate engineers who would be glad to accept nominal salaries in order to get the advantage of the instruction and actual practice which the government could offer.

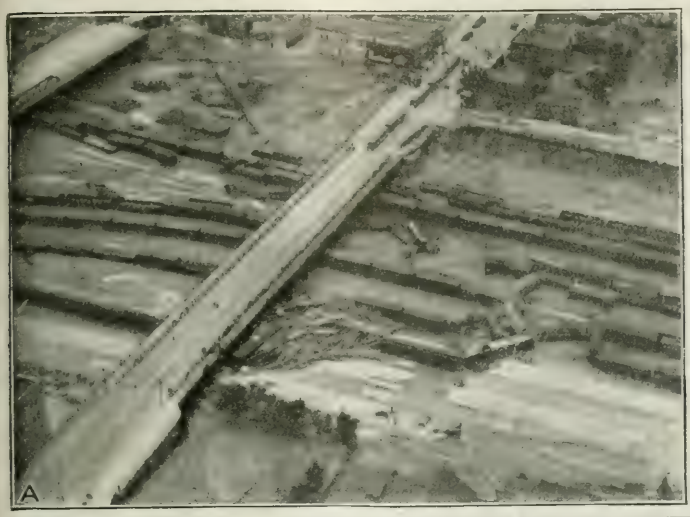
Senator Phipps, of Colorado, told the House committee that federal aid now represents only one-tenth of the amount expended on highways and for that reason he believes that the point has not been reached where federal maintenance should be given consideration. The time will come, he declared, when it must be considered.

New Yorkers Continue to Fight Passaic Valley Sewerage

The committee on pollution and sewerage of the Merchants Association of New York, which has been the moving spirit in the effort to prevent the Passaic Valley sewage being disposed of in New York Bay, has returned to the attack following the decision of the United States Supreme Court noted in these pages May 19, p. 849. In a report to the association the committee contends that the stipulations laid down by the Supreme Court are impossible of determination. Particularly it objects to the clauses which say that there shall be absence in the New York Bay and its vicinity of odor due to putrefaction of organic matters contained in the *Passaic Valley* sewage thus discharged. It claims that it will be impossible to determine if there is pollution whether it is due to Passaic Valley sewage or any of the other sewage being dumped into the harbor from various sources. The committee states "The health of over 10,000,000 people in this metropolitan district is threatened by the liquid filth that would surround us, and we should not have to wait until a great menace confronts us when pestilence and death may claim thousands of our citizens to obtain technical legal evidence."

The committee therefore recommended that it be authorized to endeavor to secure the appointment by the War Department of a competent sanitary engineer who shall be required to make frequent inspections, examinations, and analyses of the harbor at various typical points, and to make a full and complete report of the same. Further, it recommended that a taxpayers' suit be brought in New Jersey to restrain the expenditure of the amount needed to complete the Passaic Valley sewerage system on the ground that such expenditure has been rendered unnecessary by the Supreme Court's stipulations. These guarantee the elimination from the sewage of deleterious matter to such an extent that the outflow from the sewer may be located in Newark Bay, thus rendering further extensions of the sewer unnecessary, according to the committee.

The directors did not approve the second suggestion, but asked the committee to establish contact with the New Jersey State Chamber of Commerce and other commercial organizations in New York City with a view of enlisting their aid in the modification of the plan, which would make the construction of the outlet sewer from Newark Bay to New York Harbor unnecessary.



Pueblo Flood Impressions

A—Passenger trains overturned at Union Station. Station roof in right foreground. Main and Union Ave. viaducts at left. (C. Underwood & Underwood.)

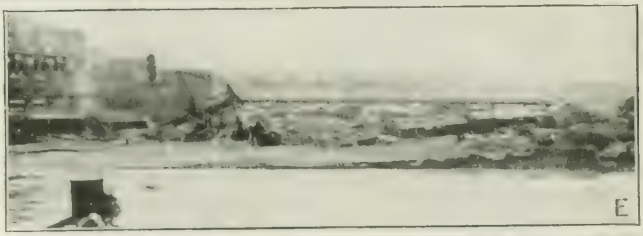
B—Concrete grain elevator undamaged.

C—A. T. & S. F. Ry. bridge over Arkansas River, with wrecked railway bridge alongside. Santa Fe Ave. bridge destroyed.

D—Victoria Ave. bridge, center of Pueblo. Union Ave. bridge in background.

E—Looking southwest at C Street viaduct over railway yards.

F—Airplane view south along Santa Fe Ave. (C. Underwood & Underwood.)



Arkansas Road Law Declared Invalid by Supreme Court

In a unanimous decision handed down June 6 the U. S. Supreme Court, reversing the judgment of the State courts, has declared invalid the Arkansas road law under which local improvement districts have been formed and property within them taxed to pay for the "benefits" derived. The case was that of the Kansas City Southern Ry. Co. and the Texarkana & Fort Smith Ry. Co. vs. Road Improvement District No. 6 in Little River County. Assessments amounting to $67,900, amounting to $7,000 per mile of track for 9.7 miles within the taxable zone, were demanded from the railroads by the road commissioners for the construction of a gravel road 11.2 miles long.

The Supreme Court decision, delivered by associate Justice McReynolds, declares that "the statute under consideration prescribed no definite standard for determining benefits upon proposed improvements," and that in this case, which the Arkansas courts had held to be within the law and valid, "we think the discrimination so palpable and arbitrary as to amount to a denial of the equal protection of the law."

Taxes on Zone Basis

"They divided the farming lands into five zones," the decision says, "determined by distance from the highways and assessed uniform benefits within the same zone without regard to improvements or market value."

"Town lots," the decision adds, "were likewise assessed at $10, $15, $20 and $25 each, according to location. A pipe line, a telephone line and a telegraph line were severally assessed at $2,500, $300 and $200 per mile without any designated basis."

"Benefits from local improvements" according to the Supreme Court, "must be estimated upon contiguous property according to some standard which will probably produce approximately correct general results. To say that 9.7 miles of railroad in a purely farming section, treated as an aliquot part of the whole system, will receive benefits amounting to $67,000 from the construction of 11.2 miles of gravel road seems wholly improbable, if not impossible. Equal protection of the law must be extended to all."

The decision concludes with this instruction to the Supreme Court of Arkansas:

"The judgment of the court below is reversed and the cause remanded for further proceedings not inconsistent with this opinion."

Stoughton Resigns Secretaryship

The board of directors of the American Institute of Mining and Metallurgical Engineers has accepted with regret the resignation, after eight years of service, of Bradley Stoughton as secretary, and has put upon record its appreciation of his long and efficient service.

Delaware River Bridge

(Continued from p. 1049)

mean high water for a width of 800 ft., and the gradients of the roadway on either side will be 3¾ per cent. The cost of this structure including real estate is estimated at $28,871,000.

These recommendations were based on studies of traffic distribution (including origin and destination), core borings to determine the depth to rock at five different sites distributed over about two miles length of the river, and comparative designs and estimates of bridge structures. These studies showed that the center of population, the center of location of industries, and the center of cross-river vehicle traffic in Philadelphia lie north of Market St., that rock foundations are available at all of the sites considered at depths of 70 to about 120 ft., with least depth (80 to 90 ft.) at the Franklin Square site, that spans of 1,750 to 1,800 ft. would be required if no obstructions between pier-head lines are permitted, and that the cost would range from $29,000,000 for the Franklin Square location to $39,000,000 for a location at Washingon Square (south of Market St.).

A ruling as to the required vertical clearance was obtained from the War Department after hearings before Major L. E. Lyon, U. S. Engineer Officer, and consideration of the case by the Chief of Engineers. It was shown by the engineers of the Bridge Commission that all navigation needs would be satisfied by a clearance of 135 ft. above mean high water, and the Board's request for approval of a plan that would provide this clearance height for a width of 800 ft. and would not obstruct the channel between pier-head lines was granted.

On account of the narrowness of the Philadelphia streets a certain amount of street widening is necessary at the Philadelphia end. Sixth St. is to be widened from Market St. north to Spring Garden St., Vine St. from Sixth St. to Broad St., and Ridge Ave. running northwesterly from Vine St. to Broad St., to widths of about 80 ft. For future construction the widening of streets forming a traffic circuit around the Philadelphia business district is recommended, in conformity with prior recommendations by a city planning committee. On the Camden side of the river a short length of new street running southeastward is projected.

The structure designed by the board provides six vehicle lanes by means of a single roadway 57 ft. wide between curbs. To either side of this roadway there is provision for a street-car track, and outside the line of the cables a rapid transit track. The two parallel-wire suspension cables, each 30 in. in diameter, are 89 ft. apart, while the out-to-out length of floorbeam is 122½ ft. Stiffening trusses 28 ft. deep, continuous between towers, provide for distributing load concentrations. The type of structure is notable for having the cables anchored to the tops of the column towers, the relative movement of main and side spans being compensated for by bending of the towers.

Public hearings on the recommendations of the board of engineers will be held by the Joint Bridge Commissions within the current week, with a view to making it possible to arrive at a decision concerning the adoption of the board's recommendations before the end of the month. If work is begun without delay, the board states, the bridge can be built by July 4, 1926, the sesquicentennial of the Declaration of Independence.

The board of engineers consists of George S. Webster, chairman; Ralph Modjeski, and Laurence A. Ball. Clement E. Chase is principal assistant engineer. L. S. Moisseiff is consulting designing engineer, Paul P. Cret is architect, and Arnold W. Brunner is consulting architect.

Alaskans Ask Harding to Appoint New Railroad Commission

President Harding has been memorialized by the Chamber of Commerce of Seward, Alaska, to appoint a new commission to take over the construction of the Alaskan Railroad, being carried out by the Alaskan Engineering Commission. It is charged that there has been undue delay and wastefulness in completing the work; that while the work has already run for more than six years, private contractors at one time agreed to complete it within eighteen months. The President is asked to appoint "a practical railroad builder."

800 Present at Ridgway Dinner

About 800 engineers and contractors of the metropolitan district attended a dinner at the Hotel Pennsylvania, New York City, June 9, as a testimonial to Robert Ridgway on his recent promotion to the position of chief engineer of the New York Transit Commission. Engineers and contractors, old and young, in the city's service and in private practice, constituted a gathering unique in point of size and representative character.

J. Waldo Smith, chief engineer of the New York Board of Water Supply, acted as toastmaster and the principal speaker was the Hon. George McAneny, newly appointed chairman of the Transit Commission, who paid an eloquent tribute to the technical and personal qualifications of the commission's new chief engineer. Among the other speakers were John H. Delaney, former Transit Construction Commissioner, Judge Edward E. McCall, former public service commissioner, Major-Gen. O'Ryan, who commanded the 27th Division of the A.E.F. in France, Col. William Barclay Parsons, consulting engineer and the first chief engineer of the New York subway work, and John F. Galvin, Catskill Aqueduct commissioner. Mr. Ridgway concluded the program with an expression of thanks for the honor shown him.

The arrangements for the dinner were in the hands of W. J. Buhrendorf.

Water Works Convention

(Continued from p. 1049)

The new executive committee reappointed John M. Diven as secretary and named a new publication committee, including Prof. John H. Gregory and Abel Wolman, both of Baltimore, Md., as chairman and editor. The old finance committee was replaced by George C. Andrews, Buffalo, chairman; C. R. Henderson and J. W. Ackerman.

Officers nominated for 1922-23 were: President, W. S Cramer; vice-president, George W. Fuller; treasurer, W. W. Brush; trustees, George W. Batchelder and J. W. Ellms.

Finances—The retiring finance committee, George A. Johnson, chairman, reported a deficit for the year of $2,009, met from the reserve fund. A budget of $18,000 was announced; $1,255, it is estimated, will have to come from the reserve fund unless there is a successful drive for new members. The reserve fund now stands at $12,000 par value of $11,000 market value of the securities, mostly Liberty Bonds.

Subject to final action by the executive committee, Philadelphia was chosen as the meeting place of the 1922 convention.

Standardization Committees

In presenting its report, the council on standardization announced that the various committees will submit for approval by the association a program of the work contemplated. The committees were urged to conduct research and practical work simultaneously, so that water-works operators may benefit from the activities at an early date.

Besides the investigations to be made by the standardization committees, the council proposes to secure brief abstracts of reports and papers of interest to members, paying younger members a half cent a word for the work and printing the abstracts in the *Journal* of the association. The council has appointed the following committee on abstracts, to report by Sept. 15: A. L. Fales, of Metcalf & Eddy, Boston, J. N. Chester, F. C. Jordan, R. S. Weston and Abel Wolman.

The 15 standardization and research committees, with the names of their chairmen, are as follows:

Water Analysis, Jack J. Hinman, Jr., Iowa City; Drinking Water, A. W. Freeman, Columbus; Load Factors for Purification Plants, E. E. Wall, St. Louis; Colloid Chemistry, R. S. Weston, Boston; Watershed Protection, T. De L. Coffin, New York; Industrial Wastes, A. L. Fales, Boston; Pumping Station Betterments, Leonard A. Day, St. Louis; Distribution Systems, G. G. Dixon, Akron, Ohio; Services, J. M. Diven, New York; Sanitary Fountains, J. H. Dunlap, Iowa City; Testing Water-Works Materials, John H. Gregory, Baltimore; Water Waste Control, W. W. Brush, New York; Meter Schedules, Allen Hazen, New York; Relations between Water-Works and Consumers, F. C. Jordan, Indianapolis; Water Department Records and Reports, (municipal plants) George H. Fenkell, Detroit, Mich.; (privately owned plants) John N. Chester, Pittsburgh, Pa.

Aside from the council on standardization, and apparently due to changes caused by its creation, the standing technical committees reported little but "progress," with the notable exception of the committee on standard specifications for water meters, C. M. Saville, Hartford, Conn., chairman. The report of this committee, with full specifications, (see *Journal* of the Association for May, 1921) was adopted by the convention.

Real although slow progress was also reported for the committee on standard specifications for cast-iron pipe, F. A. Barbour, Boston, chairman. This committee, created ten years ago, and working in co-operation with a joint committee of the New England Water-Works Association, presented tentative revised joint specifications in 1917, but without the co-operation of the manufacturer members of the committee. This check, combined with war and post-war conditions, has prevented much further progress, and the committee reported that it does not yet seem opportune to attempt rapid progress. Present indications, after correspondence with a number of pipe-users and taking into account the attitude of the pipe makers, are that the proposals for uniform pipe diameter and for changes in chemical composition of pipe will be given up or postponed. Arrangements for flexure tests to throw light on chemical composition have been made with Dr. Molderke by the pipe manufacturers. It is hoped that a way may be found to make studies of pipe coatings.

Bacterial and Chemical Section

At the meetings of the bacterial and chemical section the subjects nearly all bore on colloidal chemistry and its various ramifications into the field of water chemistry. An operators' section, similar to the laboratory section, will probably be formed by next year. Discussions were live and directed mainly toward the appraisement of the new electrical neutrality methods as applied to coagulation and filtration. The newly elected officers of the section are: Chairman, Allen Hazen; secretary, J. J. Hinman, Jr.; executive committee, L. H. Enslow, H. E. Jordan, W. M. Clark, N. J. Howard, M. F. Stein, A. M. Baswell, Warren Hatfield.

Manufacturers Have Floor

An innovation at this convention was an evening program of papers by supply men, arranged by the Water-Works Manufacturers Association. Charles H. Ade, National Meter Co., under the title, "Water Supply from the Supply Men's Viewpoint," amused those present by random reflections on men and things in and near the water-works field. Peter P. Dean, Cutler-Hammer Manufacturing Co., told of the development and application of electrical operation and control of valves. F. B. Leopold, Pittsburgh Filter & Engineering Co., recited his experiences in developing an oil engine. R. K. Blanchard, Neptune Meter Co., New York City, reviewed the work of the American, the New England and the Manufacturers' Water Works Associations in standardizing meters and meter specifications. Incidentally, Mr. Blanchard stated that statistics obtained from the makers showed that the number of water meters in use was about 4,400 in 1880 and 8,450,000 in 1920.

Some of the convention papers and discussions will be found abstracted elsewhere in this and succeeding issues.

May Build $25,000,000 Bridge Across San Francisco Bay

The San Francisco real estate firm of A. J. Rich & Co. announces in the San Francisco daily press that it has arranged for the necessary capital with which to construct a $25,000,000 bridge from Candlestick Point near South San Francisco (about 6 miles in an air line south of the Ferry Building), to a corresponding point on the Alameda side of the bay. This would be a real estate devolpment scheme, contemplating the development of large areas of land near each terminal of the bridge. The bridge plans, it is stated, were prepared by Gustav Lindenthal of New York. The structure would be designed for steam and electric lines, as well as for vehicular traffic, and would have a bascule span to permit the passage of shipping. The construction is estimated to require three to four years. The approval of the War Department has not yet been secured.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS. Philadelphia. Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. University of Pittsburgh, Pittsburgh, Pa. Annual Convention, New Haven, Conn., date 28-July 1.

The Providence (R. I.) Engineering Society has abandoned its project for the purchase and use of the rectory of St. John's Church as a club house, according to information received from City Engineer M. H. Bronsdon, chairman of the committee on rooms. The committee is now investigating other prospects.

The Society of Terminal Engineers, at a meeting held May 10 in New York, elected the following officers: President, R. H. McLain; vice-presidents, B. F. Cresson, Jr., Maurice W. Williams, M. A. Long and Charles C. Hurlbut; treasurer, W. J. Barney; secretary, J. H. Leonard.

Personal Notes

T. M. Brewer has been appointed city engineer of Viroqua, Wis.

August E. Kringel has been appointed city engineer of Green Bay, Wis.

W. W. Reed, formerly city engineer of Green Bay, Wis., has opened an office in Green Bay to engage in consulting engineering practice.

G. M. Braune, professor of civil engineering and head of the civil engineering department, University of Cincinnati, has resigned effective Aug. 1, to become head of the civil engineering department of the University of North Carolina. Mr. Braune was engineer with the Southern Bridge Co., Birmingham, Ala., for five years and was for over five years connected with the New York State Barge Canal, part of which time he was assistant chief bridge designer. He has been connected with the University of Cincinnati since 1912.

Friend P. Williams, special deputy state engineer, New York, and formerly division engineer, western division, New York State Barge Canal, with headquarters in Rochester, N. Y., has been appointed secretary of the New York State Water Power Commission, which was established by the last session of the legislature to make an investigation into the water power of the state. Mr. Williams is a Cornell graduate, class of 1899, and has been in the state service since 1904.

Marshall G. Findley, who for some years has been assistant designing engineer to the board of commissioners of the Port of New Orleans, has taken a position as engineer with Villadsen Bros., Inc., engineers and contractors, Salt Lake City.

Joseph Y. L. Reid, for some time chemist and engineer for the Du Pont Co., Wilmington, Del., has been appointed by the city commission as superintendent of the Trenton, N. J., filtration plant, to succeed F. W. Daggett, deceased.

Charles M. Upham, state highway engineer of Delaware, has been granted a year's leave of absence beginning Sept. 1 to accept the position of chief engineer of the state highway department of North Carolina, which recently approved a $50,000,000 bond issue for road improvements.

Ross J. Buck, director of public works and city engineer of Muskegon, Mich., calls attention to an erroneous statement in this journal May 19, naming John B. Fik as city engineer. Mr. Buck is the city engineer.

Colonel Washington A. Roebling has been elected president of the John A. Roebling's Sons Co. to fill the vacancy caused by the death of Karl G. Roebling.

George S. Iredell, civil engineer and landscape designer, has moved from his former location in Austin, Tex., where he has been engaged in engineering and landscape designing for about fifteen years, and where he served as city engineer for a number of years, and has established offices in Tampa, Fla., where he will specialize in municipal, subdivision, landscape engineering, and city development.

B. E. Clark, acting state engineer and also acting state highway commissioner of Oklahoma, has been appointed state highway commissioner of Oklahoma by Governor Robertson. He was graduated from Washington and Lee University as a mining and civil engineer in 1906. He then engaged in construction work for the Nebo Consolidated Coal & Coke Co. in Kentucky on railway and mining development and later held the office of county engineer for Pittsburgh, Coal, Choctaw and McCurtain counties, Okla. He entered the service of the State of Oklahoma as district highway engineer and was in charge of the federal aid projects.

Franklin R. McMillan, formerly with Turner Construction Co., New York, has become associated with Shenehon & Meyer, consulting engineers, Minneapolis. Mr. McMillan for some years was engaged in railroad work, and in the construction of irrigation works for the U. S. Reclamation Service. Prior to 1917 he was assistant professor of structural engineering, University of Minnesota, in charge of design and laboratory investigations in concrete and reinforced concrete. During this period and since that time he has specialized in concrete and reinforced concrete. During the war he was research engineer for the Emergency Fleet Corp., in charge of the investigation of stresses in concrete ships. In this work he developed the strainagraph, a recording strain gage which was used in obtaining stress records for both steel and concrete ships in service and during launching. While with the Turner Construction Co. he was largely concerned with special problems in design and in the study of concrete aggregates and mixtures.

Alexander P. Gest, secretary of the Association of Transportation Officers of the Pennsylvania R.R., was relieved from active service on April 1 and placed on the company's "Roll of Honor" after 45 years of service. Among his assignments were division engineer of the Monongahela, the Pittsburgh and the New York divisions, from 1883 to 1886. In 1912 he became special agent of the New Jersey division and was promoted three years later to the staff of the general manager.

Frederick C. Horner, for several years transportation engineer of the Packard Motor Car Co., New York, is leaving the company to spend two years in Europe on a study of transportation practice in England, France, Belgium and Germany. He will sail from New York July 2.

Business Notes

Ralph S. Cooper, in addition to being vice-president and general sales manager of the Independent Pneumatic Tool Co., Chicago, Ill., has been appointed general manager. He recently returned from Europe, where he had been for eight months establishing branch offices of the company.

Harold B. Wood has been placed in charge of the New York office of the Jeffrey Manufacturing Co., Columbus, Ohio, as district manager.

The Clyde Iron Works Sales Co., Duluth, Minn., has announced three new agency connections in the Eastern portion of the United States. These are Edelen & Co., Philadelphia, Pa.; Queen City Supply Co., Cincinnati, Ohio, and Waldo Bros. & Bond Co., Boston, Mass.

The Ludolf M. Hansen Co., designers and contractors, Green Bay, Wis., have added road construction and structural steel work, especially bridge construction, to its present activities. This work will be in charge of F. A. Torkelson, formerly city engineer of Green Bay.

The Harry M. Hope Engineering Co., of Boston, has established offices in Montreal to handle its Canadian business. George W. Saunders, formerly with S. Pearson & Son, London, is Canadian manager.

Obituary

Henry B. Ledyard, chairman of the board of directors of the Michigan Central R.R., died May 25. He was born in Paris, France, and was graduated from West Point in 1865. For two years he was chief engineer of the Michigan Central R.R. He later became general superintendent and then general manager. In 1883 he became president of the Michigan Central Lines.

William B. Cogswell, civil engineer and founder of the Solvay Process Co., Syracuse, N. Y., died June 8, in Brooklyn, N. Y. He was born in Oswego, N. Y., in 1834 and was a graduate of Rensselaer Polytechnic Institute. In 1856 he was appointed assistant superintendent of the Marietta & Cincinnati R.R. and from 1861 to 1865 he was in the United States Navy. In 1862 he had charge of the steam repair and construction work in the Brooklyn Navy Yard. In 1869 he was engaged in erecting the Frankin Iron Works in Oneida County and in 1861 established the Solvay Process Co., chemical works for soda products.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Federal Trade Commission Cites West Coast Lumbermen

Price fixing and artificial curtailment of production are charged by inference in a report issued to Congress by the Federal Trade Commission, June 9, 1921, on the West Coast Lumbermen's Association. Some of the subjects treated in the report are: "Present Activities," "Restriction of Production," "Co-operation Between West Coast Lumbermen's Association and Western Pine Manufacturers Association," "Price and Curtailment of Production Activities of Loggers' Associations."

The Federal Trade Commission does not recommend legislation in the report, but it is intimated that action is expected on the part of the Department of Justice. The West Coast Lumbermen's Association has replied that it has not since the war attempted to fix prices nor has it attempted to curtail output as charged in the commission's report. It states that during the war period it did fix prices in conjunction with the War Industries Board at the request of the government and during this period it endeavored to curtail non-essential production in order to stimulate essential war production. The association also calls attention to the recent 33⅓ per cent increase in rail freight rates applied to the long haul to the eastern markets, which "disrupted competitive rate relationships of thirty years' standing, by greatly increasing the transcontinental haul to eastern markets as compared with rates to those markets from short-haul producing regions."

Bridge Plans in Indiana Involve Cost Exceeding $1,000,000

According to a recent estimate made by W. J. Titus, head of the bridge department of the Indiana State Highway Commission, between $1,000,000 and $1,500,000 will be expended this year on bridge construction. It is estimated that thirty-eight contracts will be awarded by the bridge department within the next month.

U. S. District Court To Take Up Building Combine Probe

Col. William Hayward, recently designated U. S. District Attorney for the Southern District of New York, is co-operating with the Lockwood committee in its housing investigation. It is understood the Federal court will digest the evidence adduced during the Lockwood hearings as a preliminary to a possible prosecution of a ring of building combines of a national character, capitalized for an approximate total of $2,000,000.

Wages and the Cost of Living

Relation Between Wholesale and Retail Prices Shown—Actual Decline in Living Cost Established

In order not only to understand the trend of wages, but also to be in a position to estimate approximately at what level wages are likely to be at a given time in the near future, a study must be made of the cost of living. Of course there are other factors than the cost of living that determine wages: The strength or disorganization of unions, immigration, export demand for products, general prosperity of the country as reflected in buying volume, and the margin of profit on which general industry is functioning. The matter of profit is really tied up with the general prosperity factor, for with a rising market and plenty of money, the margin of profit expands. It is at such a time that labor, whether plentiful or scarce, is more liberally paid. At the same time the very prosperity of industry, and consequently of the country, raises the cost of living, which therefore is, after all, the basic factor in adjusting wages.

To read the trend of living cost, it is necessary to study both wholesale and retail prices. The cost of living is of course the immediate reflection of consumers' prices, which usually lag behind movement in the wholesale market. Wholesale prices, however, do eventually affect the cost of living. Fig. 1 gives an idea of the extent to which the wholesale and retail curves are out of phase. The upper curve is the *Annalist* index number, showing fluctuations in the average wholesale price of 25 food commodities "selected and arranged to represent a theoretical family's food budget." As a matter of fact this curve does not indicate the cost of living, although it provides a basis for estimating the food element of the living cost of the near future. The food cost of living is indicated by the lower curve in Fig. 1, which is the average retail price of 22 articles of food, as selected and weighted by the United States Bureau of Labor Statistics.

With wholesale prices falling 45 points from Aug. 1, 1919, to Nov. 1 of that year, retail prices moved as follows: August 192, September 188, October 189, November 192, the net change being zero. This should be sufficient to show that the wholesale market is not an index of the cost of living. It is an index of industry, not of consumption.

Again, when wholesale prices began to advance in November, 1919, retail prices had been rising since Sept. 1. Wholesale prices reached the peak in June, 1920, and since then have been falling. In August, 1920, retail prices began the long swing downward and are now 52 per cent above 1913 figures, but 31 per cent below the peak of 1919-1921. The curve appears to be flattening, and it is probable that it will drop not more than 10 points in the next three months.

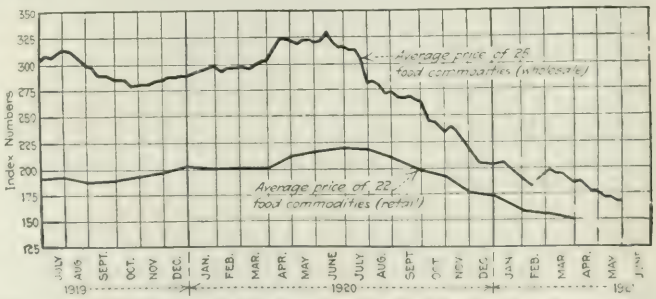


FIG. 1. PHASE DIFFERENCE OF WHOLESALE AND RETAIL FOOD TRENDS

Fig. 2 shows long period trends of labor rates and retail prices of food. The curve for farm labor at harvest time, without board, which agrees most nearly with common construction labor, runs back to 1866. The "deflation" period following the civil war was about 12 years. The long upward movement of prices of both labor and materials began in 1897 and continued with several negligible fluctuations until the end of 1915. The explosion of the next four years is graphically portrayed by this chart. The government statistics are collected yearly and therefore available figures do not extend beyond 1920.

Accepting the data in Fig. 1, the cost of food has decreased 16 per cent this year. Food, though the prime necessity of life, is by no means the sole. The innumerable items that go to make up the family budget can be gathered into five groups: Food, clothing, housing,

fuel and lighting, and miscellaneous. Expert consideration assigns the following percentages of total expenditure to these groups: Food 40 per cent, clothing 17, fuel and lighting 6, housing 14, miscellaneous 23. The miscellaneous group includes such items as doctors' bills, carfares, amusements, and the like.

The best figures available are probably those of the Bureau of Labor Statistics, but these are wholesale prices except in the single case of foods. It has been demonstrated that a decline in the wholesale market is not followed immediately by a drop in retail prices. *Engineering News-Record* has calculated that the retail decline is 36 per cent less than the wholesale. Using this measure it is possible to present the following table showing the decline in the cost of living since the peak in 1921:

	Per Cent of Total Expenditure	Per Cent Change in Retail Prices	Per Cent Change of Family Budget
Food	40	31	12 4
Clothing	17	−31	- 5 3
Housing	14	+45	+ 6.3
Fuel and lighting	6	0	0 0
Miscellaneous	23	-10	− 2.3
Net Change			13 7

The real cost of living has fallen about 14 per cent throughout the country.

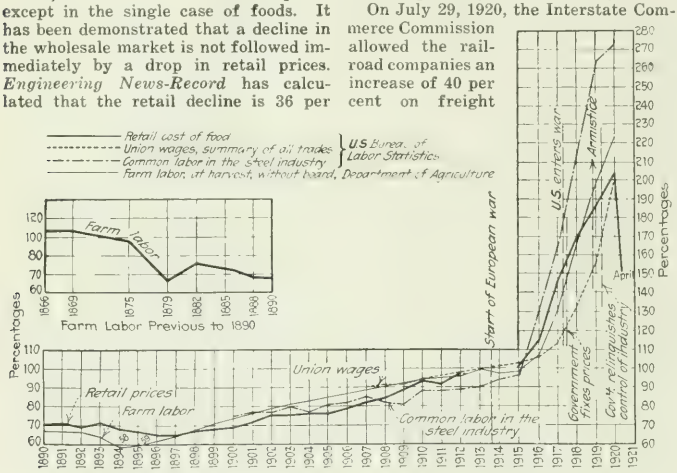


FIG. 2. MOVEMENTS OF WAGES AND RETAIL FOOD PRICES SINCE 1890

Bids Received on Milwaukee Sewage Disposal Plant Foundation

Bids were recently opened by the sewerage commission of the city of Milwaukee for the construction of the foundation for the sewage disposal plant on Jones Island. Bids were also received on a pile and concrete foundation for a power house. Eleven contractors bid for the foundation work for the sewage disposal plant, the low bid for furnishing and driving 787,250 lin.ft. of piling being $234,600. Of the twelve bidders who bid upon the pile and concrete foundation for the power house the low bid was $79,670. The engineer's preliminary estimate on this part of the work was $75,000. The complete plant will cost several million dollars.

Adjust Jersey Freight Rates on Road-Building Material

The New Jersey Public Utility Commission announced May 26 that an increase on intrastate freight rates for sand, gravel and crushed stone of 15 per cent on rates fixed by the Interstate Commerce Commission for the interstate carrying of these commodities has been allowed the railroad companies operating in New Jersey.

On July 29, 1920, the Interstate Commerce Commission allowed the railroad companies an increase of 40 per cent on freight rates including sand, gravel and crushed stone. Subsequently the railroad companies notified the utility commission that the increase would be put into effect on shipments between points entirely within the state. This action of the carrying companies drew a vigorous protest from contractors throughout the state, some of whom were engaged on state road work.

Several hearings were held by the utility board and it is now decided to forbid the increase of 40 per cent charged by railroads in interstate traffic, but it is also found by the board that a rate increase of 15 per cent, added to rates already existing and authorized by the Interstate Commerce Commission, would not be unjust or discretionary. The increase of 15 per cent allowed by the utility board will apply only to shipments of sand, gravel or crushed stone in transit between points in this state. The 40 per cent increase allowed by the Interstate Commerce Commission to be charged on shipments between New Jersey and another state will not be affected utility board's decision.

Baldwin Reservoir Contract Let

The city of Cleveland last week let a contract for building the 125,000,000-gal. Baldwin reservoir to the Hunkin-Conkey Construction Co., 601 Century Bldg., Cleveland, Ohio. The contract price was $2,052,241, 10 per cent under the engineer's estimate.

Deadlocks Continue in Building Trades Wage Disputes

Deadlocks continue in the settlement of wage disputes in the building industry in many cities. In others arbitration boards are hearing arguments, and in one instance the failure of an arbitration board to arrive at an agreement has resulted in the adoption of an open-shop policy by the contractors.

In Kansas City the arbitration board is now hearing arguments as to why wages should or should not be reduced. The arbitration board in Terre Haute failed to agree upon what was an equitable building wage basis, and in consequence the contractors are pursuing an open-shop policy. In Newark, N. J., though the open-shop plan of construction has been in effect for several weeks, it is reported that a re-opening of the question is being considered, news dispatches reporting that invitations had been received by various union business agents to attend a conference with the contractors.

Last week contractors in Springfield, Mass., voted a 15 per cent cut in wages effective immediately. Initial steps toward a reduction in building trades wages were taken also last week by the wage board in Cincinnati. The wage board is a permanent co-operative organization to whose decisions both certain employers and certain union organizations adhere.

After coming within 2½ cents an hour of an agreement, factions in Davenport, Iowa, are at a deadlock. The contractors are offering to pay 85c. for all building trades mechanics, except bricklayers and plasterers who shall receive $1 an hour.

New York Cities

All mechanics and laborers in Albany, N. Y., are on strike. The Tri-City Council, composed of exchanges of Albany, Schenectady, and Troy, is standing solidly united in the fight for a reduction in wage scales. Many Albany employers have started to run open shops, and the report is that no difficulty is experienced in securing needed men. Albany contractors are fighting for a reduction of 25 per cent from existing scales.

During the latter part of March the contractors of Rochester, N. Y., voted a 15 per cent reduction in all wages. The mechanics in all trades went out on strike on April 1 and on May 9 the proposed new agreement was withdrawn by the contractors who virtually agreed upon an open-shop plan of construction. In Buffalo contractors are operating open shops, the only changes in the past few weeks being that the bricklayers have called off their strike and have decided to accept $1 an hour under the conditions which the contractors may impose.

An approximate wage cut of 15 per cent in all lines is what the employers propose for the building trades in Trenton, N. J. The Trenton Master Builders Exchange gave mechanics until June 13 to accept the wage cut. The

bricklayers, masons, and plasterers union has already rejected the proposition, and the master masons association has severed relations with the union. It was reported that the master builders intend tying up all building operations in Trenton until workmen accept the cut in wages. An official announcement is to the effect that San Francisco contractors have severed all relations with union organizations, and, hereafter, will pursue an open-shop policy.

Increased Demand Reduces Number of Idle Freight Cars

Increased demand, particularly for coal and box cars, has resulted in a further reduction in the number of surplus or idle freight cars throughout the United States according to reports received from the railroads of the country by the car service division of the American Railway Association. On May 31 the average number of cars of all kinds in excess of current freight requirements was 394,040 or 28,783 below what it was on May 23.

Surplus box cars totaled 155,040 which was a reduction of 13,232 cars in eight days. Stimulation of coal movement through the re-opening of lake navigation also resulted in a reduction in the number of surplus coal cars, the total on May 31 being 165,102 compared with 176,442 on May 23 or a decrease of 11,340 cars.

West Coast Lumber Production

According to a recent bulletin issued by the West Coast Lumbermen's Association, for the week ended June 4, 112 mills in western Oregon and western Washington reported a production of approximately 54,000,000 ft. b.m., which is 32 per cent below normal. New business totaled 51 000,000 ft. b.m. and shipments 57,000,000 ft. b.m.

Louisiana Adopts Tax Exemption Law For Dwellings

The Constitutional Convention of Louisiana has adopted an amendment to the taxation schedule in the new basic law, whereby authority is given the cities of New Orleans and Shreveport to exempt from municipal taxes until Dec. 31, 1925, all dwellings constructed after the adoption of the Constitution and actually occupied by the owners. This new law is intended to give impetus to home building and to overcome a shortage of houses estimated at about 3,000.

Reduction in Number of Metal Lath Weights Recommended

Reduction of the number of weights of metal lath from 150 to 3 will be recommended by the Bureau of Standards at the meeting of the Association of Metal Lath Manufacturers, at Cleveland, June 21.

Construction Articles in This Issue

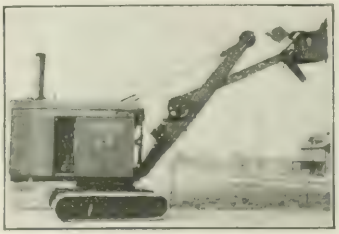
Filling High Viaducts on the Philadelphia and Reading Railway Page 1020
Building the Maricopa County Concrete Roads Page 1026
Earth Fill Irrigation Dam Has Some Novel Features Page 1030

Proposed Ad Valorem Tax on Dressed Lumber Opposed

Having learned that the Ways and Means committee of the House of Representatives is considering a duty of 25 per cent ad valorem on dressed lumber, the domestic lumber industry is protesting emphatically against such action. It is claimed that the lumber industry has not asked for a duty and that it does not want it.

Osgood Shovel Equipped with Continuous Tread Trucks

The Osgood Co., Marion, Ohio, has recently developed a continuous-tread mounting for the Osgood 29, a 1-yd. revolving steam shovel, which enables it to travel over soft or uneven ground with ease. The tread belt, extending but a short distance beyond the truck frame, interferes as little as possible with operations of the dipper. The treads are of three-piece construction —an open-hearth annealed steel casting to which are bolted a heavy steel pan,



NEW CONTINUOUS-TREAD OSGOOD SHOVEL

reinforced by heavy maple blocks, which forms a firm and smooth tread for hard use. The tread belts are so constructed as to enable either side to be adjusted independent of the other. It is propelled by direct-gear drive, and the fact that the shovel rests on two heavy steel billets allows the driving shaft to be free from weight. The driving shaft extends the entire width of the shovel and is supported by three large bearings of heavy pattern.

The new Osgood can be equipped with steel boom, extra drums, etc., for converting it into a crane, clamshell or dragline outfit.

Street and Road and Building Work Active

Analysis of the contracts let during the past week, as reported in *Engineering News-Record*, show steady activity in the construction of streets and roads and miscellaneous buildings, such as lofts and educational, amusement, religious, bank and office and store structures; and a strengthening of industrial work. Value of street and road contracts alone was $11,131,587, and of buildings, $15,026,514. Industrial contracts totaled only $2,074,307, though the number of projects was large, including new textile mills and a rubber products plant. Another noteworthy fact in the analysis of contracts let is the number of repaving projects put under contract.

The total value of all contracts let was $30,309,642.

Wage Adjustments Made in the Steel Trade

The Brier Hill Steel Co., Youngstown, Ohio, has announced a 15 per cent reduction in the salaries of all officials and employees, effective June 16. On this date, also, the Jones & Laughlin Steel Co., Pittsburgh, abolishes all overtime. Payment of time and a half for overtime was eliminated several weeks ago by the Cambria Steel Co., Midvale Steel Co., Youngstown Sheet and Tube Co., and most of the other independents. According to press despatches a further reduction is probable in July.

Los Angeles Votes Against Bond Issue for Sewers

In the election, June 7, the city of Los Angeles voted against the outfall sanitary and sewer bond issue of $12,850,000, which the special sewage disposal commission of Los Angeles had recommended be increased to $14,000,000, for trunk sewers and sewage disposal. The vote was 50,038 against 30,805 for the issue. It is not considered that the vote directly reflects the sentiment of the community in regard to this bond issue since it was involved in other issues and party politics.

The recommendations of the sewage commission, consisting of George W. Fuller, George C. Whipple, and William Mulholland, appeared in *Engineering News-Record*, May 5, p. 784, in the form of a brief news report. The recommendations of the commission in more detail will be published in an early issue.

Bids Soon To Be Asked on Detroit Street Railway Buildings

Repair shops, a transportation and office building, and an inspection car house are soon to be constructed by the Detroit Municipal Street Ry. as soon as condemnation proceedings have been completed and the 17 acre site made

available. The estimated cost of the general car-house, repair shop, and transportation building is approximately $1,000,000. Plans have been prepared by the railway's engineers and bids will be asked for the fabrication and erection of the structural steel frames and for furnishing the construction materials. The buildings will be constructed by the city forces.

Considerable progress has been made by the Detroit Municipal Street Ry. in carrying out the construction program begun last March, calling for the construction of 82 miles of street railway this season. To date the construction work is ahead of schedule, for up to May 15 31.2 miles of single-track excavation had been completed, 19 miles of single track had been laid, and 8.2 miles of single track paved in.

The material and construction equipment are being purchased by the city and construction is being carried on by the city forces under the direction of Joseph F. Goodwin, general manager of the municipal system provided for by the $15,000,000 bond issue voted last year.

Paving work and sewer construction are being carried out on a greater scale than ever this year. Greater rapidity in carrying out the city's construction program is aimed at and it is also desired to open the closed streets as soon as possible.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials only the chief cities are quoted. Moreover, The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 2, the next on July 7

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	−$4.00	$4.50	$3.23	$3.51	$4.65	$4.35	−$4.60	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	−5.50	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.25	3.25	3.75	3.13	3.53½	4.32½	2.35	+4.00	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	47½%	5%
Cast-iron pipe, 6 in. and over, ton	54.00	59.22	65.00	−54.10	62.80	70.00	85.90	—65.00	75.00
Concreting Material:									
Cement without bags, bbl.	2.80(del.)	−2.60	2.60	2.17	2.26	3.10	3.09	3.10	−3.40
Gravel, ¾ in., cu.yd	2.50	2.80	3.50	2.25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	2.25	1.60	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	43.00	40.00	50.00	55.00	37.00	47.00	27.00	28.50	−110.00
Lime, finishing, hydrated, ton	21.00	22.50	27.50	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl.	3.30	1.60	3.00	1.65	−1.50	3.10	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	−11.50	14.50	12.00	17.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	12	092	09	.12½	.11	.19
Hollow partition tile 4x12x12, block	...	15	13	096	092	.10	.14½	.12	....
Linseed oil, raw, 5 bbl. lots, gal.	80	+.78	90	−.87	.91	95	.96	.79	.84
Common Labor:									
Common labor, union, hour	.75@.80	35		1.00	50	50@.63½	.81¼	.75	..
Common labor, non-union, hour	..	25	35@.45	.45	.50	.37½@.50	50@.55	.50	35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quote at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine, and on lime in paper bags. **Montreal** quotes sand stone gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

Reports are general of a deep depression in the steel trade, warranting an official price decrease. Price shading is becoming general, Chicago reporting that almost any steel product can be purchased at 25c. under the list. Structural shapes are down 30c. in Seattle, and reinforcing bars and rivets also have fallen.

The base wholesale price of Southern pine in the New York market is $43 per M. ft. b.m. The price in Montreal is $110, a decline of $10 since the last report. There has been a slight stiffening in Douglas fir at Seattle. The West Coast Lumbermen's Association advises that for the last week of May 112 mills in Western Oregon and Western Washington reported production at 56,591,246, which was 30 per cent below normal. Curtailment of production helps explain the strengthening of the lumber market.

Cast-iron pipe is selling for about the same in Chicago as in New York, $54.10. Minneapolis quotes lump lime at $1.50 per 200-lb. bbl., as against $2 a week ago.

As to labor—Chicago advises that the end of the construction tie-up is in sight. Judge Landis has been accepted by both sides as arbitrator. Work is resumed at once at the old scale of $1.25 per hour for skilled labor, $1 for unskilled, the new rate to be effective upon the rendering of the arbitration decision, and to remain in effect until May 1, 1922. About 20,000 building trades employees returned to work on June 14. In February, 1922, the arbitrator is to hear evidence and to set a schedule that shall be effective until May 1, 1923. Settlement, if effected as outlined, will mean the resumption of work to the value of $20,000,000 and the probable opening of needed work estimated at $100,000,000.

The San Francisco Building Council has announced acceptance of an arbitration board to consider the decision reducing wages of seventeen unions on the closed-shop basis. Builders, refusing the concession, state that they will adhere to the open shop and a reduction of 7½ per cent.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 86 — NEW YORK, THURSDAY, JUNE 23, 1921 — Number 25

The Case Proved

SUBSTANTIAL evidence that it is desirable to award highway contracts early in the season is contained in the 1919 and 1920 records of paved-road construction in Illinois, which are published on p. 1081. Often the assertion of the individual contractor that he requires two or three months to get into high production is regarded as a convenient excuse for possible failure to complete work. There can be no such suspicion of the records presented by Mr. Piepmeier, as they average the operations of a score or more contractors and perhaps a hundred paving outfits. Such averages are perhaps as nearly true as can be expected under the variable conditions in highway contracting during the last two years and they fully bear out the contentions so freely made by this journal and by highway authorities that volume in construction requires contracts to be let well ahead of the working season.

The Construction Situation

FOR the past two weeks analyses of contracts let, as reported in *Engineering News-Record*, show that the value of contracts let has exceeded those of the corresponding period of 1920 by more than 40 per cent. And no account in that difference is taken of the decrease in the cost of building within the past year, consideration of which would strengthen materially the per cent gain. New highway, street and miscellaneous building construction are far more active now than in June, 1920. Contract-value figures for 1920 were high in industrial work, where invariably the large projects are found, and this year there is almost a total lack of large industrial contracts. Outside of this, 1921 greatly outdistanced 1920 in number and value of contracts let. Construction is proceeding. Someone must be doing the work. Is it then true, that, while the papers are full of stories of agencies which are casting about for means to stimulate building, the extent of work being undertaken daily is overshadowed? Or is it true that each of us, accustomed to the abnormal prosperity of war years, cannot differentiate between such a condition and a normal one? The year 1920 was considered a good construction year. Yet we are spending much more now than at this time last year for new work. When the contractor, material manufacturer, or machinery dealer says business is far from normal is he thinking in terms of 1918 or of 1914? Perhaps we are nearer to a normal condition than we realize.

Pressure for Reorganization

THE President's ire has been aroused by the obstructionist tactics that are being exerted to prevent the reorganization of the Federal government, and Washington reports have it that he is letting it be known that those who indulge in such efforts will find themselves in disfavor. We hope he will put on pressure, put it on hard and keep it on right now, while his administration is young. Pressure now will be most effective, while Cabinet officers still have an inquiring and doubting frame of mind regarding the organization and efficiency of their departments. As we have expressed it editorially before this, government reorganization will come in this administration only if it is done quickly. Probably the best support the President can have is individual expression to representatives and senators that will show that the public demands a more effective government organization. The President can urge reorganization, but it will not be made effective unless the public backs his demand with its influence.

Cost of Acquiring Land

EVIDENCE of the present cost of condemnation and damages in acquiring railroad lands will be excluded in the valuation proceedings of the Interstate Commerce Commission if the bill now pending, to relieve the commission of the duty of finding these costs, is passed. As noted in the News Section, such a bill has been introduced in the Senate. Under this amendment to the Valuation Act, the commission would still be under the necessity of finding "present value" and original cost of lands, when they can be found, but it would be relieved from finding separately "present cost of condemnation and damages or of purchase in excess of such original cost or present value." Previously, the Interstate Commerce Commission declined to find and report these elements of cost on the ground that it would not be practicable to do so. It was then compelled to do so by the Supreme Court decision in the Kansas City Southern case rendered a year ago last March. If the present bill is passed it will vitiate that decision. In its proceedings to date, the commission has reported "present value" of lands (in reproduction cost) as the acreage value of adjoining lands. This journal and its predecessors have consistently recognized that cost of condemnation and damages are factors that should at least be admitted in evidence for determining cost of reproduction. The passage of the proposed amendment would be unjust to the carriers.

Uniformity Needed in Traffic Control

VEHICULAR traffic regulation has become an acute problem not merely in a few great metropolitan centers but in scores of medium-sized cities throughout the country. In the every-day life of manufacturer, merchant and citizen at large its influence is unmistakably felt, and as a consequence there has developed a widespread attempt at traffic control. Unfortunately there has been little co-ordination in this effort. Each locality is a law unto itself, and rules and regulations are being promulgated in one place, often by well-meaning but ignorant city officials, which are directly at variance with those of neighboring municipalities. Many of the

schemes are founded on illogical principles, are cumbersome and laxly enforced. Both motor vehicle driver and pedestrian, therefore, are confronted with a condition, not only highly confusing but essentially dangerous to life and property. Unless some central agency can be developed to secure acceptance, on a national scale, of sound and uniform principles of traffic control, the same crazy-quilt effect will be produced as now exists in the field of general motor vehicle and highway legislation, where the laws in one state bear little or no relation to those of another. Engineers, thus far, have stood aside and seen traffic regulation policies developed almost exclusively by police officials, aldermen and others without technical training. The present situation opens up a vast field for engineering study. The kind of work needed is that which can best be done by the highway or railroad transportation specialist. City traffic regulation should have a far more important place in the programs of engineering society meetings than it now occupies. It is not too late to bring order out of the chaos which now threatens, if engineers act promptly.

Individualism in Traffic Signs

STANDARDIZATION of traffic principles is only one phase of the broad subject treated in the preceding note. Uniformity should be extended to the signs, signals and other devices designed to regulate the movement of vehicles and pedestrians. Effective traffic control is dependent, first of all, on public understanding and co-operation, and if properly conducted, can be made very largely automatic. By collecting specimens from those cities where traffic regulation is active, it would be possible to fill a fair-sized museum with signs and signals, no two of which are unifrom as to size. shape, color, legend, etc. The polygot character of such an exhibit, if it could be assembled, would serve as the most convincing kind of testimony of the need for uniformity. While in some cities traffic directions are pitifully meager, in others there is danger of too zealous activity in placing signs and signals, with the result that the vehicle driver is faced with so many and so varied an assortment of directions that he abandons the attempt to read them and proceeds in his own way.

International Technical Meetings

AMONG the minor immediate consequences of the European war was the cessation of all international technical society activity. This particular means of promoting world fellowship and of advancing science had been growing rapidly in the first decade of the century and several important international meetings were planned for what proved to be war years. Naturally, they never took place, nor did the various associations function during the war years. Happily now there are signs of recovery. The Railroad Congress, which was to have been held in Berlin in 1915, is now scheduled for Rome in April, 1922, and the Road Congress, intended for Munich in 1916, will also be held in the Italian capital in the spring of 1922. There is meeting in Brussels now a committee to decide the date of the next Navigation Congress, which was to have taken place in 1915. So far the only one of the large international congresses not yet announced for the early future is that interested in testing materials. The last meeting was held in New York in 1912 and the next was scheduled for St. Petersburg in 1915. Some effort is being made to renew the functioning of this association, but nothing definite has yet taken place. The war's stoppage of international meetings must not persist too long. Engineers of every country can learn from their foreign confrères, and the promoting of good will and of interchange of information which reside in the international technical meeting is too valuable to lose.

Highway Financing Again

HIGHWAY financing in Arkansas is again brought to public notice by the U. S. Supreme Court decision, noted in last week's issue, p. 1052, reversing the judgment of the state court and sustaining objections on the part of two railways to the imposition of what were characterized as arbitrary and unreasonable assessments upon their property for the purpose of constructing 11 miles of gravel road. The levy on the railroads' 9.7 miles of right-of-way, at $7,000 per mile, totaled $67,900, an amount, the court held, so far in excess of the benefits accruing from the highway improvement as to amount to a denial of the equal protection of the law. The broad principle involved in the case is the one of just assessments for local benefits. It would be idle to argue that the construction of good roads does not appreciate the value of farm lands which they serve. Where direct benefits accrue, property should bear its just burden of cost. The point here, as staeted by the Supreme Court, is that certain property cannot be taxed upon some fanciful view of future earnings, while all other property is assessed solely according to area and position. In the case under discussion no basis on which the assessment was calculated was disclosed. Much criticism of the highway financing methods practiced in Arkansas has been heard recently. The present decision, while it involves special conditions in one state, should serve as a general warning against illogical and haphazard highway financing schemes which, while they may be temporarily successsful in securing the construction of a few additional miles of highway, will, in the end, result in discrediting the cause of good roads.

England's Industrial Situation and Ours

ENGLAND never ceases to furnish more texts than any industrial preacher needs on almost every phase of industrial relations. Most of the texts are of the type on which "don't" sermons are written. Occasionally there is material for gratifying "do" preachment. Since the armistice the encouraging text has been more than ever rare, and we in this country are tempted to ask ourselves whether we must expect similar conditions. The subject is worthy of a little inquiry.

Industrially England's situation is almost chaotic. The long-drawn-out coal miners' strike could only occur in a country where industrial relations were in a bad way, particularly when all the normal methods of exerting the public's influence have been tried and found futile. That Englishmen themselves are deeply worried is evident from the repeated expressions that come from the other side. With characteristic English balance they hope for better things while picturing very black conditions. Such a picture was painted recently by E. J. P. Benn, the English publisher (see p. 1069 of this issue), while an equally frank view is presented by Sir Robert Hadfield, chairman of Hadfields, Ltd.,

the great British steelmaking corporation. The sad part of these presentations, to an American reader at least, is that they offer no promising means of amelioration. The hopes expressed do not seem to rest on a sound foundation. An American is inclined to believe that England must go through some bitter experiences in industrial experimentation before more stable conditions can be looked for.

How is it with us? We, too, have industrial troubles —strikes in great number, arising from all manner of causes. Are we headed for an era of unreasonableness and of such maladjustment of industry as never to be beyond the shadow of a serious stoppage in some industry?

Unless all signs fail, we shall continue for a long time to have serious industrial disputes. Neither employers nor employees seem to be developing an attitude that is promising of great immediate good. But even if that be the case, we have in this country a situation that makes for harmony that is lacking in England. We have a group of citizens, not partisans to the industrial dispute, of such size that its views are likely to be decisive when the controversy begins to affect the general welfare. Of that group the farmers are the nucleus. They have shown repeatedly that they will not blindly nor permanently array themselves on the side of either industrial employers or employees. With them stand the so-called middle classes—the professional people, the small shop-keepers, and to some extent, office workers. In England this group, lacking a farmer element, is, compared with us, relatively small. There, one might say, there are only partisans in the industrial dispute. Here we have a great impartial jury. In fact it is the failure to reckon with that jury that has brought grief, at different times, to both sides.

In Europe itself this influence of the agricultural classes is apparent. The troubles of European nations are in proportion to their industrial populations. Our future difficulties probably will increase as we turn more from agriculture to manufacturing, but for many, many years we can count on a situation materially better than England's.

Cutting Wages to Fit Living Cost

IN THE last year there has been more wage-cutting—certainly more discussion of the subject—than ever before in the history of the country. This is quite natural, as never before was there such a period of inflation as 1916 to date. The debate rages around the question of how quickly wages can be decreased. That there must be a decrease seems to be the universal judgment.

Wholesale food prices have declined 48 per cent since the 1919-1921 peak, according to both the *Annalist* and the United States Bureau of Labor Statistics. Wholesale prices do not reflect the cost of living, certain authorities to the contrary. The cost of living is indicated by retail prices, and Labor Statistics show that retail food prices have fallen 31 per cent since the peak in 1920. But the foods group is only one of five in the workingman's family budget. *Engineering News-Record's* best thought reveals that family expenses have decreased 14 per cent since the summer of 1920.

Despite high rents and the fact that the restaurants have not shown recognition of the trend of wholesale prices, the cost of living is coming down. Obviously living costs cannot closely approach the pre-war level while labor continues to work on the 1920 basis. On the other hand, labor can hardly be asked to accept less than a living wage.

Fair adjustment of wages depends upon both an understanding and a recognition of the present status of the cost of living and of the rate at which it is descending.

Production vs. Wage Cutting

IN CONNECTION with wage cutting it is worth noting that we hear almost nothing now about output, about the production of the individual. At the close of the war, emphasis was laid on increased output rather than wages and it was freely contended that if output were increased it might be possible to maintain the war wage levels. Such contentions were sincerely made, but were probably much colored by the high idealism that held over from the war period. In many lines we have secured greater output. Both within and without union ranks performance is better, though non-union performance has naturally had the greater increase. Even in cases where output has doubled we seem to find it impossible—despite the good intentions of post-armistice days—to hold wages up. The facts are that economic law is gradually forcing us back to conditions more like those of pre-war than of war days. Discriminating buying is at the root of the change.

Also it is apparent that we did not get out of the war new stimuli for greater production. Probably there was progress in industrial relations in certain plants, but that progress was probably no more than what might have been expected had the war not come. In the aggregate, the movement has been a retrograde one. Notions of "right" have expanded into extravagant ideas, and the sum total is a demand of greater pay for less work.

Without a doubt the present depression, with its considerable unemployment, will tend to modify these extravagant ideas. That means is a brutal one, and in the minds of some the only possible corrective. It has, however, definite limits, and those limits are narrower now than before the war, because of the greater mass resistance to anything that seems to be of advantage to the employer. If, however, we are to check permanently the rising tendency in prices—which marched inexorably upward for twenty years before the war inflation—we must increase very materially the production per individual. It is the only assurance of plenty for all.

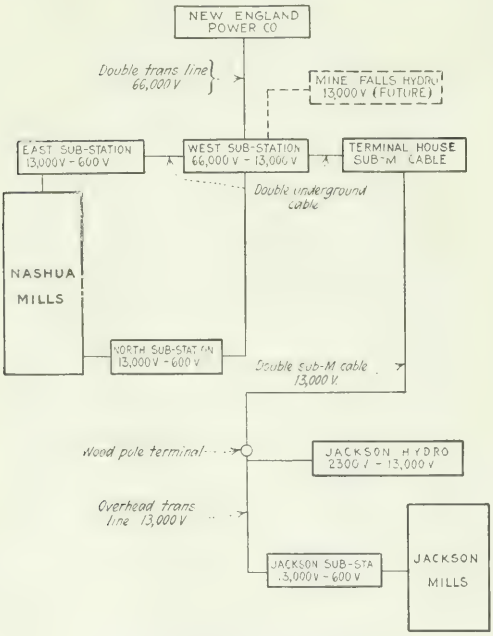
Production specialists have gone far in achieving the results they have sought, but methods and mechanisms will always be sorely handicapped until all workers, whether of hand or brain, accept the sound doctrine that only by large volume individual production can all be benefited. Following the war it seemed as if we were likely to have a general education of the public in this direction. Unfortunately the expectation has been fulfilled only in so far as distress and fear of unemployment have had an influence. In reason and out it is the duty of all of influence, whether labor leaders, employers, engineers in industrial organizations, or others, to preach the doctrine of large production. And no sane man will object if the worker, of every grade, in accepting the doctrine demands that he shall have a good share of the fruits of his labor.

Rebuilding an Old New England Water-Power Plant

Special Construction Problems in New Hydro-Electric Station for Jackson Mills Long Supplied With Power From Individual Wheels Taking Water From Nashua River

By E. H. Swett
Hydraulic Engineer for John A. Stevens, Engineer, Lowell, Mass.

For many years the Jackson Mills of the Nashua Manufacturing Co., situated in the city of Nashua, N. H., have derived their water power from the Nashua River. The old plant consisted of a dam whose crest length is about 175 ft.; a canal one-quarter of a mile long, of about 900 sec.-ft. capacity and five sets of horizontal wheels located in the basements of the various mill buildings and totaling about 1,600 hp. In 1918 the decision to build a large, modern, reinforced-concrete mill building upon the site of a portion of the canal and adjacent old mill buildings necessitated the simultaneous construction of a new hydro-electric station. The process of transforming a series of individual powers into a central station in a congested district involved a number of complicated construction problems.



POWER LINE LAYOUT FOR JACKSON MILLS DEVELOPMENT

The Nashua Mills of the Nashua Manufacturing Co. are situated on the Nashua River about half a mile upstream from the Jackson Mills. After an exhaustive study of the present and future power requirements, made in 1917, it was deemed most advantageous to electrify the Nashua Mills; develop the hydro-electric power to the fullest extent; make up the difference between power obtained at high- and low-water periods with steam electric power generated at the Nashua Mills, making fullest possible use of all byproduct steam in manufacturing, heating, etc., and finally to purchase all further power required from near-by public utilities. The Jackson Mills were already partially electrified, current having been supplied by steam turbo-generators and by generators driven by some of the old waterwheels. The electrification of the Nashua Mills was completed in 1917-1918, involving generators directly connected to the waterwheels.

Power Line Connection.—The water-power plant of the Nashua Mills consists of four sets of horizontal wheels, totaling 4,000 hp. with an operating head of 35 ft. The wheels are located in the various mill basements and supplied by means of penstocks leading from a canal. The headworks and dam are located at Mine Falls, about 3 miles above the mill. The full development of the hydro-electric resources contemplates the replacement of the present canal and wheels with a hydro-electric station at Mine Falls operating under a 50-ft. head and a transmission line to the mills. This is the last step in the development program, however, which, owing to the prevailing high prices of labor and material, has been indefinitely postponed.

To secure outside power from the New England Power Co. involved the erection of a 66,000-volt double-transmission line of wooden pole construction 18 miles long; 3 substations at various points in the Nashua Mills' yard, over 2½ miles of underground cable, 1,500 ft. of 13,000-volt double submarine cable and terminal house for same, one mile of 13,000-volt double-transmission line, and finally one substation in the Jackson Mills' yard.

There is shown herewith diagrammatically the relation of the new Jackson hydro-electric station to the system. By the proper use of disconnecting switches power can be sent from this station to either the Jackson substation or to the West substation.

The West substation differs from the others in that it is of the outdoor type, consisting of reinforced-concrete poles with structural steel cross members. The manner in which these poles were carried down to firm foundation through quicksand is a construction feature well worth recording. The poles ranged from 25 to 32 ft. long and were cast on the ground with the reinforcing rods projecting 15 to 20 ft. beyond the base. Steel casings for reinforced-concrete piles were driven from 30 to 35 ft. to ledge at the site of each pole. The precast poles were picked up by the pile-driver, adjusted to proper elevation and alignment, with the reinforcing rods extending down into the steel casing. The pile casings were then filled with concrete. This method resulted in poles 50 to 70 ft. long with continuous reinforcement, although built in two sections. A view of the completed substation is shown.

The method of supplying the Jackson Mills' substation from the West substation in the Nashua Mills' yard was given considerable study. An overhead line would have to run through the heart of the city, with consequent complications concerning right-of-way, etc. The Nashua River, on the other hand, offered a direct

and unobstructed avenue of communication between the Nashua Mills and the Jackson Mills, which fact resulted in the selection of a combination underground and submarine system of power transmission. Accordingly two 500,000-cm. 3-conductor sector-shaped 13,000-volt cables were installed underground from the West substation to a point on the river-bank wall in the Nashua Mills' yard, where a small cable terminal house was built. The underground lines connect through disconnecting switches with a short section of uncovered buses in this building, which projects 15 in. over the river wall. Taps from the end of the overhead buses connect through potheads with two submarine cables.

These cables are 3-conductor, 0000, 15,000-volt armored cables 3½ in. diameter. They rest directly on the river bottom and run for a distance of approximately 1,500 ft. to the Jackson dam. They leave the river at this point on the opposite side from the hydro station and terminate in potheads carried on two wooden poles which mark the beginning of the overhead lines leading to the Jackson substation.

The installation of the cables was effected in the

REINFORCED-CONCRETE POSTS USED FOR WEST SUBSTATION

winter of 1919-1920. They were laid on the ice in the location desired and properly spliced. The ice was then sawed through and the cables allowed to sink to the bottom.

Power-House Equipment.—The Jackson station was designed to utilize the increased 10-hr. flow of the Nashua River which will result from the additional pondage to be developed at Mine Falls. The station will have an ultimate capacity of 4,200 hp., derived from three units. Only two of these units are installed at present, the third to be installed upon the completion of the Mine Falls project. Each unit consists of a 1,400-hp. S. Morgan Smith open-flume-type vertical wheel directly connected to an 880-kw., 2,300-volt, 60-cycle, 3-phase General Electric generator, operating at a speed of 100 r.p.m. Each unit is equipped with a Woodward oil pressure governor and a belted exciter driven from the waterwheel shaft. Owing to the slow speed of the unit this method of excitation was found to be more economical than the direct-connected exciter. Power generated at 2,300 volts is stepped up to 13,000 volts through a bank of three 1,100-kva. transformers, located at one end of the station, whence it

DREDGE EMPTYING INTO MOTOR TRUCK IN TAILRACE EXCAVATION

is conducted to a bus structure located in a switch gallery over the transformer room. To this bus structure are connected two Type H, 13,000-volt switches, each of which is located in an outgoing line extending to the overhead transmission line on the opposite side of the river.

The map shows a general plan of the development. The work in general involved the construction of a forebay wall of the gravity type parallel to the railroad and varying from 20 to 34 ft. in height; the excavation and lining with concrete of a forebay whose depth below normal water level increased from 7 ft. at the entrance to 21 ft. in front of the racks; the construction of a power house upon a rock foundation, and the excavation of a tailrace 1,000 ft. long.

As the Jackson Mills obtained its condensing and fire protection water from the old canal it was necessary to maintain this canal in operation as long as possible without seriously affecting the progress or cost of the work at the new power-house site. Excavation was, therefore, carried on behind the old canal wall running from the north abutment of the dam to the railroad right-of-way until the danger of a serious leak developing through the wall became a menace. The excavated material consisted of sandy loam overlying coarse gravel interspersed with large boulders. A ¾-yd. shovel dug the material, which was hauled away at first by teams and later, as the depth of the excavation increased, by five-ton trucks. The spoil was used in filling in a wasteway channel near the site of the work, in grading for a sidetrack, and later on in filling the old canal.

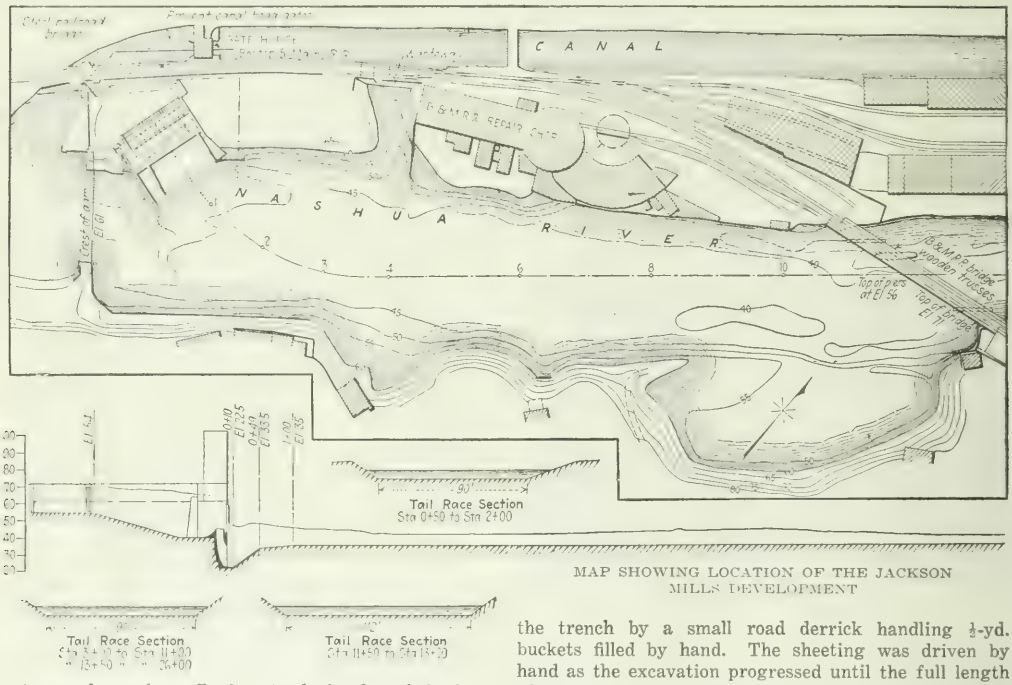
[illegible]

The final plans for furnishing condenser and fire-protection water to the Jackson Mills called for a 30-in. cast-iron pipe line 1,500 ft. long extending from an intake chamber in the new forebay wall along a trench in the bottom of the old canal to a pump sump in the mill yard. By the time it became necessary to close the canal this pipe material was on the job. Closing was first effected by the stop logs and gates of the old gate house which was located across the canal about 150 ft. from its flaring entrance. As soon as the waste gate a the lower end had drained the canal work was immediately started in that portion of the pipe line below the gate house and rushed to completion. Simultaneously with the closing of the canal gates work on the cofferdam to drain the whole forebay site was started, and brought to completion by the time the pipe line below the head gates was finished. Work was then concentrated upon the intake chamber, adjacent portions of the forebay wall, and the remainder of the pipe line to connect the intake chamber with the completed portion of the line below the old gate house. A temporary wooden flume was built leading from an opening through the cofferdam to the intake chamber and the pipe line put into service at the earliest possible moment.

Construction of Power House.—The cofferdam finally constructed across the old canal entrance and tying into the north abutment of the dam consisted of a skeleton framework of 6 x 6-in. wales, 2 x 10-in. uprights and cross-braces, and $\frac{7}{8}$-in. tierods. The wales were spaced about 4 ft. apart vertically, with horizontal tierods on 5 ft. centers and uprights cross-braced every 15 ft. Eighteen-foot wales were used with diagonal lap joints. A tierod and cross-brace came at each joint, thus making the skeleton continuous and flexible. The framework was erected on a raft and as each section was finished the raft was pushed out from under. The cofferdam was filled with material taken from the power-house excavation and used as found with the exception that any large boulders were excluded. The side sheeting was simply placed in the framework and lightly nailed to the wales just ahead of the fill. Motor trucks filled the whole cofferdam by forming a ramp at the shore end and backing out over the finished fill.

Owing to the proximity of the railroad tracks excavation for about 100 ft. of the deepest portion of the forebay wall had to be carried down within well-braced sheeting. Three-inch sheeting and 12 x 12-in. wales and bracing were used. Material was removed from the trench by a small road derrick handling $\frac{1}{2}$-yd. buckets filled by hand. The sheeting was driven by hand as the excavation progressed until the full length of the sheeting was used. Below this point the method of sheeting was as follows: A short section of the trench was excavated to a further depth of 5 ft., which was the distance between horizontal wales and a new system of wales and braces started. Five-foot lengths of sheeting were then tucked in behind the wales. The deepest portion of the trench obtained a depth of 25 ft. in this manner.

As soon as a section of the excavation was completed concreting was started and carried up in 5-ft. lifts. The bracing and wales were removed as the concreting progressed. The sheeting served as a back form on one side of the wall, while a proper batter was given to the front side of the wall by panel forms braced and wired to correct position against the front sheeting. While the wall was being built the power-house and forebay excavation continued, care being taken to leave a sufficient shoulder between the deep trench and the open excavation to take care of any thrust that might be transmitted through the bracing from the railroad side of the trench. With the completion of the



MAP SHOWING LOCATION OF THE JACKSON MILLS DEVELOPMENT

wall this shoulder was subsequently removed by the steam shovel.

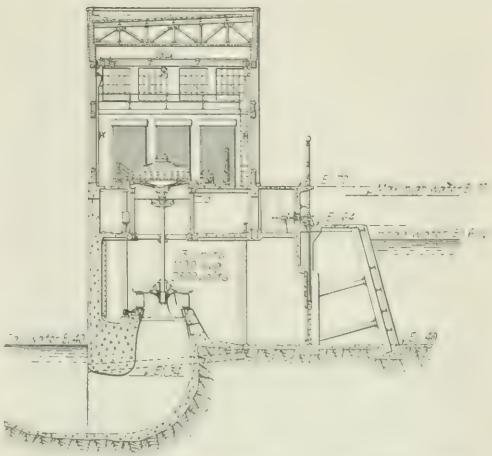
The power-house foundations were on ledge throughout, rock being encountered at from 2 to 5 ft. below the grade of the wheel chamber floors. The excavation for the draft tubes extended 15 ft. farther into the rock. Drilling and blasting was performed by a night shift and the mucking was done in the day time. The muck was removed by the steam shovel and dumped into skips. These skips were picked up by a stiff-leg derrick and emptied into trucks which hauled the material to the dump.

The draft-tube forms were built at a point about 100 yd. from the power-house site. The ribs were built from patterns drawn on a laying-out platform and accurately assembled in place in the skeleton framework by the use of longitudinal templates. Seven-eight-inch lagging was used, varying in width from ½ in. to 6 in. The forms were moved on skids and rollers to the edge of the excavation, whence they were picked up and swung into position by a stiff-leg derrick especially guyed and counterweighted for the purpose.

The concreting plant for the whole job consisted of one ¾-yd. mixer located under sand and gravel bins. The bins were served by a stiff-leg derrick equipped with a clamshell bucket which took the material directly from cars on the railroad siding or from the stockpile. Concrete was placed in the lower portions of the work by chutes suspended from a wire cable spanning the site. Side chutes conducted the concrete directly into forms or into buckets, which were then placed by a stiff-leg derrick. When the pouring had progressed to such a height that sufficient grade could not be maintained in the chutes the concrete was placed by buggies from runways.

Design of Power House.—A few features influencing the design of the power house, a cross-section through which, given herewith, may be worth mentioning. An unusual depth of water seal was provided for the draft tubes to make certain that should it become commercially desirable in the future to develop the few remaining feet of fall in the Nashua River near its confluence with the Merrimack by further dredging of the channel the seal would still be sufficient for the proper operation of the draft tubes.

A basement in the power house was found necessary to provide space for a heating plant, machine shop, storage-battery room, toilet facilities, etc. To have this basement floor above maximum high-water level would not only increase the cost but make the generator floor at an undesirable level. It was therefore decided to make the basement floor only 18 in. above normal head-water level and provide for uplift. This led to the adoption of structural steel framing for the generator and basement floors, and two trusses to run longitudinally through the basement. The generator and wheel loads, water thrust, and all other generator floor loads are carried on the top chord panel points, while the basement floor loads and uplift are carried on the bottom chord panel points. Proper rigidity and freedom from vibration was provided for by assuming the full load of generator, turbine and thrust to be concentrated at a single point of generator support at one time and designing the truss members accordingly. The wheel pit openings in the basement floor were closed by removable structural steel diaphragms provided with stuffing boxes in which the turbine shaft rotated.



CROSS-SECTION THROUGH THE JACKSON STATION

This consideration of having the basement floor well below maximum high-water level necessitated providing a water-tight wall on the forebay side of the basement. This was accomplished by the use of stuffing boxes on the shafts running through the wall to connect the main-line shaft of the headgate operating mechanism within the basement to the screw-stem-gate hoists located in the raking platform outside.

The excavation of the tailrace offered unusual difficulties, which, however, were successfully solved. The river below the dam flowed between high banks about 175 ft. apart. The normal channel followed the right bank, while an overflow channel followed the left bank, leaving a long narrow island covered with trees and undergrowth between the two and extending to the Boston and Maine R.R. bridge, which crossed the river about 1,000 ft. below the power-house site. The original plans called for widening and deepening the river channel for some distance beyond this bridge in order to develop the same head for the new station that the old wheels operated under. The consummation of the original plans would have involved the expenditure of a considerable sum of money on the piers and temporary bents which had been installed in the river bed to bolster up the rapidly deteriorating superstructure of the bridge, most of which would be thrown away upon the erection of a new bridge. As it is only a matter of a few years before the old structure will have to be replaced it was decided to postpone all work under and below this point until such time as the railroad is ready to carry out its replacement plans.

Building Tailrace.—Test pits and wash borings indicated that under the surface layer of boulders and river shingle the material was coarse sand and gravel. Two traveling stiff-leg derricks were accordingly installed and equipped with clamshell buckets, one working down-stream and one working up-stream. The narrow island along the middle of the river bed was especially favorable to this type of equipment and enabled the material to be deposited directly on each side of the river.

After the commencement of digging operation it became evident that the rate of progress would be in-

sufficient to complete the tailrace excavation by the time the power house was ready. A new type of equipment was therefore devised. A scow 40 ft. long and 27 ft. wide was built and launched in the deepest portion of the river and equipped with holding spuds in each corner. Upon one end of the deck was mounted a swinging and hoisting engine and 100-hp. boiler, while at the other was installed a bull wheel, A-frame, steam-shovel boom and dipper stick equipped with a ¾-yd. dipper. Later an additional boiler was added and the boom lengthened 8 ft.

This miniature dredge was successful from the start. It started operation at a point 400 ft. below the power house and traveled downstream, excavating a channel 30 ft. wide and to the full depth required along the right bank and depositing the material directly along the side. It then crossed over immediately upstream from the railroad bridge and excavated a similar channel along the left bank working upstream and depositing the material outside the channel as before. It was then floated back downstream and attacked the mid-portion of the channel. The material excavated from this mid-portion was deposited by the dipper into scale pans, which were picked up by one of the traveling stiff-leg derricks and swung over to the spoil bank on the right-hand side of the river. A view of this operation is given.

The stiff-leg derrick was mounted on three sets of wheels, one set under the mast and a set under each weight box. The wheels traveled on two lines of railroad rail and ties, one line of rail for the wheels under the mast and the other for the wheels under the weight boxes. When it was necessary to move ahead, a 30-ft. section of rail at the rear was unbolted, picked up by the boom with all ties attached and swung ahead into position and bolted up. The roadbed was prepared in advance by dumping an occasional scale pan load where needed instead of on the spoil bank. The derrick would then use the boom to pull itself ahead. In this manner 600 ft. of the tailrace was excavated. The downstream tailrace derrick was then dismantled and removed.

Meanwhile the excavation had so lowered the water level in the river that the water occupied only a narrow channel along the right bank from the dam down to the completed portion of the tailrace. This fact enabled the steam shovel which had completed the draft-tube and seal-pit excavation, to atack the tailrace at the upper end, working in the dry. The upstream tailrace derrick which had been handling the muck from the draft tube and seal pits continued to work with the shovel and dumped the scale pans directly upon spoil banks along the left-hand side of the tailrace.

The dredge then proceeded to excavate the narrow channel toward the dam to grade. A natural dike or roadway was left between the dredge operations and the steam-shovel operations. This dike extended from behind the upstream tailrace retaining wall connecting with the power house, paralleled the narrowed river channel and then swung over to the left bank. Motor trucks backing out along this dike, as shown in one of the views, removed the material excavated by the dredge.

By the time the dredge had proceeded far enough upstream the steam shovel had completed its operations behind the dike and climbed out of the hole. The pumps which had kept down the seepage were then stopped and the water allowed to rise behind the dike. The dredge then cut through the upper end and with the aid of motor trucks completed the tailrace excavation by removing the dike.

The depth of the tailrace excavation varied from 12 ft. at the upper end to 6 ft. at the lower. In all, 40,000 yd. were removed from the tailrace channel at a cost, including contractor's overhead and profit, of $1.78 per cu.yd.

The last feature of the project was the removal of the forebay cofferdam. Preparatory to this removal a stiff-leg derrick was erected on wooden piers in the forebay behind the cofferdam with the mast located so that all portions of the cofferdam came within the working range of the boom. The tops of the wood frame piers under the mast and weight boxes were well above normal water level. A platform was built over the top of the 30-in. pipe intake walls, upo nwhich were installed the derrick engine and boiler. The derrick was then rigged to operate a ¾-yd. clamshell bucket.

The forebay was filled through the opening in the cofferdam which supplied water to the flume running to the 30-in. pipe intake chamber. This flume was removed and the power-house gates closed preparatory to filling, and as the water rose the cofferdam framework was loosened as much as possible by removing the wales from the forebay side. After filling was completed the cofferdam material was cleaned out as much as possible, with clamshell buckets, and deposited by the derrick behind the forebay wall for back fill, and the balance taken to the dump by motor trucks.

Special precautions were taken at all times to guard against high-water damage or breaks through the cofferdam during construction. Any lowering of the water level above the dam would have broken the seal of the draft tubes of the Nashua Mills' wheels and deprived them of considerable power. No serious trouble was encountered.

The concrete work was performed by the Raymond Concrete Pile Co. in accordance with the designs and under the supervision of John A. Stevens, engineer, Lowell, Mass.

Log Rules Found Inaccurate in Mill Check

A comparison of log gagings by both the Doyle and the Scribner rules recently carried out for the Forest Products laboratory on a large sawing of red and white oak at Proctor, Ark., showed that both the rules are quite inaccurate. On small logs, up to about 20 in. diameter, both rules were well below the actual yield of the mill, by amounts ranging from 15 to over 30 per cent. The Doyle rule here gave the larger deficiency. At 22 to 24 in. diameter the yield of the white oak logs agreed fairly closely with both rules, but the red oak yield was still more than 15 per cent in excess of the rules. Approaching 30-in. diameter, the agreement of the rules with the red oak yield was fairly satisfactory, especially with the Scribner rule, which falls somewhat below the Doyle rule at about 28 in. in diameter. The sawing was one in a band mill. The red oak was plain-sawed, except in the case of the last quarter of exceptionally good logs, which were quarter-sawed; the white oak logs were in general plain-sawed up to 22 and 24 in., larger logs being quarter-sawed. Most of the sawing was to 1-in. stock.

Graphic Wattmeter Checks Gravity Plant Operation

Details of Distant Operations Indicated on Chart at Construction Engineer's Desk—Foremen Compete for Best Charts

IN PLACING 24,000 cu.yd. of concrete for a coke oven substructure at Milwaukee, Wis., the construction engineer checks every operation of a concrete gravity plant by means of a wattmeter graph which unrolls before his eyes. Delays, lack of co-ordination, underloading, plant defects and lagging work are positively indicated by the graph at the moment they occur and remedial action can be taken as promptly as the circumstances warrant. The graphic evidence when placed before the foreman curtails argument and excuses and sends them back to the job to obtain results. Besides the reason indicated, the construction is interesting because of its character and volume.

The old by-products coke ovens at the plant of the Milwaukee Coke & Gas Co. have been in operation over fifteen years. Last fall it was decided to replace these ovens with Koppers combination by-product ovens. As every available square foot of ground around the old batteries was used for operation and it was essential that the new work be done without interruption of the plant operation, the agreement was made that all engineering work and material be furnished by the Koppers Co. and the construction be performed by the engineering force of the Milwaukee Coke & Gas Co. In all 120 old ovens will be removed and replaced with 150 new ovens. This work has been scheduled so that 40 old ovens will be shut down at one time, these replaced by 50 new ovens and these ovens put in operation before the next set of 40 old ovens is shut down.

Many changes of railroad track, water, gas, steam and liquor piping, electrical wiring and pole lines had to be made before the first battery was shut down. When all the preliminary work had been accomplished, the first battery of 40 ovens was shut down and wrecking was commenced. About 700 tons of scrap iron were removed from this battery, loaded into railroad cars and sold direct to scrap dealers. The disposal of the old brickwork was accomplished by using railroad dump cars which were switched alongside the job and loaded with the help of one yard dump boxes and locomotive cranes, one on each side of the foundation. Fig. 1 shows the old concrete slab, dump boxes and locomotive crane in operation. In all 800 cu.yd. of concrete, 2,000 cu.yd. of dirt and 7,500 cu.yd. of brick were removed from the old battery.

The old concrete mat was on piles spaced 3 ft. on centers. These rows of [illegible] were driven along side the old slab and a new slab 30 in. thick was poured over the new piles and the old slab. On this the new concrete foundations for the battery were placed. A total of 1,150 cu.yd. of concrete were poured in this new slab.

There will be about 8,000 cu.yd. of concrete in each battery foundation and 230 tons of reinforcing steel. The foundation for the stack contains 360 cu.yd. of concrete, the stack being 200 ft. high and 8 ft. in diameter.

The concrete mixing plant, was designed by the company engineers in conjunction with the engineers of the Boehck-Lowe Machinery Co. which furnished the equipment consisting of a 120-ft. steel tower, a motor-driven hoisting engine, a 28-ft. tilting mixer, a 120-cu.yd. slag and a 40-cu.yd. sand storage bin which were loaded by a ten-ton, 40-ft. boom, locomotive crane.

FIG. 1 GRAVITY PLANT WITH STRUCTURE TENTED OVER TO PREVENT FREEZING

Blast furnace slag was used instead of stone due to the heat resisting qualities of the slag. Experiments have shown that stone gradually disintegrates from the high temperatures to which these foundations are subjected thus reducing the life of the concrete.

Cement was wheeled directly from box cars to the mixer floor which was sheeted and arranged to store 1,200 bags. Sand and slag ran by gravity from the storage bins to a batch hopper where the cement was added. In this way a batch was prepared for the mixer while the previous batch was still in the mixer. Water was admitted to the mixer from two barrels through a 4-in. supply line. One barrel was being filled and heated while the other was dumping. The heating was done by the injection of live steam. It was found possible to complete a batch in 40 seconds and the best day's run was 480 cu.yd. in nine hours. Due to the weather conditions and the necessity of covering up the green concrete 250 cu.yd. per day was taken as the average run; this permitted the changing of chutes and the covering

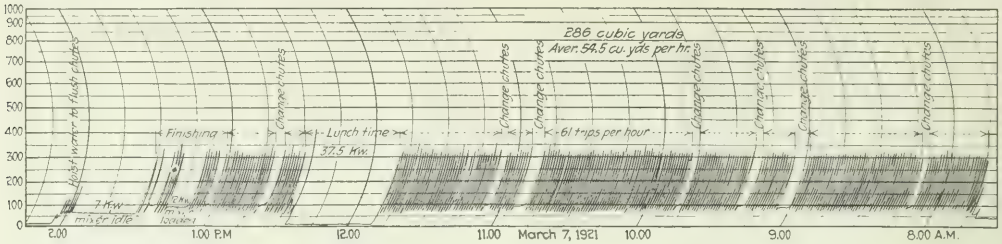


FIG. 2. WATTMETER CHART OF TYPICAL DAY'S OPERATION

up, as well as the actual pouring, to be done in an eight-hour day.

Fig. 1 shows the arrangement used to protect the concrete from frost. Steam lines were run alongside the forms and over the top where the concrete covered a large area. A canvas tent was then spread as shown. A man was left in charge who took temperatures at different places around the covered concrete and saw that at no time did the temperature at any point drop below 32 deg. F. All the concrete was handled in this way without freezing.

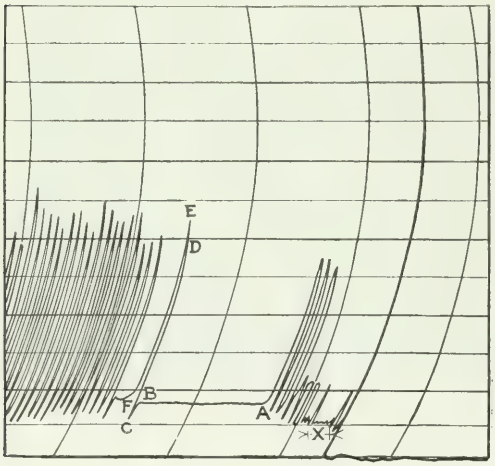


FIG. 3. DETAIL OF CHART ANALYZED TO INDICATE USE

The concrete gang consisted of one hoisting engineer, three cement handlers, two cement dumpers, one concrete mixer operator, one water tender, one tower man and seven men spreading the concrete and moving the chutes. One foreman was in charge of the whole gang.

As indicated by Fig. 1 the gravity plant was a standard boom type outfit. To follow the operation of this main plant unit, there was installed a graphic wattmeter with a 500-amp. shunt on a 250-volt circuit. The meter was placed close to the desk of the engineer in charge and enabled him to tell exactly how the concrete work was progressing at any minute of the day. One of the charts, a typical day's run, reproduced in Fig. 2, shows exactly how the work proceeded from the beginning at 7:30 a.m. until 1:30 p.m., at which time the day's pour of 286 cu.yd. was completed. It will be noticed that during one hour's run from 9:45 to 10:45 a.m., sixty-one trips were made representing 61 cu.yd. of concrete.

The smaller section of chart, Fig. 3, shows how the graphic record of the day's operation may be used. Thus, the section X shows the power consumed by the mixer and the hoist running idle; from *A* to *B* represents the power used with the mixer charged, and from *B* to *C* the drop in power when the mixer dumps into the hoist bucket. From *C* to *D* is shown the increase in power due to hoisting the load; from *D* to *E* the extra power for dumping the mix into the chute hopper, and from *E* to *F* the drop in power due to dropping the bucket. A light load can be immediately detected on the chart due to less power being consumed for hoisting. A defect in the dumping apparatus can be detected, the speed of operating the mixer and hoist can be determined and the actual number of trips made and the material used can be calculated. The engineer in charge can thus keep in constant touch with the operation of the plant and have graphic information to guide him in making changes toward producing greater efficiency.

The construction work is being done by J. Seton Gray and S. C. Peters, engineers for the Milwaukee Coke & Gas Co.

Railway Construction in Brazil in 1921

Because of the present transportation crisis throughout Brazil, the National Congress has authorized the government to construct new railway lines and to improve those already existing, the funds for the work to be secured by the ordinary federal revenue and by additional credit operations. According to the local press the present expense budget sets aside 2,000,000 milreis for the termination of the construction of the Sao Luiz to Caxias railway; 2,000,000 milreis for the prosecution of the construction on the Central of Piauhy; 1,700,000 milreis for the Petrolina to Therezina railway; 534,000 milreis for the Cruz Alta railway; 1,000,000 milreis for the Paranapanema Rio de Peixe line; 1,000,000 milreis for the Ararangua and Urussanga; and 1,500,000 milreis for the Mossoro railway, all for the account of the ordinary revenue receipts. For the constructions on the Great Western and the Rede Bahiana, bonds of the public debt will be emitted in accordance with the respective contracts.

Besides these expenditures, the budget is said to authorize the following expenses "for the account of credit operations or other extra resources": 2,000,000 milreis for the San Luiz to Caxias, intended for the large bridge connecting the island of Marahao to the continent; 1,000,000 mil--reis for the Central of Piauhy; 4,300,000 milreis for the Petrolina railway; 400,000 milreis for the Cruz Alta; 10,000,000 milreis for various lines of Rio Grande do Sul and the San Pedro de Alcantara to Uberaba; 900,000 milreis for the construction of the Central of Rio Grande do Norte; 3,000,000 milreis for a line from Massiaambu, in Santa Catharina; 4,000,000 milreis for the coal lines of Parana; 1,500,000 milreis for the Mossoro railway; and 2,000,000 milreis for the coal lines in Santa Catharina. These constructions reach the sum of 39,534,000 milreis.—*Commercial Attaché W. L. Schurz, Rio de Janeiro, Brazil, in Commerce Reports.*

Causes of the Economic Disturbances in England

By Ernest J. P. Benn
Of Benn Bros., Ltd., London

[*Mr. Benn's firm is the publisher of eleven technical and trade magazines. His article is an abstract of an address delivered last month before the New York Business Publishers Association.*—Editor.]

The thing that does not seem to be understood here (in America) is that we in England are absolutely steeped up to the neck in socialism. There are innumerable brands of it. You start with Bolshevism proper and work up to communism, collectivism, syndicalism, guild socialism, state socialism, and many other brands and varieties.

From the top to the bottom of society—and the more dangerous people are at the top, especially the women—these ideas have been absorbed: that business and profits and wealth are wrong. That sort of thing works its way out first in taxation which is, with us, not so much a matter of necessity as a matter of punishment for success. I understand you have an income tax. I have made a few inquiries about it and my impression is that you are infants in the early stages. You have no conception of the possibilities of this taxation business.

These ideas work out through the various branches of the labor organizations in such a way that it seems as if many of the workers have almost decided to do no work. This goes back to H. G. Wells, the man who is more responsible than any other. The fiction writers have a great deal of responsibility in the spread of propaganda for the simple reason that socialism has a sentimental touch which fiction loves.

But it is a mistake to suppose that our laboring class are actuated by any evil intent. I give them credit, full credit, for doing what most of them believe to be right. Their actions are due to a false conception of economics which starts upon the total fallacy that wealth is a fixed quantity; that there is a certain amount of money and work, and it is good business to prolong that business and make it afford work for three men where one was before. We must first eradicate false economics.

The Remedy

The remedy that is needful in our country is a big crusade on behalf of capitalism, capitalism properly understood. To begin with we need a synonym for "capitalism." It is a most unfortunate and misleading word. The word "capitalism" conveys to the minds of most people some system designed for the purpose of creating capitalists, individuals with great wealth, and in that sense it is an unfortunate word. We must drive it into the minds of our people that capitalism, the system of thrift, work and economy, is the only system which can care adequately for the lowliest. We must make it clear where we stand; that our faith in capitalism is due to our desire to benefit the whole community. And from that we must start out on a system of instruction in simple economics; simple economics, which, in our land at least, have long since been forgotten. Even our universities no longer teach the science of economics; the only thing that you can learn there is Sidney Webb-ics.

We must make it clear that capitalism is the only system in which the consumer stands a chance; that with socialism the producers stand as its logical end in rationing coupons, ques, and dictation from above or from below of the quantities and qualities and descriptions of comforts which we, as consumers, are to be permitted to enjoy. We must rub it home that there are four elements which are essential to successful industry and to successful civilization, and those *four elements are high profits, high wages, low prices and high production*; four elements which I commend to you, because I believe, if you will examine any instance in history of successful industrial enterprise, you will find those four elements always present.

We must come out and stand up boldly to justify profits; profits, like the magneto in a motor car, the one thing which through the ages has been the incentive to activity and the incentive to production. To suggest that civilization can continue without profits is in my humble judgment to suggest that which is totally false. You can no more carry on industry without profits than you can be born without a woman. In a free market the profit is the cheapest of the items that go to make up the cost of an article. Profits may be defined as a commission on economy, and no form of control in our old country yet discovered has proven half as economical as the most rapacious profiteer.

I do not want to give you the impression that I am too much of a reactionary. I am an individualist, but I combine with that a belief in organization, a belief in trade unionism, a belief in collectivism. But that makes me an optimist as to the future. We are passing through the early stages of collectivism misunderstood; collectivism misapplied. It is an error to suppose that collectivism and individualism are necessarily opposed to one another. The real sort of collectivism, the real sort of organization, is that which enables the individual to start from a higher plane.

If some of our reformers would put half the brains into the study of capitalism which they now waste in arguing about the unthinkable and proving the impossible they would find that the wisdom of the ages is not so mad as they imagine, and that there is still illimitable scope for the further good of all in thrift and work and economy.

In conclusion, may I say that I have painted a black picture of conditions in England, and I think it is a true picture of conditions as they exist at this moment. But it will come all right. It generally does come all right in our old country. We have a thing there of which we are immensely proud, an attribute that we call British common sense, and it has pulled us through many a crisis and it will pull us through this.

Fissured Rails

With increased experience in the detection of fissures in rails in the track the increasing number of fissured rails discovered has attracted attention to the potential danger of such defects. Investigations carried on for some time by Robert W. Hunt & Co., consulting engineers, Chicago, show that fissured rails discovered on various railways have been produced by various mills and subjected to widely differing traffic conditions, but detailed study of individual cases has failed to reveal any definite cause for the defects. Further study is thought to be desirable along the line of a comparative analysis of the numerous records already at hand, in an endeavor to find some common condition which may be a cause of fissures. The theory that fissures are due to stresses induced by excessive wheel loads does not appear to be fully supported by the evidence. Another theory is that they are due to abnormal conditions which occur without apparent reason during manufacture and which continue until discovered and corrected, thus affecting all rails of certain heats.

Next in importance to the prevention of fissures is their detection in the track. To assist in this the Hunt company has sent cards to roadmasters and other railway officers explaining the conditions, the signs of fissures and the necessity of close inspection to detect these signs. This company is also inviting such officers to inspect its collection of fissured and fractured rails. It has been pointed out that the action to be taken when a rail fissure is discovered in the track is a serious question, as all the rails of the same heat may be under suspicion. Removal of all these rails would be a drastic and expensive precaution, but the company urges that there should be a quite careful inspection of the other rails and frequent inspection (if not immediate removal) of such rails as show indications of fissures.

Wisconsin Experience with Day-Labor Road Construction

Fundamental Purpose of Force-Account Construction Was to Determine True Costs, the Records to Include All Base Cost Items of a Contractor's Estimate

By W. C. Buetow
Assistant Engineer, Wisconsin Highway Commission, Madison, Wis.

Last year the Wisconsin Highway Commission deemed it advisable to secure precise cost data on concrete road construction. Largely by arrangement with counties the Commission undertook several day-labor operations. The results justified the experiment financially, and also because of the practical information secured. The widespread interest exhibited in the experiment and the fact that the Commission will continue to conduct a certain amount of force-account construction each year led Engineering News-Record *to secure an authoritative account of the results obtained.*—Editor.

DAY-LABOR operations were undertaken in Wisconsin in 1920, either because no bids were received or because it was thought that the prices bid were too high. The recorded costs include all the items a contractor should include in his base figures of cost. The depreciation values used were arrivd at by a joint conference of Highway Commission representatives, county representatives, machinery men and contractors. They were used by the Commission in preparing estimates, and, presumably, by the contractors in preparing their bids. The percentages include not only depreciation but interest on investment, insurance, storage during idle times, and all repairs to the equipment. All percentages are applied on the original cost of the equipment.

Values were worked out on a basis of charging off certain percentages of the original cost per mile of 18-ft concrete pavement of the Wisconsin standard type, having a thickness of 8 in. at the center and 7 in. at the sides. For other widths and thicknesses it will be necessary to apply corrections to these values.

As an example of how the values were arrived at consider a paving mixer: It is assumed that the average paving mixer will build 30 miles of standard 18-ft. concrete pavement, at the end of which time it will be completely used up. The same depreciation would be obtained if we assumed that it would build 24 miles, at the end of which time it would have a salvage value of 20 per cent of the original cost. With the 30-mile figure, noted above, and an average mileage per year of 6 miles, the life of the mixer would be five years. The depreciation charge per mile then works out as follows:

	P. C. Orig Cost
Depreciation in five years	100
Repairs in 5 yrs. at 10 per cent per year.	50
Interest, storage and insurance over five years, at 6 per cent per year	30
Total charge for thirty miles	180
Charge per mile	6

Charges for grading machinery and hauling equipment, such as trucks and industrial railway, are percentages of the original cost per operating day. The percentages will vary with the kind of equipment used, the condition under which it is used, the number of earning or operating days per year, etc., but the proper percentages to charge will usually be betwen ¼ per cent and ½ per cent of the original cost per operating day.

The following is a list of the equipment used on the different jobs and the percentages of depreciation charged:

Item	P. C. per Mile
Camp and camp equipment	8
Pit equipment, crushers, etc	3
Bins, etc	7
Belt conveyors	12
12-ton road roller	2
Unloading equipment	4
Paver	6
Stationary paver	5
Pump and pipe line	6
Hose	20
Steel forms	12
Wood forms	27
Finishing machine	7
Hand concrete surface roller	20
Cement covers	10
Wheel barrows	16
Shovels	50

Cost data are valuable only when accompanied by a description of the methods used and of the conditions under which the costs were incurred. Table I is a comparison of the day-labor cost with the low bid received on each job and Table II shows unit costs on the day-labor work. Comment on the tables follows the descriptions of the separate operations.

Neenah-Oshkosh Road

When completed the Neenah-Oshkosh project will consist of 6.27 miles of Federal aid and 2 miles of state aid work or a total of 8.27 miles. Work was begun at the north end at Sta. 0 and carried as far south as Sta. 204, or 3.86 miles, which represents the 1920 work. Grading and paving operations stopped at the same point, so the road was in fine shape for travel during the winter.

Grading operations began about May 1, but ceased for a month during the summer as there was some doubt about getting aggregates for the concrete work. All excavation was with teams, using No. 2 wheeled scrapers. The roadbed was broken by a rooter and then loosed by plowing, teams being used for power in practically all cases. On the whole the cuts were shallow and the hauls were exceedingly long for this kind of equipment. In order to provide a suitable place to deposit the aggregates for paving the subgrade was excavated level to the interurban tracks and all excess yardage was dumped on the east side of the road.

Grading ahead of the mixer consumed 84 days and shouldering and ditching, after paving operations were completed, 34 days, or a total of 118 days for the grading operations for the season. The total yardage moved in that time was 12,453 cu.yd., at a cost of $1.45 per cubic yard. The shouldering cost 20.5c. per lineal foot of pavement. Teams were hired locally at $9 per 10-hour day. A portable barn was erected for stabling purposes and a camp was run for the grading crew only. All other crews were furnished transportation to and

from Oshkosh, Government light aviation trucks being used for that purpose.

The culvert work was principally patch work, consisting of lengthening existing structures or repairing broken end walls, and most of the culverts were placed with special drop inlets on the track side, where the center line of the road was so close to the track that an end wall if built would interfere with the interurban snow plow, which requires 5 ft. clearance outside the rail. No regular culvert crew was maintained, but men were used whenever they could be spared from other work.

Paving Operations

Paving operations were delayed until late in the summer, due to the delay in the early part of the season in getting a siding from the railway. Later in the season paving operations were not begun because of the embargo on freight cars used for hauling road materials. The Eastern Wisconsin Electric interurban line, operating between Neenah and Oshkosh, extends the full length of the project and was very favorably located for hauling materials.

At Sta. 383 the C. & N. W. Ry. cutoff to Medina Junction crosses the project at right angles to the highway. A double-end siding 1,100 ft. long, costing $2,377, was laid just west of the road. At the extreme west end of this siding a cement shed having a storage capacity of three cars was built to take care of large shipments of cement that could not be hauled directly to the road for immediate use. Material was unloaded from the railroad cars directly into 12-cu.yd. side-dump cars stationed on the E. W. E. Co. spur track, which paralleled the railroad siding. A caterpillar crane using a ½-cu.yd. bucket unloaded the material. It was not found necessary to stockpile any of the shipped-in material, as it could be hauled to the job as quickly as it was unloaded. The average haul for the season was 5.32 miles. The material was hauled to the road by the interurban work car, drawing four 12-yd. dump cars to the train. By stripping the lock on the dump cars the materials were deposited on the subgrade automatically without the use of air by having the load slightly overbalanced toward the road. When the subgrade was lower than the track the material when dumped cleared the rail of the interurban track so as not to interfere with traffic of passing interurban cars, but whenever the subgrade was higher than the track it was necessary to shovel the material away from the rail. This necessitated two men constantly to clear the track as quickly as possible.

All material was shoveled from the subgrade and wheeled to a four-sack paver. Four-sack or three sack batches were mixed according to the size of the crew. When deposited the concrete was leveled, struck off and tamped with a screed, then rolled, belted and finished by hand. The pavement was cured and covered in the usual way. When men were available two or three men covered the pavement, otherwise the whole crew covered each morning. The water supply was obtained from local wells and was pumped to the road through a 2-in. pipe line. Transverse joints were placed every 50 ft. Practically all of the cement was trucked from the railroad cars to storage, then rehandled and hauled to the job, either by truck or trolley. While this rehandling was expensive, it assured continuous operation with no delays waiting for cement.

The paving crew began to pour concrete July 21 and completed the work Oct. 4. During that time there was a total loss of five days due to rain, one day due to lack of labor and one day taken off for the County Fair. The total number of working days spent in paving, counting all fractional days as full days, was 57. The average amount of pavement laid for each of these days was 358 lin.ft., or 716 sq.yd. From Sept. 8 to Oct. 4 the pavement was completed from 118 + 44 to 204, an average of 428 lin.ft., or 856 sq.yd., per day. The maximum run for one day of 10 hours was 528 ft., or 1,044 sq.yd. The pavement was 18 ft. wide, 7 in. thick on the side, 8 in. in the center and of 1:2:3½ concrete.

The labor organization is shown below with the wages that were paid at the close of the season.

	Rate Per Day
Unloading and Hauling Aggregates	
1 clamshell operator	$7 50
2 men cleaning up cars and moving them to clamshell	6 00
1 man leveling dump cars	6 00
2 men spotting material and keeping material away from electric line to give clearance to interurban cars	6 00
Cement	
Three trucks were used to haul cement, driver and one man on each truck	6 50
When electric line was used to haul cement, trucks were idle and drivers and helpers handled cement	6 50
Mixer	
16-20 men shoveling and wheeling material into mixer (usually there were 5 men on sand, the rest were on stone)	6 00
3 men on subgrade	6 00
2 form-setters	13 00
1 mixer operator	7 00
1 mixer fireman	6 25
1 mixer dumper	6.25
2 puddlers	6 00
2 on strike board	6 00
1 finisher	6 50
1 pump man	6 00
1 water boy	2 50
1 man wetting concrete	4 50
When available 2 to 3 men covered the concrete with earth, otherwise the whole crew covered each morning	6 00
General	
1 team with driver and extra man kept subgrade ahead of mixer in shape with small grader; also hauled the forms ahead each day and did other small jobs	15 00
Superintendent was in direct charge of paving operations, per month	200 00

The total yardage moved in grading was 12,453. Grading operations consumed 84 days grading ahead of the mixer and 34 days shouldering, a total of 118 days. The organization was as follows:

	Rate Per Day
Foreman in charge of grading, month	$175 00
2 men holding wheels	5 00
2 men dumping wheels	5 00
2 men staking ahead or trimming behind other operations	5 00
1 man driving grader	5 00
2 plow teams	9 00
1 patch team	9 00
6 to 10 teams on scraper, depending on length of haul	9 00

Milwaukee-Fond du Lac Road

In Washington County the day-labor operations were a continuation of the concrete road from Germantown north on Route 15, toward Jackson. The total length of pavement laid during the season was 3.77 miles. Contracts were let for bridge and culvert work and for hauling the materials, but the production of the aggregates, the grading and the paving were by day labor.

Aggregates were produced in a pit about one mile north of Jackson. The material was excavated with a stiff-leg derrick and clamshell and loaded into small dump cars which were drawn up a trestle, by a hoist and cable, to the screens. The material was washed and separated to proper sizes, the small amount of oversize stone being discarded. It was hauled to the road by trucks and dumped in stockpiles on the subgrade. The average haul was 7.5 miles.

During paving the material was shoveled from the subgrade and wheeled to a four-sack paver. The concrete when placed was struck off to the proper crown by a screed, and the surface was rolled and finished

by hand. The pavement was then covered with earth and wetted thoroughly until properly cured. The slab was 18 ft. wide, 7 in. and 8 in. thick and of a 1:2:3½ concrete. Joints were placed every 50 ft. The grading was made difficult because of the number of large boulders in the subgrade and ditches. Also the subgrade was of such a nature in low places that it was difficult to haul materials over it. The organization for the work was as follows:

Grading:	Rate per Day
1 foreman	$7 50
1 man on dump	6.50
1 man loading	6.50
1 hoist engineer	6.00
5 teamsters on wheelers	5.00
2 plow teamsters	5.00
3 men on dump	5 00
1 man on cable	5 00
1 cook	5.00
1 helper	3 00
1 water boy	2.00
7 teams	5.50
1 horse on cable	2 75

Note—Board, cost $1.67 per day, added to above rates.

Pit Operations:	
1 foreman at pit, per month	$250 00
1 derrick operator, per month	250 00
1 hoist engineer on trestle	7.50
1 pump man	6.50
1 man dumping cars	6.00
1 man tending hopper	6.00
1 man spotting cars	6.50
1 man tending sand hopper	6.50
1 traction engine and man, per hour	1.60

Note—Board was not furnished to this crew.

Paving:	
16 men shoveling or wheeling	$5.00
2 men handling cement	6.00
3 men on grade	5.00
3 puddlers	5.50
1 strike board man	5.50
1 strike board man	7.00
1 mixer operator	9.00
1 form setter	10 00
1 form helper	5.00
1 cook	6.00
2 flunkies	5.00
1 water boy	2.50
Foreman, per month	300 00
1 Finisher	9.00

Note—Board, cost $1.67 per day, added to above rates.

Janesville-Edgerton Road

A central mixing plant was used. Good gravel deposits were located along the project at convenient points just off the highway. The first section of the road, 9,080 ft. in length, was completed from the first set-up opposite Sta. 68. Weather conditions shut down the work after 6,751 were laid from the second set-up.

Materials were excavated with a power scraper operated by a hoist and cable. A jaw crusher reduced the oversize gravel to proper size, the fine material passing through a grizzly directly to the elevator. The bins were designed to be knocked down and re-erected at the various pits. A five-sack stationary mixer was placed directly in front of and lower than the bins so that the mixer could be charged by gravity. An industrial railway hauled the mixed concrete from the plant to the road. A train, composed of three cars, two five-sack batch boxes per car, was hauled by a three-ton gasoline locomotive. Three trains were used. The boxes were lifted from the cars by a road crane on the subgrade. After dumping the batch box was cleaned out by compressed air. A finishing machine was used on the entire work. The first section had a joint every 50 ft., but the second section was built without joints. On account of the stony nature of the excavation straw was used to cover the concrete. The curing was done in the usual way, by wetting thoroughly for a period of two weeks.

At the second set-up a steep grade leading from the pit required the assistance of a pusher engine to get a train load to the road. Each engine in turn spotted its train of empties at the mixer and acted as a pusher to the train ahead. One pump was not capable of furnishing enough water pressure for the mixer and also for curing purposes, so an additional pump was placed in the line. The pit layout at the second set-up, which furnished material for the road from 108 + 49 to 176, was by far the better of the two and an additional feature was elevating the cement to the hopper of the mixer by a belt conveyor. The cement was emptied into a hopper at the cement platform. At both pits there was a large excess of sand and a man and team were employed to haul this sand to a waste pile.

The grading was contracted at $1.10 for the rough grading ahead of the mixer. The shouldering was done by day labor and cost $0.20 per linear foot for both sides. The culverts were built by contract.

The record run of the year for the job was 504 lin.ft., and the average for the season was 510 sq.yd. per operating day. The average haul was 0.65 miles. The organization was as follows:

Pit	Rate Per Day
Pit foreman	$9 00
Hoist operator	6 00
2 men on crusher	6 00
1 pit man	6 00
1 traction engine operator	6 00
1 team hauling waste sand	10.00
1 man driving team	6 00
2 men in sand bin	6.00
Paving	
3 truck drivers (cement)	6 00
3 truck helpers	6.00
2 pump men	6.00
1 man on service car	5.00
1 man in charge of locomotives	7 00
2 dinky drivers	6.00
1 crane operator	7.00
1 mixer operator	7.00
2 men handling cement	7.00
1 mixer fireman	6.00
1 mixer dumper	6.00
1 sack baler	6 00
1 man on finishing machine	6 00
3 puddlers	7.00
1 man dumping batch boxes	7.00
1 man cleaning and taking off forms	6.00
2 form setters	6 00
2 men on grade	6 00
1 finisher	6 00
1 team	10 00
Extra man with team	6.00
Boy wetting concrete	3.50
Engineer on job, per month	200 00
Timekeeper and purchasing agent, per month	200 00

Discussion of Tables

A few words in explanation of the unit costs shown in Tables I and II are desirable:

Neenah-Oshkosh Road.—The cuts were light and the hauls were too long for No. 2 wheelers, which were used on this work. On account of the interurban track lying so close to the roadbed and to facilitate dumping the aggregates from the 12-yd. dump cars the shoulder material had to be placed on the far side in order to leave the subgrade alongside the track perfectly clear.

The culvert cost really cannot be compared with the low bid price, which was for standard culverts, as shown on the original plans. As stated in the history of the job, the end of the culverts next to the track had to have special inlets. This necessitated intricate forming and excavation for a small yardage of concrete. Had the work been done by contract a special agreement would have been entered into to take care of this special work.

In addition to this, had there been a crew organized and kept continuously on this work the labor and over-

TABLE I. COMPARISON OF DAY LABOR COSTS WITH LOW BIDS

	Winnebago County Neenah—Oshkosh Road				Washington County Milwaukee—Fond du Lac Road				Rock County Janesville—Edgerton Road			
Item	Quantity	Cost	Day Labor	Low Bid	Quantity	Cost	Day Labor	Low Bid	Quantity	Cost	Day Labor	Low Bid
Grading	12,453 c.y.	$1.45	$18,063	$1.25	17,194 c.y.	$1.43	$24,633	$1.22	$20,976	12,859 c.y.	$1.346	$17,319	$1.25	$16,073
Culvert	112 c.y.	41.62	4,661	25.00	115 c.y.	27.00	3,105	25.00	2,875	164.78 c.y.	19.38	3,194	29.40	4,844
Paving	40,842 s.y.	2.42	98,923	3.02	39,775 s.y.	2.80	111,411	3.08	122,507	31,627 s.y.	2.08	65,915	2.65	83,812
Total			$121,647				$139,149		$146,358			$86,428		$104,729
Total per mile			$31,515	$36,712			$36,809		$38,821			$28,809		$34,909
Total saving			20,062				7,209					18,301		.....
Saving per mile			5,197	.....			1,912					6,100		....
Saving paving only			24,419				11,096					17,896		.....
Total per mile paving only			25,627	31,954			29,551		32,495			21,971		27,937
Saving per mile			6,326				2,943					5,965		.....
Miles of road built			3.86				3.77					3.00		.....

The above day labor figures do not include the items of taxes, bond and liability insurance. A contractor must add these values to his base price. For the Neenah-Oshkosh work these items amount to 3.89% of the grading cost, 2.40% of the culvert cost and 2.41% of the paving cost. For the Milwaukee-Fond du Lac work the percentages are 3.95% of the grading cost and 2.73% of the paving cost. For the Janesville-Edgerton work the percentage is 4.32% of the paving cost.

TABLE II. UNIT COSTS OF FORCE ACCOUNT ROAD CONSTRUCTION IN WISCONSIN

	Winnebago County Neenah—Oshkosh Road				Washington County Milwaukee—Fond du Lac Road				Rock County Janesville—Edgerton Road			
	Yardage	Cost per Cu.Yd.	Cost per Sq.Yd.	Total Cost	Yardage	Cost per Cu.Yd.	Cost per Sq.Yd.	Total Cost	Yardage	Cost per Cu.Yd.	Cost per Sq.Yd.	Total Cost
Right of way				$100.00				$7,727				$219
Culverts	160 c.y.	$41.62		$6,659	181.8 c.y. 133.0 c.y.	$27.00 31.58+	..... (Bridge)	4,908 4,200	164.78 c.y.	$19.38		3,194
							extras	366				.....
Grading	12,453 c.y.	$1.45		$18,062	17,194 c.y.	$1.43		$24,633	12,859 c.y.	$1.346		17,319
Paving	40,842 s.y.				39,775 s.y.	....			31,627 s.y.			
Material in bin or siding	(Siding)	$2.30	$0.674	$27,507	(Bin)	$1.44	$0.515	20,623	(Bin)	$1.49	$0.43	13,586
Cost of unloading	11,748 c.y.	0.31	089	3,642								
Cost of siding		099	234	9,575								..
Cost of hauling	.....	716				1.67	60	23,884				
Mixing and placing			469	19,144			796	31,638			0.832	26,309
Cement-storage-hauling	13,711 bbl.	$2.81 bbl.	944	38,559	12,836 bbl.	2.73 bbl.	882	35,067	9,862 bbl.	2.63 bbl.	.822	25,990
Contingencies			012	496			005	198			001	30
Total			$2.422	$98,923	Total		$2.798	$111,410	Total		$2.085	$65,915
Sack loss per sq.yd. (included under cement)			$0.0016				$0.0019				$0.0015	

head could have been materially reduced. The culvert crews acted as a replacement division and furnished men temporarily for other work during the period of uncertain rail deliveries.

Milwaukee-Fond du Lac Road.—On this job the grading operation shows a loss. This part of the state is densely settled and the fence lines are close together. This feature made it very difficult to get shoulder material and to dispose of the large amount of big boulders encountered.

The paving operations on this road were rather a disappointment. The county men in charge set a 300-ft. mark as the day's operation. No matter what time of the day this mark was reached the crew was done. His idea was that the crew would "get to going good" sooner after paving operations started and have some object in view to push the work. The mark was set altogether too low and the costs show it. The wages paid were higher than were absolutely necessary to secure and keep the labor.

Janesville-Edgerton Road.—There were no unusual conditions encountered on this work. The rough grading was done by contract and the shouldering by day labor.

On the culvert work the county furnished the cement and steel and contracted for the balance. In Table II the unit cost of aggregates in the bin for the Washington and Rock County operation is based on the yardage actually hauled and does not include the material wasted at the pit. The waste in the Washington County pit was quite small and consisted of large stones only. The amount was not sufficient to warrant a crusher operation. In the Rock County pits the sand content ran quite high and necessitated the handling of a large yardage in waste

Concrete Roads in London

(London Correspondence)

In all, about seventy concrete roads are in use in this country, the majority of which are successful. In the cases of those roads which are not it is the general opinion of the Ministry of Transport that failure is due rather to bad workmanship than to faulty design or material. There is no doubt that road and concrete machinery will eliminate most of these failures.

Concrete as a road surface material is being used extensively in and about London. One south London borough, for instance, has reconstructed as many as twenty-five of its roads during the past two years with concrete and is about to begin on another fifteen. Macadam material, when removed from the road surface, is passed through a washing and grading machine to form the aggregate for the new concrete road.

The new north circular road will be 100 ft. wide over all, made up as follows: 16-ft. footway, 24-ft. roadway, 20 ft. to be reserved possibly for a tramway or high-speed traffic, 24-ft. roadway, 16-ft. footway. At first only one section of this road, the first 24-ft. roadway, is to be constructed. On this section the roadway will be of two layers, 1 bottom course of 5 in. will be of concrete 6:1, the aggregate to pass through a 2-in. seive but to be retained on ⅜ in. The top course, of 3 in., is to be of concrete 3:1 aggregate ⅜ in. These dimensions and proportions are provisional and may be altered. Moreover, a space of 4 in. will be left on top of the roadway which will be filled with a wood or asphalt paving should the concrete surface fail. Mr. Dryland, the county engineer of Middlesex, says the success of this road depends upon its ability to carry the heavy traffic which will be diverted from the main highways of London city itself.

Combination Quay and Pier Built in Restricted Space

Unusual New York Harbor Layout for Irregular Area—Concrete Cylinder Foundations on Sloping Rock Ledge—Two- and One-Story Sheds—Track Connections at Wings—Steel Frame Construction

COMBINING elements of quay and pier, a new waterfront development for Ellerman's Wilson Line is nearing completion at Castle Point, Hoboken, N. J., at the narrowest point of the Hudson River in New York Harbor. To make full use of an irregular, restricted space, with the pierhead line only 210 ft. from the marginal street, the layout is somewhat unusual, including a pier side 296 ft. long and a quay 950 ft. long, carrying a two-story shed with one-story wings as storage areas for railroad transfers. The pier is built adjacent to a high rock bluff, and it was found necessary to provide concrete foundation cylinders on about one-third the length of the quay front to carry the structure on the sloping rock ledge for lack of sufficient penetration in suitable material to hold piles. The substructure is of the usual pile and timber type, with concrete deck and pile foundation clusters cut off at about mean tide and capped with concrete carrying the superstructure columns. The sheds are of steel-frame construction, with galvanized-iron siding and steel sash. Rolling steel doors are located continuously on the face of the quay at both stories and on the pier side, and also at both wings on the marginal street where they adjoin the tracks of the electrically operated Hoboken Manufacturers' R.R.

Prior to this development, the Wilson Line occupied only the one-story shedded pier immediately southward. For extension to the north the only space available was a narrow strip with wings at each end, then partially occupied by a ship-repair plant, with the waterfront undeveloped. With the established pier-head line only 210 ft. from the shore shed limit, the quay face was established 100 ft. back of the pier-head line for protection of ships while berthing. With this restricted area it was desired to use a two-story shed, but to simplify construction and to utilize fully the wing areas, one-story sheds were adopted for the wings, these to serve as storage and transit areas for the transfer of freight between pier, dray, and cars—the two-story shed extending for the entire 940 ft. length, 100 ft. wide.

Because of the difficulty of securing proper approaches, no attempt was made to carry the tracks onto the pier. However, new front tracks were laid along the street at each wing with capacity for five and seven cars, respectively. To insure that the doorways will not be permanently blocked no unloading platform is provided, the tracks of the electric railroad being laid in the paved marginal street. Each wing will be used both for inbound and outbound movement. It is intended to operate the transit area largely by tractor trailers. The second story will be used practically entirely for inbound light freight from steamers. This light freight will be delivered to the first story or to trucks and drays by the nine cargo chutes, located as shown in Fig. 1, representing the plan layout and trackage. A swinging cargo beam, 75 ft. above mean low water, traverses the entire length of quay front and two-story portion of pier side. Nine electric winches will be placed at intervals along the quay front and pier side to work in connection with ships tackle and cargo-beam operation.

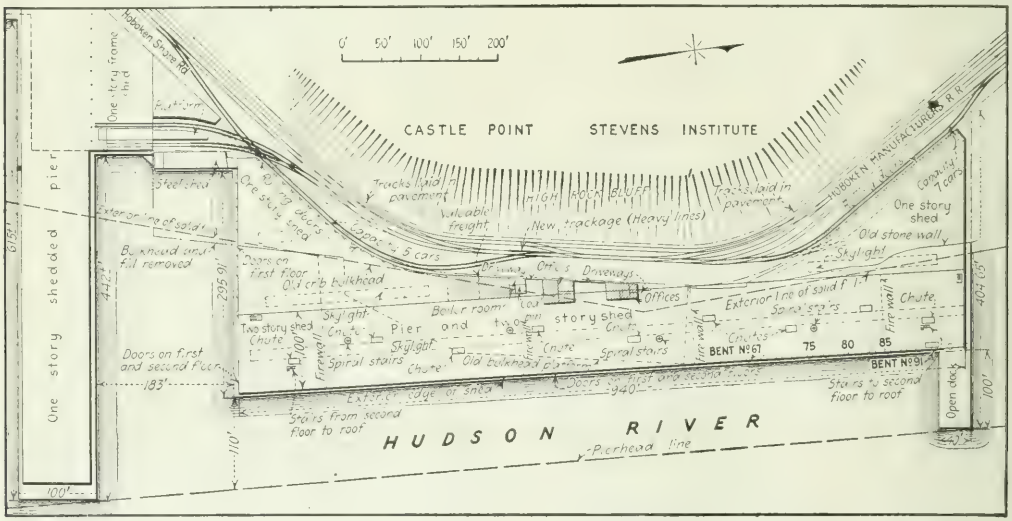


FIG. 1. WATERFRONT LAYOUT FOR WILSON LINE COMBINES ELEMENTS OF BOTH QUAY AND PIER

Access for drays and trucks is provided by four doorways on the street side, in addition to the thirty-six doorways at the wings which may be used for dray service if cars are not loading or unloading. The receiving and delivery offices are located on either side of the main driveway.

As shown in Figs. 2 and 3, the superstructure is of ordinary steel-frame construction with sides of No. 22

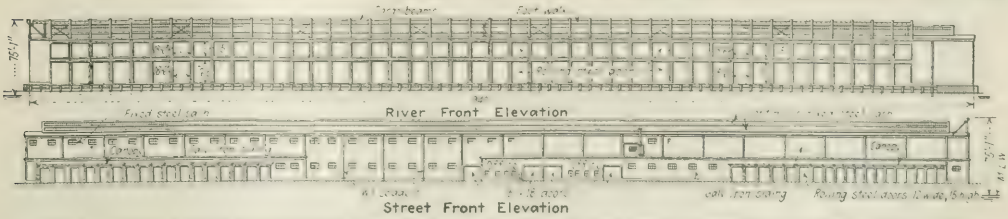


FIG. 2. RIVER FRONT AND STREET FRONT ELEVATIONS ROLLING STEEL DOORS AND WING APPROACHES

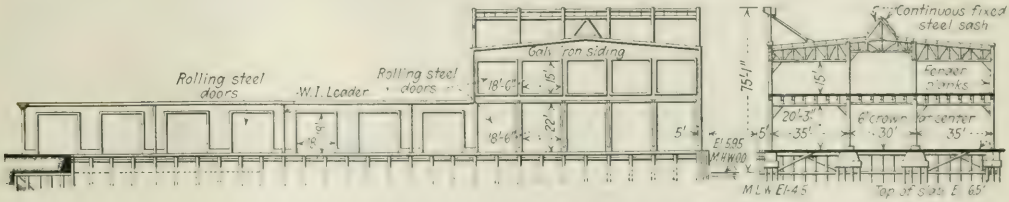


FIG. 3. SOUTH ELEVATION AND SECTION THROUGH TWO-STORY SHED

gage corrugated galvanized iron. Instead of the usual type of monitor with vertical sides a V-shaped skylight is provided at the center of the two-story shed for its entire length with continuous fixed steel sash on both slopes. It is thought that this design gives better and more direct lighting as well as simpler construction. The roof of the two-story shed consists of reinforced-cement tile, 2 x 5 ft. x 1½ in. thick carried on the roof frame. For the one-story shed roof, cement tile 2 ft. wide x 1¾ in. thick x 6 ft. 8 in. to 7 ft. 3 in. long are used.

The floor of the second story is laid with 1¼ in. thick asphalt blocks with the joints grouted, supported on a ½-in. layer of semi-dry sand and cement on a reinforced-concrete slab 4 in. thick. The entire street level floor area within the shed, including wings, is paved in the same way except that the asphalt blocks are 2 in. thick and joints are not grouted. The reinforced-concrete slab is 10 in. thick, supported by a timber pier substructure of piles with 12 x 12-in. cross-caps and 5 x 10-in. low water diagonal bracing. At each column

FIG. 5. WINGS BUILT TO FIT AROUND ROCK BLUFF SERVE AS TRANSIT AREAS

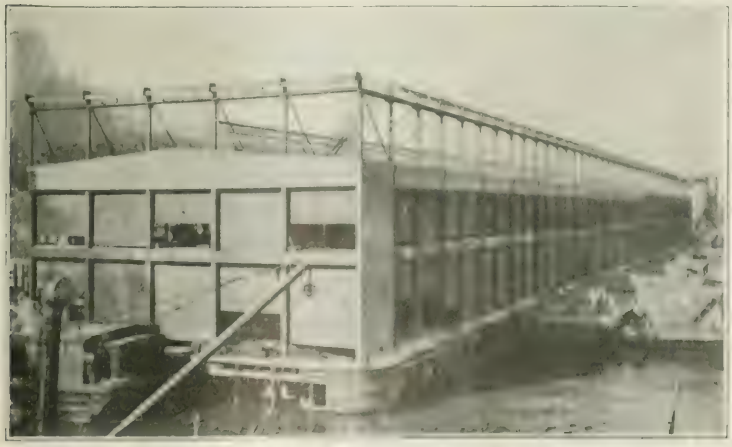


FIG. 4. LONG QUAY FRONT PIER SUPPORTED—PILES—FOR IN FOREGROUND

base there is a cluster of piles cut off about midway between mean high water and mean low water capped with a block of concrete with base 2.8 ft. below mean high water and 1.7 ft. above mean low water. It is thought that this construction can be considered "permanent" since the small portion of the pile exposed for short periods at low tide will be kept constantly wet.

The quay front looking toward the pier side is reproduced in the photograph, Fig. 4, showing the rolling steel doors on both floors and the swinging cargo beam above the roof. The rolling doors are controlled by

hand chain and are easily operated by one man. The peculiar shape of the wings to fit the roadway running around the base of the rock bluff is shown in the other photograph, Fig. 5. This topography, with a sloping rock ledge running off close to the dredging depth of 35 ft. required at the quay front, necessitated special foundation design to carry the structure for about one-third the length of the front affected by the rock ledge, which came so close to the dredged bottom that piles alone would not hold.

As indicated in Fig. 1, fifteen concrete cylinders were placed at 20-ft. centers along the face of the quay from bent No. 95 to bent No. 67. The construction of the steel cylinder casing and a typical section of bottom conditions encountered are represented in Fig. 6. It was necessary to dredge for 35 ft. depth of water at the quay front with approximate mud line slope of 2 to 1 from shore. Soundings taken by driving piles determined the cross-section of rock ledge and mud at various bent intervals. South of bent No. 67 it was found that the surface of rock was far enough below the bottom to give sufficient holding power to piles. From this point to the north end it was necessary to build foundations on the rock ledge to hold the structure safely.

After dredging in two cuts to approximate the 2 to 1 slope, a steel cylinder was sunk to rock, the cylinder having a removable top section with a 10-in. diameter hole on each side. Mud at the base of the cylinder was then removed with an 8-in. centrifugal pump, the holes in the removable top section admitting water to compensate for pumping out of the cylinder so that the limit of suction lift would not be reached. As soon as soundings with jointed pipe lengths determined the

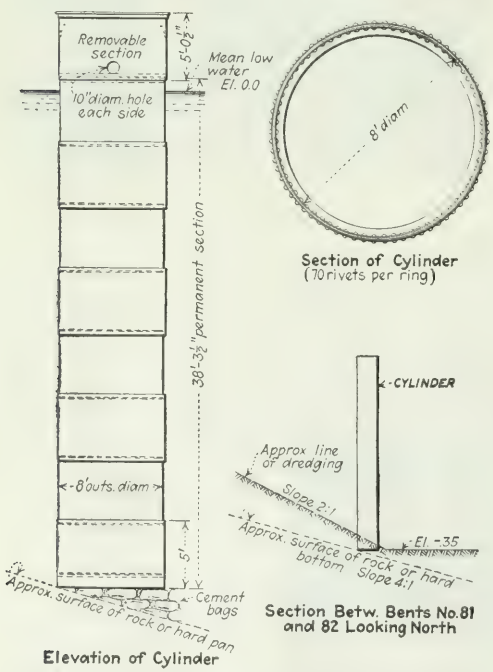


FIG. 6. CONCRETE-FILLED STEEL CYLINDERS CARRY STRUCTURE ON SLOPING ROCK LEDGE

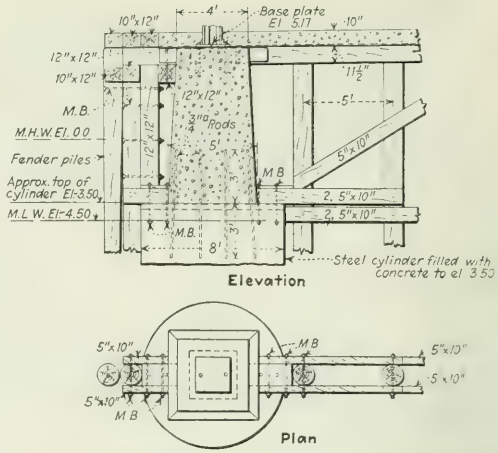


FIG. 7. STRUCTURE TIED IN TO CYLINDER FOUNDATIONS

bottom to be reasonably clear a diver was sent down inside the cylinder to finish clearing up and then to place cement bags around the lower side to form a seal to hold the concrete. Before the first concrete was placed in the cylinder by dump buckets the entire bottom as well as that around the circumference of the cylinder was sounded by the construction engineer. Then the cylinder was filled with concrete.

A pyramid of concrete of 5-ft. base and 4-ft. top surmounts each cylinder as shown in Fig. 7. The structure as a whole is tied in with the cylinders by bolted stringers and diagonals.

The development is now nearing completion and will be put in service immediately. Construction work started in March, 1920. The construction work has been carried out for the Ellerman's Wilson Line by Henry Steers, Inc., contracting engineers, New York City, who also made the design. David Bonner, Jr., was superintendent of construction. J. E. Snell, Newark, N. J., was supervising engineer for the Wilson Line.

Timber Cut from Live and Dead Trees

Prejudice exists in certain quarters against the use of timber cut from dead trees, and some purchase specifications insist that only timber cut from live trees will be acceptable. All the information available at the Forest Products Laboratory indicates that timber cut from insect- or fire-killed trees is as good for any structural purpose as that cut from live trees. If a tree stands on the stump too long after it is killed, the sapwood is likely to become decayed or badly infested by wood-boring insects, and in time the heartwood also will be similarly affected. The same thing is true of logs cut from live trees and not properly cared for. The heartwood of a living tree is entirely dead, and in the sapwood only a comparatively few cells are living. Most of the wood cut from trees is dead, therefore, regardless of whether the tree itself is living or not. Such being the case, all that is essential in purchase specifications, instead of providing that material must not be from dead trees, is to state that material showing evidence of decay or insect infestation exceeding a specified limit will not be accepted.

Freight and Passenger Terminal Problems at Chicago

Steam Railways for Rapid Transit—Freight House Developments—Freight Transfer by Tunnel and Motor Truck

VARIOUS aspects of Chicago's local transportation problems, presented at the spring meeting of the American Society of Mechanical Engineers, held in Chicago on May 23 to 26, included: (1) Intensive and economic use of suburban service on the steam railways; (2) similar use of freight terminals, and (3) the handling of freight to improve the service and relieve the congestion of street traffic.

Steam Railways and Rapid Transit—In the plans for development at railway terminal facilities in Chicago it is unfortunate that no provision is made for rapid transit service. There is no rail communication between the stations, which are thus traffic dumping points instead of distributing points. This was purport of the paper by Bion J. Arnold, consulting engineer, who considers that development of the railways for long-haul rapid transit service can be carried out at a fraction of the enormous expense of providing a new and independent rapid-transit system, such as has been proposed from time to time.

The statement is frequently made by railroad executives, and without refutation, that the commuter rapid-transit business does not pay or is carried at a large loss which must be made up by the long-distance passenger and freight business. There is no better time than the present for the railroads to establish the facts and endeavor to have this traffic handled in a more practicable manner. However, there are some who believe that railroad accounting has not yet been perfected to reveal fully the equitable allotment of terminal and service charges as between long-distance and local rapid-transit service. A careful research into the economics of railroad suburban business should be instituted at once to determine whether the railroads should handle it or should turn it over to some other agency better organized for the purpose.

The steam railroads, which are so strategically located with respect to long-haul suburban commuter traffic, should undertake an immediate reorganization of this great arm of local transportation and co-ordinate its service with the other services of the city in such a way that unified operation of the entire local transportation business may be carried on with the least total expense and maximum usefulness. Local transportation has long ceased to permit of competition as an instrument of regulation, and careful studies of the Chicago situation have shown conclusively the advantages of intimate operating unification, but as a result of misrepresentation of facts the public unwisely opposes this policy.

City Freight Distribution

Steam railways have been driven out of suburban service to a large extent by electric lines, according to E. H. Lee, vice president of the Chicago & Western Indiana R.R. In disagreement with Mr. Arnold, he considered that steam railways utilize their terminals to full advantage and that double-decking their right-of-way for overhead rapid transit lines would not benefit the railways or the public. Existing elevated lines, he said, would not serve the public so well if they had been built over steam railways, as they reach districts not touched by the latter.

Exceptional facilities for the distribution of freight are possessed by Chicago in the underground network of a narrow-gage electric railway system serving numerous railway freight stations and retail and wholesale establishments. The possibilities of this system were reviewed in a paper by J. R. Bibbins, of the National Chamber of Commerce, and E. J. Noonan, engineer of the Chicago Railway Terminal Commission. Although only about 1,800 tons of freight daily are handled at present, the capacity could be increased to 10,000 tons, thus removing a large amount of team and truck traffic from the streets.

Freight movement by motor trucks, including the use of detachable bodies and trailers, was discussed by Hugh E. Young, engineer of the Chicago Plan Commission, who referred particularly to the present tendency toward handling freight by transfer companies under contracts, rather than by the equipment of individual shippers. He mentioned also the proposed marginal thoroughfare on South Water St., which will provide for bypassing much transfer traffic which now passes through the business district and adds to its congestion. (See *Engineering News-Record*, July 22, 1920, p. 173.)

Air Rights and Unit Terminals

Economies promised by the utilization of high-value land in the business section of Chicago by the erection of multiple-story structures were presented by E. J. Noonan, chief engineer of the Chicago Railway Terminal Commission, who dealt particularly with the proposed terminal development outlined in *Engineering News-Record* of May 19, p. 845. Unit operation of various Chicago terminals, introduced under government control during the recent war, was endorsed as a successful move by J. H. Brinkerhoff, general agent of the Northern Pacific Ry., who was terminal manager at Chicago for the United States Railroad Administration. Thus congestion at local freight stations was relieved by sending business to other stations which were not so busy.

Congestions always starts at one point and if prompt measures are not taken it spreads to other lines. Under unified control, measures can be taken to relieve congestion. Under individual operation this has never been accomplished. The handling of a terminal where there is a variety of interests is best accomplished by having it under one head, whose authority should be supreme in deciding questions that arise continually between individual carriers.

This opinion was supported by Mr. Noonan, who suggested that Chicago has an excess of terminal facilities in the business district and a shortage of such facilities on the outside. Unit operation would eliminate many individual agencies, as has been done with success in the stock yards district. Further competition in terminal facilities is not to the interest of the public, he said. In his opinion the railways should give the subject more careful study and consideration than it has yet received.

Drafting-Room Kink

On my drawing board I have a cheap manilla paper about $\frac{1}{8}$ in. thick which is used for a surface and after changing from a small drawing to a larger one it was very annoying when my pencil would drop into the shell holes made by the Big Bertha thumb tacks, so I now use mucilage. A very little on each corner of the sheet holds it down nicely and to loosen it one corner may be lifted and pulled back. It will leave the corners a little stiff and they will not roll up quite so easily.—F. A. McCurdy, Muncie, Ind.

Construction of Substructure for Platte River Bridge

Concrete Piles Jetted in Sand for New Bridge of C., B. & Q. R.R.—Sand Ejector Clears Concrete Caissons —Steam Box for Rapid Curing of Piles

By J. H. Merriam
Resident Engineer, C., B. & Q. R.R., Lincoln, Neb.

CONCRETE piers and bents with jetted concrete piles supporting steel girder spans and concrete slab spans having a concrete ballasted deck compose the new bridge over the North Platte River, near Bridgeport, Neb., which was put into service in August, 1920, by the Chicago, Burlington & Quincy R.R. This structure, Fig. 1, replaces a much longer timber trestle built about twenty years ago (new 674 ft., old 1,790 ft. originally, shortened by filling to 1,017 ft.).

A characteristic of the Platte River is shallow water in a wide bed between low banks, with usually two main channels, one near each bank, the middle of the stream having extremely shallow water or low sand bars. The river level has a range of about 6 ft. between extreme high and low water. The bed consists of coarse sand which scours at the rate of about 3 ft. for each foot of rise of the water. Narrowing the river channel is an advantage in that it causes the channels to scour to a greater depth and thus provide openings for the passage of drift and ice during high water. To provide for the above conditions at the Bridgeport bridge, it has been found practicable to deepen the two channels by reducing the width between the banks and placing relatively long spans over the channels, with pier foundations sunk below the line of possible scour.

The new bridge consists of six 60-ft. plate-girder deck spans, three over each channel, with ten 25-ft. reinforced concrete slab spans over the shallow portion of the river between them, and two 16-ft. concrete slab spans at each bank. For the steel spans there are concrete piers supported on concrete piles, while the concrete spans are supported on the caps of double bents built with similar piles. The substructure is built for double track, but only a single-track superstructure has been placed at this time. This is on the upstream ends of the piers and will be the southbound track when the second track is built, the latter being laid on the location of the old trestle.

Preliminary Work.—To permit the use of the old trestle in building the new bridge, a temporary pile trestle to carry the traffic was constructed 20 ft. downstream. It was necessary to alter portions of the old trestle to provide longer spans at the points where piers were to be constructed, each of these long spans being so built as to be removed readily in one piece by a derrick car when work was in progress on the pier below it. Filling 340 ft. of the old south approach required 13,000 cu.yd. of earth, and 15,500 cu.yd. were used to widen both approach fills to provide for the shifting of the main track 14 ft. from the old alignment to the new superstructure. All this material was obtained by widening cuts about four miles north of the river. About two miles of track were required to serve the material storage yard, as the low swampy ground near the river necessitated locating this yard about 3,000 ft. south of the bridge.

Jet Piles—Reinforced-concrete jet piles of the Bignell type are contained in the bents of the concrete spans and in the foundations of the piers of the steel spans; 550 such piles were manufactured at the site. They are 16 x 16 in. in section (Fig. 3) and 40 ft. long, with a 4-in. opening through the entire length, through which water was pumped at pressures varying from 150 to 300 lb. At the lower end this opening is reduced to 1½ in. by a cast-iron nozzle embedded in the concrete, thus forming a jet which bores its way into the sand and clay of the river bed, allowing the pile to sink by its own weight. Lateral pipes extending to each face of the pile are provided at intervals, through which the water is discharged, being diverted upwards by elbows so as to overcome side or skin friction and to wash the displaced material toward the surface. The distance between these laterals is reduced gradually, the first being 10 ft. 2 in. below the head and the sixth being 2 ft. above the point. The piles were handled and sunk with an ordinary bridge derrick car, being slung by the clamp and equalizer outfit shown in Fig. 2.

For the jetting there were two locomotive boilers, one 20 x 8 x 18-in. duplex pump and two 20 x 12 x 10-in. duplex pumps, delivering the water through two 6-in. pipe lines, 400 to 1,000 ft. long. Connection between pipe and pile consisted of two lengths of ordinary

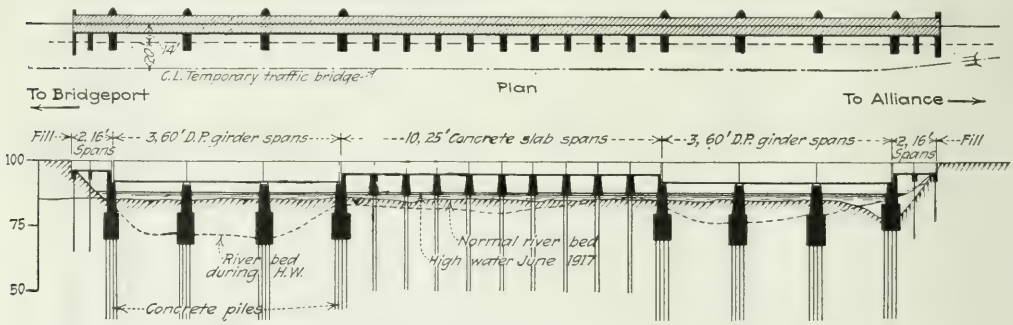


FIG. 1. NEW NORTH PLATTE RIVER BRIDGE; C., B. & Q. R.R., AT BRIDGEPORT, NEB.

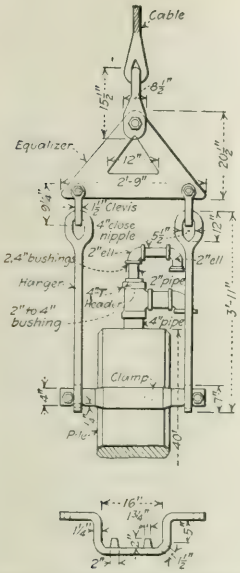


FIG. 2. HANDLING RIG FOR PLACING CONCRETE PILE

2⅝-in. fire hose coupled to a 4-in. T or header, Fig. 2. The hose was attached while the pile was in a horizontal position. After the pile had been raised with the derrick and spotted for sinking, a connection was made with the pipe line and water was applied. From two to ten minutes were required to sink a pile to its full length of 40 ft. About 70 per cent of the piles were sunk to depths of 52 to 55 ft. These, however, were in cofferdams from which the sand had been excavated to 15 or 20 ft. below the surface of the water.

By means of a special attachment the header was readily disconnected from the driven pile and brought up to be used again. This auxiliary attachment consists of a 36-in. length of 6-in. wrought-iron pipe, split and spread to fit over and around the 4-in. T on top of the pile (Fig. 3), so as to form a socket wrench, which was operated by the stem of smaller pipe extending to the surface, the split pipe being turned so as to unscrew the header.

Pier Caissons—Each of the eight deep piers for girder spans was begun by building a three-pocket reinforced-concrete open box caisson or cofferdam, 12½ x 38 ft., with 15-in. walls 10 to 12 ft. high, Fig. 4. Owing to the shallow water these caissons were constructed in place, with 12 x 12-in. timbers for the shoe or cutting edge, two to five courses being used, depending on the depth of the water. The concrete box was built on top of these timbers and additional 12 x 12-in. timbers were placed on top of the caisson, the latter being removed after the completion of the pier. The boxes were sunk by excavating with a clam shell bucket handled by a derrick car.

As sinking progressed, additional weight was applied by placing concrete piles on top, 160 tons of additional weight being used in some cases. The caisson was kept level by excavating on the high side or end, and also by shifting the additional weight on top as required. Some riprap rock was encountered, and at times this would collect under the cutting edge, where it could not be reached with a clamshell bucket. This difficulty was overcome by the free use of a large water jet which would displace the rock. Small shots of dynamite during the sinking process assisted materially in settling the caissons into final position.

When the cofferdam had reached the proper depth, the concrete piles were sunk to place (45 to 48 piles in each pier). As a clamshell bucket could not be used after these piles were in place, the sand was removed from around the pile heads by means of a home-made hydraulic sand ejector, built up of 3-in. wrought-iron pipe for the discharge and 1¼-in. pipe for the water inlet. These pipes were clamped together side by side, with the 1¼-in. pipe extended a little below the other and returned up into the 3-in. pipe by means of elbows, the returned end being fitted with a nozzle ¾ to 1 in. in diameter. With this device lowered into the sand and water applied at 150 lb. pressure, the sand was readily forced through the 3-in. discharge pipe and delivered outside of the caisson.

After the removal of the sand a 4-ft. sealing course of concrete was placed through the water by means of a tremie. After allowing this concrete to set for about 24 hours, the cofferdam or box was unwatered, the top of the sealing course cleaned, and the base of the pier concreted in the dry to its proper elevation. Neat work forms were placed and the pier completed, as shown in one of the details in Fig. 5.

Double pile bents of twenty piles each (ten for each track) are used under the 25-ft. slab spans, as also

FIG. 3. CONCRETE JET PILE AND DETAILS OF HANDLING RIG

shown in Fig. 5. These piles were sunk to depths of 36 ft. The tops, projecting about 4 ft. above the water, were capped with concrete and finished to the proper elevation. The heads of the piles in the two rows are connected by stirrups embedded in the caps. Each of the approach bents consisted of twelve concrete piles in lengths of 18, 26 and 30 ft.

Concrete Work—Precast slabs were used for the four 16-ft. end spans, these being made at the bridge site and placed by derricks. The ten 25-ft. concrete slab spans were built in place, using falsework of two 3-pile bents for each span to support the forms. Each of the

steel girder spans was handled and placed on the new piers as one unit, its weight being about 30 tons. Precast concrete deck slabs were then placed on the girders, and the bridge was completed with ballast and track.

The concrete plant for the bridge work was operated also for the purpose of manufacturing concrete piles

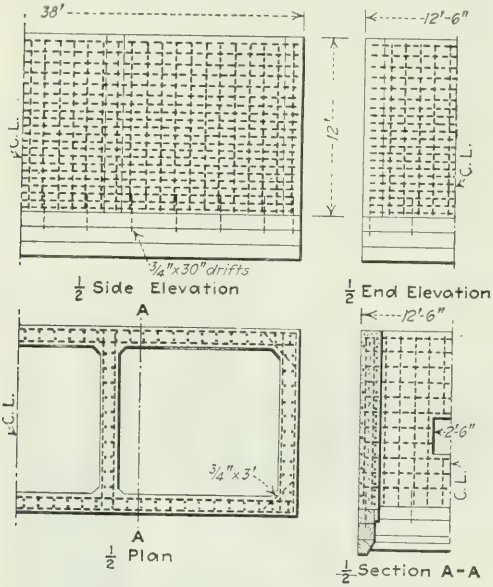


FIG. 4. CONCRETE CAISSON FOR PIER

and slab spans of various lengths for general use on the northwest lines of the Burlington System. During 1919 and 1920 the following products were manufactured and shipped from this plant: 34,000 lin.ft. of 14½ x 14½-in. solid concrete piling; 482 reinforced-concrete slabs, 7 x 14 ft. to 7 x 20 ft., and 1,833 concrete blocks 36 x 36 x 4 in. These were all made in connection with the bridge work, using the same force and equipment. Concrete work was carried on throughout the winter months, using heated materials and warm water. Finished work was protected by covering with tarpaulins and heating with steam. A portable concrete plant was used for the entire work. It consisted of a 10-ft. drum mixer mounted on a flat car, steam being furnished by a small vertical boiler mounted on the car. Gravel and cement were handled from cars adjoining. This outfit was readily moved from place to place as required. The mixer

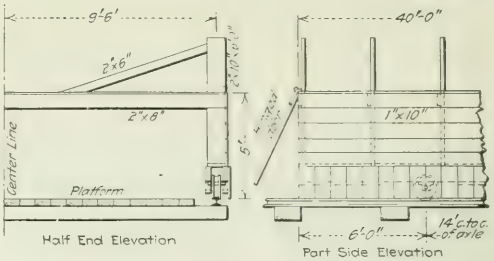


FIG. 6. STEAM BOX FOR CURING CONCRETE PILES

discharged at the end of the car, permitting the concrete to be spouted to either side of the track. A light locomotive assigned to the job did all the switching and handling of equipment and loads. Two derrick cars of about 25 and 30 tons' capacity were in use most of the time, only one of these being self-propelling.

Steam Curing—Steam boxes, or drying houses fitted with steam pipes, were used in curing the concrete piles and other products, which were cast in forms laid on a platform 20 x 300 ft., constructed of timbers embedded in the ground. These steam boxes spanned the platforms and were operated by hand on a track of 19-ft. gage, being placed over the freshly-poured concrete products. By this means it was possible to remove piles from the forms in 14 to 16 hours after being concreted, enabling the forms to be released for use. The piles were picked up in a horizontal position, loaded on flat cars and unloaded in a storage yard where they were permitted to cure for thirty days before being shipped.

The steam boxes, Fig. 6, were designed and used for the purpose of expediting the process of curing and thus reducing the number of forms and the platform space required, as well as to permit concreting to be done in cold weather. They were of light timber construction, each being about 19 x 40 ft. and 5 ft. high, with ends hinged at the top so that they could be swung out and up when moving the box over the forms. Each box was mounted on six or eight double-flanged wheels.

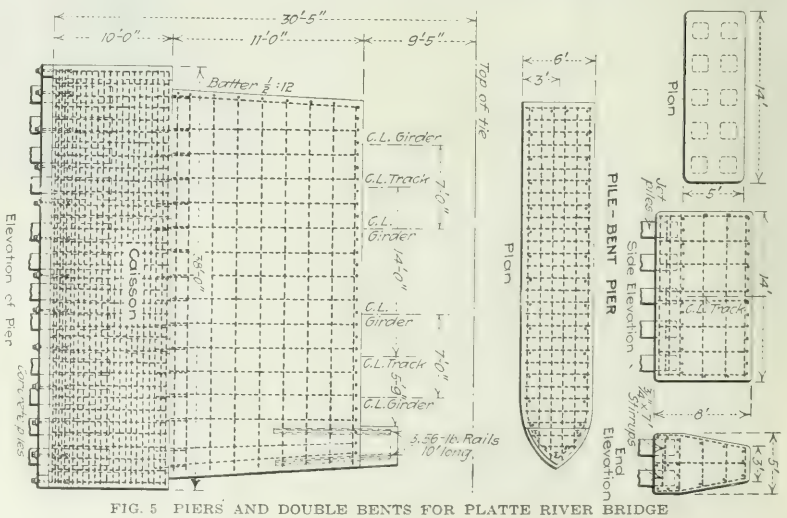


FIG. 5 PIERS AND DOUBLE BENTS FOR PLATTE RIVER BRIDGE

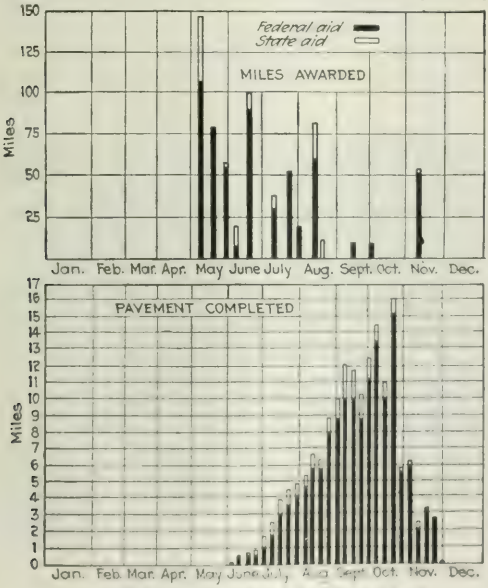
when the box was in place over the freshly-filled forms the ends were lowered and fastened and steam at low pressure was applied through 1½-in. pipes suspended from the roof and sides of the box. Three of these boxes were used on the work.

Construction work was begun in August, 1918, and the bridge was put in operation on Aug. 18, 1920. All work was done by company forces under the supervision of A. W. Newton, chief engineer Chicago, Burlington & Quincy R.R.; G. A. Haggander, bridge engineer, and F. T. Darrow, assistant chief engineer. The writer was resident engineer.

Contract Dates and Peak Outputs

By B. H. Piepmeier
Engineer of Construction, Springfield, Ill.

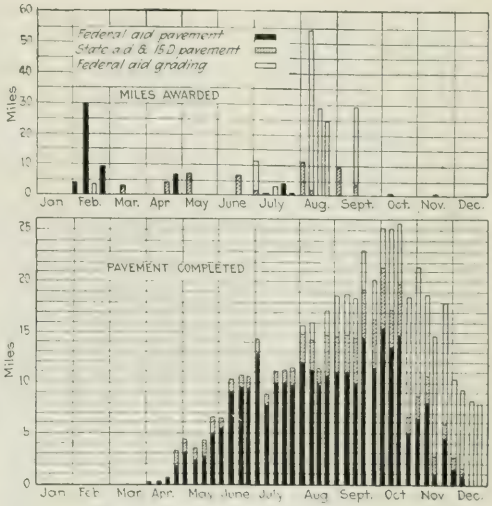
An examination of two years' work in constructing paved roads in Illinois clearly shows the advantage of letting contracts early in the season. During 1919 approximately 504 miles were awarded in April, May, June and July, the peak of awarded mileage being in May. The progress chart for 1919 shows that the contractors did not reach their peak of miles completed per week until October, some five months later. It takes a contractor 60 days to organize and get ready to lay



HIGHWAY CONSTRUCTION AWARDED AND COMPLETED IN 1919

pavement and from 30 to 50 days to reach his maximum output after he starts construction.

The 1920 chart shows that the peak mileage constructed for any one week was reached the week ending Oct. 1. However, a very large weekly mileage was reached in June and was practically maintained for a period of four months, when construction suddenly slumped on account of winter. A good record was made in June on account of the large mileage of work brought forward from 1919. In the spring of 1920 many of the contractors had equipment on their jobs and were ready to start construction as soon as weather conditions permitted and they could organize their forces.



HIGHWAY CONSTRUCTION IN 1920

The chart indicates a large mileage of earthwork awarded during the late summer months of 1920. The peak of grading work was reached the week ending Nov. 4, a comparatively short period after the peak of awards. On grading work a contractor can reach his maximum of yardage moved per day within 30 days after receiving his contract, while on pavement construction he must count on at least 90 days.

On account of unfavorable conditions that existed throughout 1920, no exceptional records were made or no one method of handling work proved to be worthy of special mention or recommendation; however, general statistics of the work are of interest: (1) The largest number of days a concrete paver was operated on a single job was 131. The largest output with one mixer was 86,592 sq.yd., or 8.2 miles of 18-ft. pavement. This record was made in 107 working days, using trucks to deliver materials direct to the paving mixer. (2) The largest number of square yards laid under the supervision of one contractor was 260,000, or 27.45 miles. (3) The largest daily output with one mixer was 1,694 sq.yd., or 847 ft. of 18-ft. pavement. On this job an eight-bag paver and an industrial railroad for transportation of materials were used. The largest week's as well as the largest month's record (0.72 miles and 2.44 miles, respectively) were made by a contractor using a four-bag paver with industrial railroad delivery of materials.

A further analysis of all jobs shows that industrial railroad equipment was used on 44 jobs, and the averages were 1,940 ft. per week and 5,264 ft. per month. Central mixing plants, with truck delivery of mixed concrete, were used on 12 jobs, and the averages were 1,495 ft. per week and 4,272 ft. per month. For batch boxes on trucks delivering materials direct to the paving mixer, there were 11 jobs and the averages were 1,331 ft. per week and 2,589 ft. per month. There were four jobs with material dumped on subgrade and a belt conveyor to the mixers, and the averages were 1,022 ft. per week and 5,563 ft. per month. On 48 jobs with materials dumped on subgrade and shoveled or wheeled to a paving mixer, the averages were 1,462 ft. per week and 3,117 ft. per month.

Notes on California Rock Tunneling Practice

Tunnel Sizes and Methods of Driving, Recent Improvement in Equipment for Drilling and Mucking, Electric Exploders, Terms of Tunnel Contracts

By A. J. Cleary
Consulting Engineer, Construction Company of North America, San Francisco

HYDRO-ELECTRIC development has received a very strong impetus since the war. Most of the hydro-electric projects in the West include considerable tunnel construction and, in many instances, the tunnels are controlling time factors, governing the date on which the projects can be completed and a revenue obtained. Under these conditions it is natural that speed and economy in tunnel work have recently been given very careful study by construction engineers, particularly in California, and some notable achievements have been recorded. The trend of rocktunneling practice in some of the factors that have a direct bearing on these developments is discussed in the following notes:

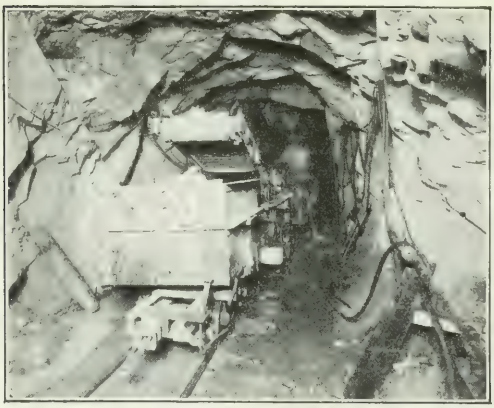
Intermediate Headings—In the survey for a long aqueduct tunnel it is frequently economical to lengthen the alignment in order to secure suitable adit or shaft sites, in order that the distance between headings may be reduced.

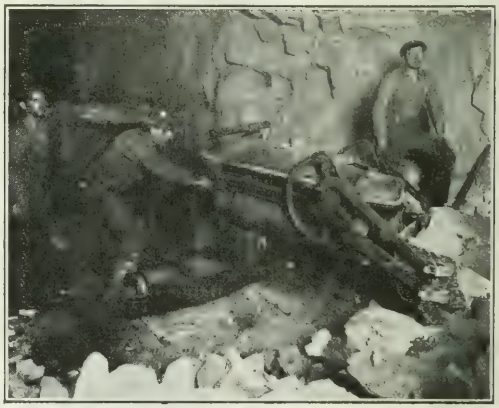
On a tunnel of considerable length, after the final location survey has been completed, it has been found advisable, if a close estimate of the cost is required, that a series of diamond drill borings be made along the tunnel line. These drill holes should be put down from the surface to intersect the tunnel grade at intervals sufficiently close to enable a competent geologist, after a field study, to plot with a reasonable degree of accuracy the formations through which the tunnel will pass. Not only can the geological formation be thus determined, but some idea can be obtained as to the location and extent of water-bearing strata. These are important factors in the cost of the tunnel.

Methods of Attack—In tunnels under 16 ft. in width and height, three methods of breaking ground are in common use: (1) The top-heading-and-bench plan, (2) shooting the full face in one operation, and (3) undercutting and trapping. In a long tunnel it may be advisable to try out for a short period all three operations and adopt that which proves cheapest. In most tunnels under 14 ft. in width and height, working the full face has a number of definite advantages over either the heading-and-bench plan or undercutting: It is possible to get in a more effective round of cut holes and pull longer rounds; time and labor are saved over mucking back a heading by hand preparatory to setting up drill columns; the entire round can be mucked by machine; by using a staging, drilling and machine mucking can be done at the same time.

Drill Steel—The manufacture of drill steel has been brought to a high degree of perfection abroad in recent years. On the Hetch Hetchy project tests were made on practically every brand submitted by American and foreign manufacturers. It was found that for the particular type of rock traversed by the 18-mile Hetch Hetchy aqueduct tunnel, Viking brand Swedish steel stood up best and was most economical. The experiments were made in 1919 and 1920, and as a consequence, Swedish steel has been used continuously on the Hetch Hetchy work ever since. There is no reason, however, to predict that this condition should continue, as American manufacturers are now giving more study to the subject of producing a more efficient and economical drill steel, realizing the importance of manufacturing a better product than has heretofore been produced.

Drill Forges—Oil furnaces are used extensively in the blacksmith shops of modern tunnel camps in connection with drill sharpening, shanking and welding, and are much to be preferred over coal forges. They are more economical in time and cost, provide a more



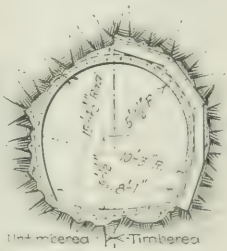


MYERS-WHALEY AND SHUVELODER MUCKING MACHINES IN SMALL-SECTION TUNNEL

uniform heat, are cleaner, and take up less floor space. There are several types and sizes of oil furnaces manufactured. Where one sharpener is in operation a No. 3 Ingersoll-Rand furnace or its equal gives good results. The cost of operating a No. 3 oil furnace with fuel oil at 7.5c. per gallon is $1.11 per 8-hour shift. For a coal forge with coal at $40 per ton the corresponding cost is $1.80.

Various experiments have been made with removable bits for drill steel, the theory of the inventors being that these would save the cost of drill sharpening, since they could be manufactured at a very low cost and thrown away when dulled. To date none have come within the writer's knowledge that gave efficient or satisfactory results.

Heading Machine—Another device, for which much was claimed by its manufacturers, but which did not succeed on the hard rock encountered on the Hetch Hetchy tunnels, was the Karns "heading machine." This was in effect a large piston drill pneumatically operated, designed to drill a central hole 12 in. in diameter. This hole, which was not loaded, was intended to take the place of the ordinary center cut, affording a free space to which the material could break when the other holes, drilled with ordinary 1¼-in. drills, were shot. The device worked fairly satisfactorily for a few days, but could not stand up under continuous use.



HETCH HETCHY TUNNEL SECTION

Drilling Layout—Considerable study has been given of late to determining the most effective positions and directions of the drill holes. This will vary with different formations, with the size of tunnel and the length of the round to be pulled. When the proper angle for the cut holes has been determined in a particular instance, templets are frequently used for the direction of the drills so that there may be no variation or misplaced holes.

Drill Carriages—Where progress is not so essential as to be given preference over economy, a drill carriage with the requisite number of drills mounted and ready for operation is sometimes used. Since drilling and mucking cannot be carried on simultaneously by this method, its use means a slowing up of progress; this does not cause as much delay as might at first appear, however, particularly where the headings are being driven from the same adit or shaft. In such cases drilling is carried on in one while mucking is done in the other, and vice versa. With a drill carriage and a full tunnel face, the holes can be pointed with absolute accuracy. No time is lost setting up drills. Steel and tools are at hand, with no loss of wrenches, etc., in the muck pile; and only short lengths of air and water hose are necessary. The use of such a carriage also facilitates loading. When drilling is completed, the entire carriage is brought out of the tunnel and all drills are gone over and made ready for the next round. Moreover, where motor-driven mucking machines are used, a drill carriage makes possible a large saving in power since the compressors can be shut down when the drilling is finished.

Firing—A separate firing circuit is generally used with electric delay exploders. It terminates at a safety firing switch, which may be kept about 1,200 ft. from the heading. Ordinarily 440 volts are used, a strong current lessening the liability of misses due to poor connections. The California Cap Co. now manufactures a special-interval delay-action exploder which allows more than double the standard interval between delays. With delay-action exploders a round of holes can be more accurately timed than with fuse and cap, the possibility of missed holes from water and cutoffs lessened, and the noxious smoke from burning fuse eliminated.

In electric blasting a simple expedient has been adopted to make sure that there will be no missed holes. The terminal wires on the delay-action exploders are wrapped with different colored cord and connected in parallel to bus wires. By this simple means, when all holes are loaded and ready to shoot, the shift boss can simply count the number of like colored terminals attached to the positive bus wire and the number of a different color attached to the negative. These must check up with the number of holes to be exploded. This prevents attaching the two terminals of the same exploder to the same bus wire, which would result in a missed shot. A yellow and a black wire are most easily distinguished in the dim light of a tunnel.

Power Mucking—Heretofore the removal of muck has been the most tedious and costly part of tunnel driving. In fact, mucking was considered such a serious factor, in comparison with drilling and shooting, that not more than two years ago on an important hydro-electric development in California the dimensions of the tunnel were increased so that the effective area was almost doubled in order that air shovels could be used in the tunnel to handle the muck. The fourth edition of the American Civil Engineers' handbook, published in 1920, states, "Many mechanical muckers have been devised, but none have come into general use except the small steam shovel operated by compressed air." Since the above statement was published it is conservative to state that mechanical muckers have come into general use for small tunnels. In California there are in use today at least 12 Myers-Whaley mucking machines and 20 "Shuveloder" machines. Both of these types have effected a considerable saving over hand loading. They can handle from 6 to 10 cu.yd. per hour, and aside from the saving in cost of mucking, tend to reduce the labor turnover.

To obtain the best results it is essential to keep a siding for empty muck cars as close to the heading as possible, and have ample car and haulage capacity so that the machines can work continuously in handling each round. Portable sidings are essential and should be kept within 200 ft. of the face to save time in switching. The Shuveloder is operated by compressed air and moved around by hand, while the Myers-Whaley mucker is operated and moved electrically. A study of local conditions is necessary to determine which machine is best adapted and most economical for a particular job. The Myers-Whaley has fewer breakdowns; the Shuveloder is cheaper in first cost. Other mucking machines, among which the Hoar shovel may be mentioned, have been used with satisfactory results. On at least one Pacific Coast tunnel job the Hoar machine is now being tried out in competition with the Myers-Whaley and the Shuveloder.

SOUTH FORK TUNNEL, HETCH HETCHY

The principal defect of mucking machines is the frequency with which break-downs are apt to occur. The manufacturer who improves his shovel so as to most nearly eliminate this defect will have the best opportunity to get future business in this line.

Where speed of construction is an important factor, it is now necessary to provide two machines for each heading in order that a reserve machine may be ready for service when break-downs occur. Even with the additional first cost necessitated by such procedure, the saving in time and delays from the disruption of the working forces justifies the additional expense in first cost, and is good economy.

Haulage—The cost of hauling muck from the heading to the dump has been decreased by the use of electric or gasoline motors. In California the law prohibits the use of "fuel-burning locomotives except in tunnels open throughout their length," because of the poisonous fumes released by the exhaust from gasoline motors, which may prove dangerous except in exceedingly well-ventilated tunnels. Electric motors are therefore used exclusively in California for tunnel construction operations.

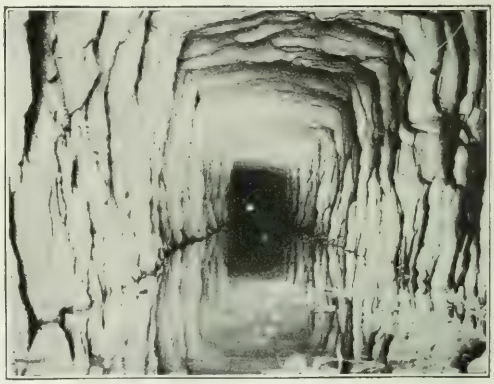
The advantage of storage battery over trolley motors for use in tunnels of small diameter is the elimination of exposed high-voltage trolley wire with its incident hazards in close quarters. An efficient storage battery locomotive for a long tunnel should have a minimum drawbar pull of 1,200 lb. and be able to handle 50-ton trains at 4 mi. per hr. against a 0.15 per cent grade.

Such locomotives are manufactured by the principal large electrical companies. Storage battery equipment which has been found satisfactory consists of 80 cells of Edison A-6 batteries and two H.M. 828 GE ball-bearing motors or their equal. Such a locomotive can pull 50 tons 12 miles up a 0.15 per cent grade without recharging.

A motor-generator set with a capacity of 15-kw., consisting of a three-phase 440-volt motor direct-connected to a 150-volt d.c. generator, fully recharges a discharged locomotive in 7 hours. As the load hauled toward the heading consists generally of nearly empty cars, requiring a correspondingly smaller expenditure of current, an average distance that a battery locomotive can negotiate every day in the year would be from 40 to 50 miles. This includes allowance for time required for recharging.

Lining—Hard-rock tunnel aqueducts are frequently lined with concrete, for the sole purpose of increasing their capacity by reducing friction. Where the formation warrants, it is generally more economical to obtain this greater capacity by using a larger unlined section. In many formations, however, lining is absolutely essential, particularly for pressure tunnels. The pneumatic method of mixing and placing concrete is fast superseding hand placing on long tunnels. At least two successful pneumatic mixers are now on the market. One company has recently developed a portable mixer which is shifted along with the forms. This minimizes the expense of discharge pipe and also the amount of air necessary to mix and place each batch.

A machine recently developed on the Pacific Coast for placing concrete tunnel lining, known as the Webb & Cox universal concrete gun, has gained rapidly in popularity after making good records on a few jobs.



LARGE-SECTION TUNNEL (KERCKHOFF), MUCKED BY AIR SHOVEL

It consists essentially of a cylinder into which a batch of mixed concrete is dumped and from which the concrete is forced into the delivery line by a piston actuated by compressed air. This puts a positive thrust behind the charge and gets it into the delivery line in a compact mass, after which delivery to the forms is effected by air pressure in the usual way. The gun is used for short-distance delivery only, the concrete being taken into the tunnel to it in dump cars. It effects a considerable saving over the amount of air used in the ordinary pneumatic process. As used in the recently completed tunnel on the Caribou project, this gun placed an average of 10 cu.yd. of concrete per hour.

To keep pace with the increased speed of mixing and placing concrete which pneumatic delivery systems have introduced, important developments have been made in the traveling steel form. Speed in collapsing, moving forward and re-setting is their chief advantage over the forms that have to be taken down to be moved.

Cost-Plus Contracts—In tunnel work, as in most construction operations of great magnitude where unforeseen hazards may greatly affect prices, the plan of contracting for cost-plus-fixed-fee with maximum cost guaranteed is now often preferred to the flat unit-price plan. The forfeit in case the guarantee is not met may include any portion or all of the fixed fee, or any part of or the entire amount by which the guaranteed price may be exceeded. A percentage of the saving effected

by performing the work lower than the guaranteed cost is often included in the contractor's compensation. The advantages of such contracts are mutual.

How the cost-plus-fixed-fee contract reduces the cost of the work is shown in the accompanying table of itemized bids on 18 miles of Hetch Hetchy tunnel. The prices given are averages of bids made in April, 1920.

ITEMIZED BIDS ON UNIT PRICE AND COST-PLUS-FIXED-FEE, HETCH HETCHY TUNNEL

Item No.	Item	Quantity Estimated	Unit	Unit-Price Bid Items	Unit-Price Bid Totals	Cost-Plus-Fixed-Fee Bid Items	Cost-Plus-Fixed-Fee Bid Totals
1	Lined tunnel between Early Intake and South Fork	16,400	Lin.ft.	$107.00	$1,754,800	$78.95	$1,294,780.00
2	Lined tunnel between South Fork and Adit No. 8-9	24,744	Lin.ft.	105.00	2,598,120	84.20	2,083,444.80
3	Lined tunnel between Adit No. 8-9 and Priest Portal	41,600	Lin.ft.	109.00	4,534,400	82.08	3,414,528.00
4	Extra price for permanently timbered tunnel	10,000	Lin.ft.	10.00	100,000	25.00	250,000.00
5	Concrete lining in tunnels excavated by the City	24,000	Cu.yds.	20.00	480,000	16.50	396,000.00
6	Concrete lining in shafts excavated by the City	2,700	Cu.yds.	22.00	59,400	20.00	54,000.00
7	Construction Shaft No. 2, with lining, below the part excavated by the City	425	Lin.ft.	400.00	170,000	330.00	140,250.00
8	Additional excavation in tunnel and shaft	5,000	Cu.yds.	10.00	50,000	10.50	52,500.00
9	Additional concrete in tunnel and shaft	5,000	Cu.yds.	20.00	100,000	15.00	75,000.00
10	Extending Adits	100	Lin.ft.	40.00	4,000	45.00	4,500.00
11	Excavation in open cut	500	Cu.yds.	8.00	4,000	2.50	1,250.00
12	Concrete in open cut	500	Cu.yds.	20.00	10,000	15.00	7,500.00
13	Extra cement	5,000	Bbls.	6.50	32,500	5.00	25,000.00
14	Furnishing and placing reinforced steel	40,000	Lbs.	.10	4,000	.10	4,000.00
15	Placing reinforcing steel furnished by the City	10,000	Lbs.	.05	500	.02	200.00
	Total cost				$9,901,720		$7,802,952.80
	Alternative for part to be enlarged, unlined section (average)			$91.00		$67.35	

Five miles of the Hetch Hetchy tunnel have now been bored and the present cost is very close to the contractors' guarantee. With recent decreases in the cost of labor and materials, it is believed that a considerable saving below the contractors' guaranteed price will be effected. The Hetch Hetchy work is being carried on under the direction of M. M. O'Shaughnessy, city engineer of San Francisco, by the Construction Company of North America.

Washington's Town Plan for Alexandria

THE original manuscript plans made by George Washington in 1748 and 1749 for the town (now city) of Alexandria, Va., have been acquired by the Library of Congress. The following statements regarding the maps is taken from the Report of the Librarian of Congress for 1919-20:

The library is fortunate in having secured the manuscript plans by George Washington, of the city of Alexandria, Va. As there is no mention made of this work in any notice of Washington's writings, a full description may be of interest: "Plat of the Land where on Stands the Town of Alexandria. By a scale of 15 Po to ye Inch. 12¼ x 15½. (1748) A Plan of Alexandria now Belhaven 12¾ x 15¾. (1749)."

Alexandria is located on land which formed part of a large grant to Robert Howsen in 1669. Howsen sold his land to John Alexander in 1677.

In 1730 a public tobacco warehouse was established on this tract, and the hamlet which grew up about it was called Belhaven, and was known by that name until the town was laid off under an act of the General Assembly of the Colony of Virginia, which was passed in 1748. This act authorized the survey and laying out of a town at "Hunting Creek Warehouse on Potomac River," the town to cover 60 acres of land "parcel of the lands of Philip Alexander, John Alexander, and Hugh West," and "that the said town shall be called by the name of Alexandria."

The trustees appointed for the town included Lord Fairfax, William Fairfax, George Fairfax, Richard Osborne, Lawrence Washington, William Ramsey, John Carlyle, John Pagan, Gerard Alexander, Hugh West, and Philip Alexander. The surveys having been made in accordance with the charter, the first meeting of the trustees was held on July 13, 1749. On the two days following, the town lots were sold at auction under the supervision of the trustees, and at the next meeting of the trustees, on Sept. 20, deeds for these lots were executed.

Of these two maps of Alexandria drawn by George Washington the earliest is the "Plat of the Land where on Stands the Town of Alexandria," the title being noted on the reverse of the map, probably at some later date.

It is an outline of the area to be covered by the town which is here marked, "Area 51 acres 3 Roods 31 Perch." At the upper end of the area buildings are indicated and marked "Mr. Hugh West Ho. & Ware Hoss." The road upon which these buildings are indicated extends from "Ware Ho. Point" through the area and is marked. "Road round Hd of the Crk. &c." Beyond the road is "A fine improvable Marsh."

Along the water front the river is marked: "The Shoals or Flats about 7 feet at High Water." and a line farther out in the river reads, "The Edge of the Channell of the River. 8 Fathoms." The following note appears at the foot of the map: "Note that in the Bank fine Cellars may be cut from whence wharfs may be extended on the Flats witht any difficulty & ware Housses built thereon as in Philadelphia & C. Good Water is got by sinkg wells at a small depth. The above area of 51 Acres 3 Rd. 31 Perch belongs to Capt. Phill. Alexander, Capt. John Alexander, Mr. Hugh West."

This map was evidently made in 1748, when Washington was 17 years old, after his return from his surveying expedition on the lands of Lord Fairfax in the Northern Neck of Virginia, 1747-48, and subsequent to the act by the General Assembly.

In Washington's Journal of 1747-48 the only reference he makes to a survey of Alexandria follows a place where several pages are torn out. The reference reads:

The Courses of the Town of Alexandria
The Meanders of the River
S 84 Et 3 Chain
S 52 Et 4 C 17 L
S 24 E 5 C 9 L to the Point at the sm; Hickory stump above the Landing Place
S 70 E 1 C 25 L
S 45 E 3 C 18 L

The other map, "A plan of Alexandria now Belhaven," was evidently made prior to the organization of the municipal government at the first meeting of the trustees, on July 13, 1749.

Engineering Studies for Philadelphia-Camden Bridge

Location Fixed by Traffic, Street Conditions and Cost—Rock at 100 Feet Depth—Single-Span Superstructure With 135-Foot Clearance Height—Suspension Bridge Cheaper Than Cantilever

When New Jersey and Pennsylvania and the city of Philadelphia agreed to construct jointly a highway bridge across the Delaware connecting Philadelphia and Camden, about a year ago, the location and type of bridge had not been decided upon, the foundation conditions were not known, and only very rough estimates of the probable cost of the enterprise were available. The joint commissions charged with the work therefore referred these subjects to a board of engineers for study. Since the appointment of this board last October its investigation has been in progress, covering studies of traffic, of the conditions governing river clearance, of subsoil and depth to rock, and of the relative costs of different types of structure. The board reported on June 9, as noted in our issue on June 16, p. 1049. The details of its analysis of the problem as well as its results have important bearing on large bridge planning. A summary of the essential points is therefore given in the following:

Earlier studies of the project had been made by J. A. L. Waddell and by W. P. Laird. Dr. Waddell four years ago reported that a bridge would be preferable to a tunnel, and prepared a suspension bridge design with helical incline approaches. A short time later Prof. Laird made a study of the most desirable location of a high-level bridge, with the result of recommending a location terminating at Washington Square, in the neighborhood of Sixth and Locust Sts., Philadelphia. The board also had before it proposals by various parties for other crossing sites, ranging over a two-mile length of the river from Lombard to Spring Garden St., each with active partisans. The instructions to the board on the matter of location were that the three best sites in the range between South and Green Sts. should be compared and the most desirable one recommended for adoption.

As indicated by the sketch map, the Delaware River at Philadelphia is of substantially uniform width and almost straight, with pierhead lines 1,700 to 1,800 ft. apart. The water depth is about 50 ft. Shipping past Philadelphia is of small volume. On the Camden side a sharp bend not far north of the line of Spring Garden St. limits favorable locations. The shore on the Camden side is quite flat, while on the Philadelphia side it slopes up somewhat. As the Philadelphia streets are generally quite narrow, special importance attaches to minimum interference of bridge approaches with thoroughfares, and efficient distribution of traffic at the terminals.

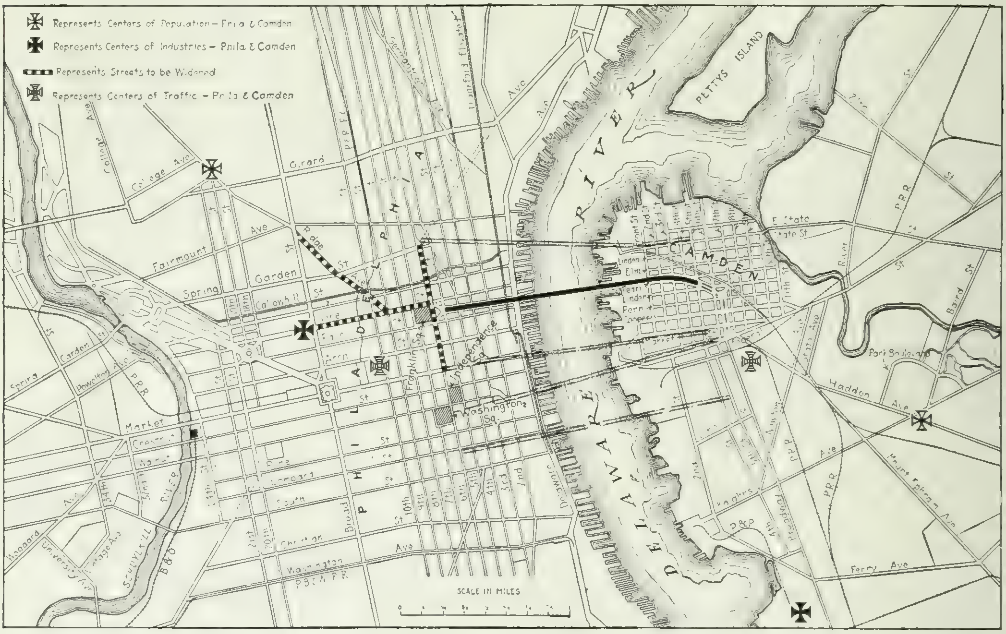


FIG. 1. DELAWARE RIVER BRIDGE LOCATION WITH RESPECT TO MAIN STREETS AND CITY FOCAL POINTS

Factors Determining the Location—Five locations were studied by the board, as indicated on the map. Each was considered with respect to the practicability of developing suitable approaches; adaptation to local obstacles such as railway terminals and yards; the amount, origin, and destination of the present cross-river traffic; the relation of the bridge to future through traffic; and foundation conditions as disclosed by core borings. At the same time the matter of navigation

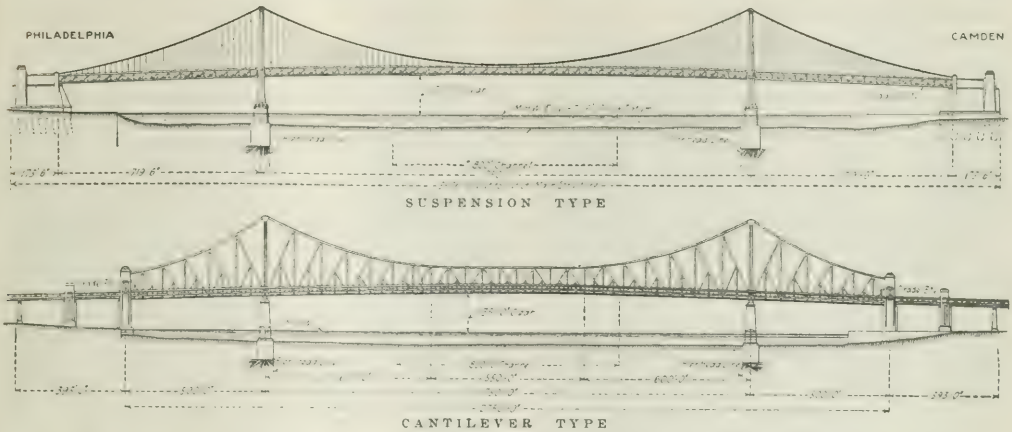


FIG. 2. SUSPENSION AND CANTILEVER BRIDGES COMPARED FOR DELAWARE CROSSING—SUSPENSION TYPE FOUND CHEAPER

clearance height was taken up with the War Department through the local engineer officer, Major L. E. Lyon.

Borings showed the underlying rock to be Wissahickon gneiss, overlaid by disintegrated rock 5 to 35 ft. deep. At the west and east banks at the three main sites the first core samples were recovered at the following depths: Spring Garden, 69.5, 111.4; Franklin Square, 86.7, 91.6; Washington Square, 111.8, 104.5.

Traffic Studies—Present ferry traffic (1920) includes about 2,500,000 vehicles and 48,000,000 passengers annually, of which 61 and 77 per cent respectively go by way of the Market St.-Federal St. ferry. Something over one-fourth of the total of passengers goes to the railway trains on the Camden side, but the larger local passenger traffic indicates the need for bridge shuttle trolley car service in addition to rapid transit car service over the bridge.

With respect to vehicle traffic, a census of origin and destination of traffic was taken on three representative week days of December, 1920, with returns from 16,269 vehicles. Because of the season, this census did not cover the farm produce trucking to Philadelphia or the coast-resort passenger touring; on the other hand, it covered the daily commercial vehicle interchange, and the long distance traffic, which two classes are stated to constitute 80 per cent of the total present ferry traffic. From the resulting data the centers of origin and destination of vehicular traffic on each side of the river were determined as marked on the map herewith; the Philadelphia center of traffic is at Tenth and Filbert Sts., while that in Camden is considerably farther south. The farm produce traffic (10 per cent of the total) is directed largely south of Market St., but summer passenger automobile traffic is mainly north of Market St., on account of the distribution of the outlying district of Philadelphia. With respect to the traffic included in the ferry census, the street distances by the five bridge routes considered from the Philadelphia traffic center to the Camden center were computed to be, Market St. route, 2.54 miles; Washington Square route, 2.65 miles; Franklin Square route, 2.9 miles; Lombard St. route, 3.0 miles; Spring Garden St. route, 3.6 miles.

Future traffic development was considered, but no reason was found for believing that the objectives of the cross-river traffic movement in Philadelphia would shift southward, especially as the center of population and of industry are both located north of Market St., as shown.

A forecast of future vehicle traffic across the river, using the rate of increase shown by ferry traffic for the past twenty years, indicates a parabolic curve with a present average daily traffic of 6,500 vehicles, an average daily peak hour of 550, a maximum daily traffic of 10,000 vehicles, and a maximum rush-hour demand of 1,250 vehicles. In 1926 it is estimated that the maximum hour's demand would be 2,000 vehicles, and in 1931 it would be 3,000, if the growth were no faster than that obtaining with the ferries alone.

Effect on Bridge Location—As Market St. and Federal St. are the east and west axes of Philadelphia and Camden respectively, a bridge connecting these streets would be central. But a bridge on Market St. would produce intolerable congestion in that thoroughfare, it was considered, and the structure would destroy the present ferry terminals and the most highly developed industrial section of Camden. The cost of land for approaches also would be excessive. In consequence the Market St. site was early eliminated. A Market St. location with two-branched approaches was rejected for the excessive cost of the double approaches and the necessary elevated plaza at the junction of approaches and main span. The Lombard St. site was rejected on account of its great distance south of Market St., held to be completely at variance with the Philadelphia traffic requirements. Further, the probable greater depth to rock and the slightly greater length of span at this site would have increased the cost. More detailed consideration was given to the other three sites—Washington Square (or Locust St.), Franklin Square (or Race St.), and Spring Garden St.

In comparing these three, the board concluded from the traffic studies that the principal demand of vehicle movement, both local and through, was for a location north of Market St., this requiring a shorter distance of travel through Philadelphia streets. The New Jersey Highways converge to the region of Sixth and Market Sts. in Camden, and with respect to through traffic any location with terminus convenient to this point would be satisfactory.

The Washington Square location was held to be objectionable because of being south of Market St., its greater cost, ($38,000,000, or 31 per cent greater than the Franklin Square structure), the inevitable absorption of Washington Square in the bridge plaza, and the reconstruction of the Camden trainshed of the Pennsylvania R.R. which it would require. Objections to the Spring Garden St. location lay essentially in the remoteness of the bridge from the heart of the city (Market St.), interference with a yard of the Philadelphia & Reading R.R. on the Philadelphia side, and with ferry terminals on the Camden side. The cost of the Spring Garden St. bridge, at first thought to be lower than a Franklin Square bridge, was found on the contrary to be somewhat greater.

The reasons for the resulting choice of the Franklin Square site may be summed up in the fact that this site was concluded to "convey traffic to its desired destination with economy and directness." Street widening of moderate amount was found sufficient for proper traffic distribution in Philadelphia: at first Vine St. from Sixth to Broad, Sixth St. or Eighth St. to Market, and Ridge Ave. from Vine to Broad, to about 80 ft. width, and later (as part of a traffic circuit planned by the city) a number of other streets.

Costs were estimated for bridges at Washington Square, Franklin Square, and Spring Garden St., at totals of $38,650,000, $28,871,000, and $29,480,000, the cost figures thus also favoring the Franklin square location.

River Clearance Requirements—Request was made by the board to the War Department for approval of a bridge structure providing a single span between pierhead lines at a clear height of 135 ft. for the central 800 ft. of the span. After a public hearing and consideration of the shipping and naval interests affected, this request was granted. Demand had been previously made by commercial and shipping interests for greater clearance, but the evidence presented by the board of engineers in favor of the lower clearance appeared to cover all the factors involved.

The board urged that the East River bridges at New York City have a clearance of 135 ft. (133 ft. for the Brooklyn Bridge) above mean high tide, and that both merchant and naval vessels are built accordingly; that lower clearances exist in other important thoroughfares of the world (Kiel Canal, 138 ft.; Manchester Canal, 74½ ft.; Willamette River, Portland, 135 ft.); that all the U. S. Shipping Board vessels would be suited by a 135-ft. clearance, and all naval vessels with top masts housed; that of five months' shipping traffic at Philadelphia, every one of 710 steamships and all but nine sailing vessels could have passed under the proposed bridge; that sailing vessels generally dock in the south part of the city, and 80 per cent of all shipping docks below the Franklin Square location; and that the only vessels which could not pass, the largest liners of foreign construction would pass under the bridge by arranging to house their top masts.

Capacity of Bridge—Highway traffic being the principal service to be accommodated, the roadway capacity was the first point to be investigated. A study was made of the operation of the roadways of the four East River bridges at New York City. The Brooklyn bridge with one roadway in each direction, the Williamsburgh bridge with a two-lane roadway in each direction, and the Manhattan bridge with a single four-lane (35-ft.) roadway, were found inadequate, the Williamsburgh bridge because breakdowns easily block traffic, and the Manhattan bridge because of trouble in passing on the inner or fast lines of traffic. The roadway of the Queensboro bridge, 53 ft. 2½ in. between curbs, carrying usually six lines of traffic, adapts itself with great flexibility to the traffic and has ample capacity. It was concluded that six lanes should be provided on the Delaware bridge, but the allowance per lane was increased to 9½ ft., making a total width between curbs of 57 ft.

In view of the necessity of providing bridge shuttle-car service and separate rapid-transit service, two tracks in each direction were also provided, outside of the 57-ft. roadway; and two 10-ft. pedestrian ways were considered necessary.

For the vehicle roadway and the tracks, maximum grades in the neighborhood of 3 per cent and 5 per cent respectively were considered desirable limits. The actual design allowed the maximum roadway grade to be kept down to 3½ per cent and the track grade to 5 per cent, except for 5.22 per cent grade for a short length of the rapid-transit approach.

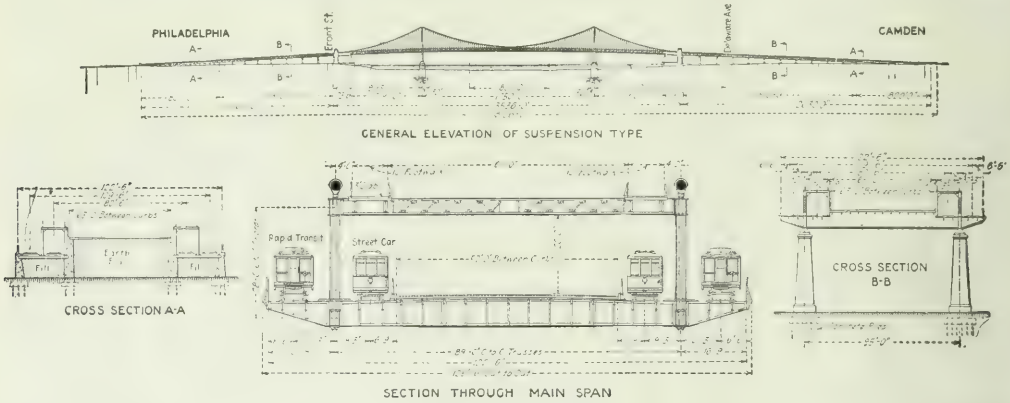


FIG. 3. SUSPENSION BRIDGE RECOMMENDED BY BOARD OF ENGINEERS—TWO PARALLEL-WIRE CABLES, SHALLOW STIFFENING TRUSSES, AND SIX-LANE ROADWAY

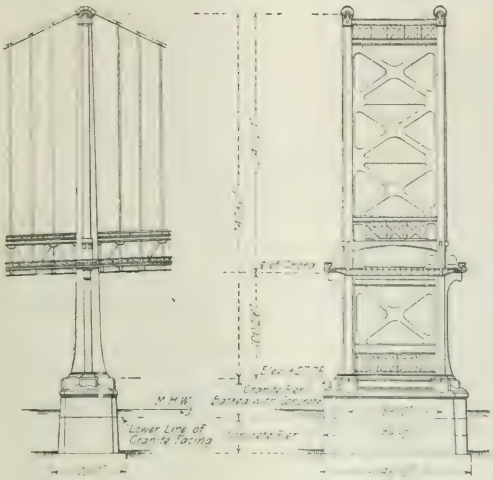


FIG. 4. FLEXIBLE STEEL POSTS WITH CABLES ANCHORED TO SADDLES

Loads—Congested or extreme loading was computed at 2,000 lb. per foot of rapid-transit track, 1,500 lb. per foot of surface-car track, 70 lb. per square foot of roadway, and 50 lb. per square foot of footway, making a total of 11,990 lb. per lineal foot of bridge. Therefore, 12,000 lb. per foot was taken as the congested or emergency loading and half this amout as normal full loading (infrequently reached). Other assumptions were: Floor load, 30-ton concentration; impact on floor and direct carrying parts, but not on main members; wind, 50 lb. per square foot exposed area; temperature variation, 55 deg. from normal.

High-strength alloy steel was decided upon for the main parts of the structure, and high-carbon steel wire for cables and hangers of the suspension bridge design. A unit stress of 72,000 lb. per square inch in the cable wires was considered permissible under the emergency live loading and 60,000 lb. under normal full loading.

Type—With a distance of 1,690 ft. between pierhead lines or 1,750 ft. between pier centers at the Franklin Square location, only suspension and cantilever structures were considered available. Arch construction was believed out of the question because of the depth to rock. The advantage of superior rigidity possessed by the cantilever bridge was believed to be negligible in highway service. The cantilever saves a large item of cost in simpler anchorages and approach construction. The suspension bridge, on the other hand, is not only very much lighter, but was considered to involve less risk in construction, to be adapted to subdivision of contracts, to require less time to build, and to be cheaper in maintenance on account of having less metal exposed. It was also considered to have the esthetic advantage over the cantilever bridge.

Detail designs and comparative cost estimates showed a difference of $1,986,000 in favor of the suspension bridge. The weight of metal in the two structures was 47,000 tons for the cantilever and 33,000 tons for the suspension bridge (the latter including more costly material and more expensive anchorages, however). The cost comparison, the greater ease and safety of erection, and the shorter time required for construction were the reasons for deciding to recommend the suspension bridge.

Suspension Bridge Design—As the proposed span exceeds by 150 ft. the longest existing suspension bridge span in the world its design elements are of exceptional interest.

Suspended side spans were adopted, since the local conditions require that the anchorages be set a considerable distance back of the towers. Street conditions made it convenient to fix the length of the side spans at slightly less than half the main span, a desirable ratio. The sag of the cables was set at 200 ft., as the most desirable compromise between increased cost of towers and increased stresses in stiffening trusses, cables and anchorages.

In fixing the width of the bridge the deck arrangement had first to be determined. It was desired to avoid double-deck construction because of the complication of the approaches resulting therefrom. By placing the footways on the upper lateral bracing, a single deck of practicable width was obtained. A single roadway was

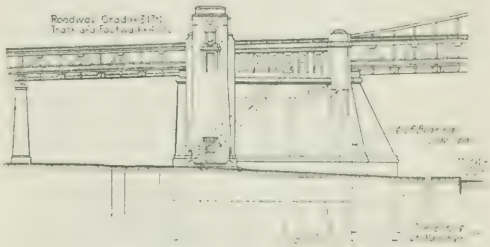


FIG. 5. ANCHORAGE WITH INCLINED CYLINDER FOOTINGS

considered desirable. The deck arrangement resulting is shown by a cross-section. The spacing of main cables is 89 ft.; a two-cable arrangement was considered preferable to a four-cable. This called for 30-in. cables, which represent a large increase over the 15¾-in. cables of the Brooklyn bridge, or even the 18⅝-in. and 20½-in. cables of the Williamsburgh and Manhattan bridges. Each cable will be composed of 16,500 parallel wires, 0.192 in. diameter.

Hangers, spaced about 20 ft., consist each of four 2⅝-in. galvanized wire ropes attached to a cast-steel saddle. A short panel length was considered desirable for the stiffening trusses (20.5 ft. for main span, 20.75 ft. for side spans). The trusses are relatively shallow (28 ft.), for economy and for efficient distributing function of the suspension system as a whole. The trusses are of simple triangular web system, are continuous across the span, and are supported at the towers by stiff hangers.

As in the Manhattan bridge, the towers are solid built steel posts bearing the cables firmly attached to their saddles (instead of having movable saddles on rollers). The necessary bending of the towers is allowed for in the design. The cross-section of each post increases from 7 x 12 ft. at the top to 7 x 40 ft. at the base.

A simple steel floor system, a concrete slab roadway structure with wood block paving, and open tie floors for the railway tracks constitute the essential features of the deck. The pavement, the only inflammable

material used in the bridge, is considered to be free from fire danger because of its support on a concrete slab.

Careful attention to proportions in the design of masonry and other details was depended upon for beauty of appearance. The results are evident in the general drawings.

Of the total cost of the suspension design for the Franklin Square site, $22,479,000 represents construction cost and $6,392,000 real estate cost. The construction cost, in turn, is made up of $13,355,000 for the main bridge, $6,468,000 for the approaches, plazas, sewer and grade revision, etc., and $2,656,000 for engineering administration and contingencies. The board of engineers believes that the design recommended can be completed by July 4, 1926.

The board consists of Ralph Modjeski, chairman, George S. Webster, and Laurence A. Ball. Its engineering staff included L. S. Moisseiff as consulting designing engineer, Paul P. Cret as architect, Arnold W. Brunner as consulting architect, Clement E. Chase as principal assistant engineer, and E. B. Bergendahl as chief draftsman and assistant engineer. The news article in last week's issue erroneously stated, p. 1052, that Mr. Webster was chairman of the board of engineers.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Concerning Business Prophecy

Sir—Regarding your editorial "Gary Hopeful" in the issue of June 2, p. 921, let us hope he is nearer right in his views on the business outlook than he was a little over a year ago when he "could see no dark clouds ahead" and was predicting three to five years of prosperity for the United States. Our political economists' views of the future business conditions have been nearer correct in the past two years than our big business men like Gary, Schwab and Ryan. R. E. WHITE.

Los Angeles, Cal., June 10.

A Rainmaker's Contract with Alberta Farmers

Sir — In January of this year a contract was executed between the United Agricultural Association of Medicine Hat, Alberta, Canada, and Charles N. Hatfield, a professional "rainmaker," which has some features that will interest irrigation engineers. The chief features of the contract are as follows:

"Said Hatfield hereby agrees to construct and build a rain precipitation and attraction plant at a favorable site to be chosen by him for its operation. Said plant to be kept in constant operation from the first day of May, 1921, to the first day of August, 1921, in the endeavor to bring about the largest possible increased precipitation over and about that portion of Alberta, Canada, within a radius of 100 miles of the city of Medicine Hat. The operations of said Hatfield tend to contribute a 100 per cent increase over and above natural rainfall.

"It is hereby understood and agreed that all rain falling from the first day of May, 1921, to the first day of August, 1921, in the above district that said Hatfield, through the efforts of his operations on the atmosphere, shall be given credit for one-half of the precipitation that falls, at a uniform rate of $4,000 per inch up to 4 in. or fraction thereof. The maximum consideration of this contract being $8,000 for a 4-in. rainfall. All rainfall in excess of 4 in. no extra charges whatsoever."

In a letter to R. S. Stevens of Gulf Lake, Sask., Mr. Hatfield, in referring to his Alberta contract states, "The fact is that these operations upon the atmosphere produce an increase upon the rain that falls naturally. Whatever your natural rainfall is to be, a 100 per cent increase is the result. My contract calls for the maximum of 4 in. during this period, but I wish to state for the benefit of the united farmers of Alberta that this amount will be far exceeded. Candidly I believe that with the powerful operations that are to be conducted this summer in your field that fully 8 or 10 in. will be forthcoming."

It is interesting to note that records of the Weather Bureau Station at Medicine Hat since 1884 show that in only nine of those 37 years has the precipitation been below 4 in. during the three months period covered by this contract and that the average over this 37-year period is 6.04 in. for the three months mentioned. Hence it may be concluded that a 4-in. rainfall during the summer of 1921 could quite reasonably be expected. K. T. ROBERTS.

Los Angeles, Cal., June 10.

Concrete Casing of Steel Chimneys

Sir—In *Engineering News-Record* of May 19, p. 855, a description is given of the "felling of four steel chimneys lined outside with concrete," these chimneys being taken down for the reason that they tilted as much as 4 ft. 8 in. out of perpendicular and for this reason the concrete lining was not successful. In *Iron Age* of April 28, 1921, a case is cited of four stacks larger and taller than the ones previously referred to and apparently treated in the same way, but after two years an inspection revealed nothing by way of defect excepting superficial cracks.

The difference between the method of applying the concrete in the two cases, in the former case the concrete having been applied to the stocks when they were cold and in the latter case when they were hot, may have been the cause of different results. We do not understand that the stacks which you mention were lined with brick, but it would be interesting to know the cause of successful installation in one case as against unsuccessful installation in another case. LUKENS STEEL COMPANY,

Alfred Goodfellow, Chief Construction Engineer.

Coatesville, Pa.; June 3.

[It is a fact that large numbers of steel stacks have been cased with reinforced concrete by the cement-gun process with successful results. The reasons for failure of the four stacks at Kewanee are given in the following letter.—Editor.]

Sir—Replying to your inquiry of June 9, regarding concrete encased steel smokestacks in our plant, we are pleased to give you the following information relative to their construction and service. The chimneys were unlined, self-supporting steel stacks, erected in the winter of 1912 and 1913. In 1916 they were enclosed in a concrete shell 6-in. thick at the bottom and 5-in. at the top. This concrete was placed while the stacks were cold, the steel forming the inner form.

Soon after the stacks were put in service after they had been encased, cracks developed in the concrete, gradually becoming worse, and before the oil fuel had been used we had discussed seriously the matter of replacing them. The stack serving the fourth boiler, in which no oil was used, disintegrated more rapidly than the others and has already been replaced, indicating that the use of oil as fuel in the furnaces was not directly concerned with the failure of the concrete. We believe that the failure of the concrete shells was due to three causes: (1) Poor quality of concrete; (2) no provision for expansion of the steel; (3) insufficient time allowed for the concrete to set before the boilers were put in service. WALWORTH MFG. CO. (Kewanee Works),

By C. S. STAUFFER, Works Engineer.

Kewanee, Ill.; June 13, 1921.

HINTS FOR THE CONTRACTOR

Contractor Saves Rope in Hanging Chutes

By C. W. Garrison
The Lakewood Engineering Co.

THE Arthur Tufts Co. employed an economical method of hanging concreting chutes on the construction of the new Coca-Cola plant at Baltimore. From the load line, which is hung over the top of the tower, single lines of wire rope were dropped to which were attached the regulation double and single manila rope

CHUTE SUSPENDED FROM LOAD LINE WITH MANILA ROPE BLOCKS

blocks for raising and lowering the chutes. Each single line of wire rope takes the place of a double length of manila, and also shortens the length of lead line.

Power Operated Scraper Shortens Haul on Tunnel Muck

IN THE process of enlarging tunnel sections on the Southern Pacific Railroad over the Techahapi grade, muck is brought out of the tunnels on the down grade by gravity in ½-cu.yd. dump cars and the cars are pushed back up grade by hand. Where the approach to the portal is for some distance in cut, so that a haul considerably beyond the portal would be necesasry to reach a point where the muck cars could discharge on a dump, it has sometimes been found economical to install near the portal a power-operated scraper for handling muck over the outer bank of the cut. Where the outer bank is not too high this operation is not costly, the power rig is operated by one man and considerable saving is made in getting muck cars and men back into the tunnel quickly.

The accompanying installation shows the tunnel muck cars dumping into a cut made at right angles to the

MUCK CAR DUMPING INTO CUT

track in which a scraper is operated back and forth by means of snatch blocks at each end of the haul. A gasoline engine that supplies the motive power for the scraper is just out of the picture to the left.

Dry Masonry Laid as Riprap

By F. W. Epps
Bridge Engineer, Kansas State Highway Commission

THIS job of riprap on federal-aid road project No. 6 in Bourbon County, Kansas, is notable for the care which was exercised in laying up the slopes to true lines and carrying the slope around the bridge abutments on true curves. The masonry was laid to a series of lines stretched from the shoulder to the toe of slope.

LAYING RIPRAP SLOPES TO TRUE LINES

The stone for this work was hauled 2½ miles from an old rock fence; 270 cu.yd. of rock were hauled which covered 711 sq.yd. of riprap. The following data was obtained:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Cost of Dressing Slopes ..	[illegible]
Cost of Laying Rock	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

This work was under the supervision of the Kansas State Highway Commission, Blair Boyle, resident engineer, and L. P. Scott, division engineer.

NEWS OF THE WEEK

New York, June 23, 1921

Delaware Bridge Commission Holds Hearings

Public hearings to consider arguments for and against the several sites advocated for the Delaware River bridge (Philadelphia to Camden) were held by the Delaware River bridge Commission during the past week. These hearings followed the report of the board of engineers, rendered June 9 as noted in last week's issue, p. 1049. A detailed report on the engineering features of the structure selected appears on p. 1086 of this issue.

Three new members were recently appointed to the Pennsylvania commission, one to fill a vacancy. They are Samuel M. Vauclain, president of the Baldwin Locomotive Works; Richard Wegelein, of the Philadelphia City Council, and Thomas J. Jefferies. Mr. Vauclain has hitherto been active in discussion of the bridge project as an advocate of the Spring Garden St. location, the most northerly of the five sites considered by the board of engineers. He has stated, however, that as a member of the commission he will have no bias in favor of any location. The board of engineers reported in favor of a more southerly location at Franklin Square, Philadelphia.

To Hold Conference on International Standards

The conference of secretaries of national standardizing bodies held at London recently reached the view, as reported by Dr. P. G. Agnew, secretary of the American engineering standards committee, that international co-operation in industrial standardization work should proceed along informal lines, and that attempts to form a general international standardizing body are not desirable at the present time. However, arrangements are being made for close co-operation between the national standardizing bodies and the International Chamber of Commerce, which will give special consideration to standardization at its convention in London during the week of June 27.

The meeting of secretaries was attended by R. J. Durley, for Canada; G. Gerard, for Belgium; C. le Maistre, for Great Britain; E. Hijmans, for Holland; A. Eriksen, for Norway; M. Zollinger, for Switzerland, and Dr. Agnew.

Arkansas Seeks Highway Engineer

A state highway engineer in Arkansas is wanted to replace V. P. Knott, recently resigned. The salary of the position is $5,000 a year. Applications may be addressed to Herbert R. Wilson, state highway commissioner, at Little Rock.

Denver Water Bonds Not Voted

The $5,000,000 bond issue for conduits, filters and distribution mains for the Denver water-works system voted upon May 19 were defeated despite the efforts of the business associations and a strenuous educational campaign indicating that delay would likely result in a water famine next season. Petition for a separate election this fall on the water question alone will be filed as soon as it is legally possible to do so.

Bill to Amend Valuation Act Opposed by Carriers

At hearings held June 10-11, before the Senate committee on interstate commerce counsel for the carriers opposed a bill introduced by Senator Cummins, chairman of the committee, to relieve the Interstate Commerce Commission of the duty of reporting separately the "present cost of condemnation and damages or of purchase in excess of such original cost or present value" of carrier lands. The bill if passed would amend the Valuation Act by striking out that portion requiring the Interstate Commerce Commission to find and report separately such additional costs of acquiring right-of-way. Hearings were held before the subcommittee during May and its members indicated that they favored the amendment. In the hearing held June 10 and 11 before the entire committee, however, a decided sentiment against the amendment was indicated on the part of some of the committee members.

Passage of the bill would halt the work of ascertaining present cost of acquisition of railroad lands over and above acreage value of adjoining lands, now being carried on by the Interstate Commerce Commission in obedience to the writ of mandamus issued by the Supreme Court in the Kansas City Southern case, March, 1920. The view is held that passage of the amendment would also amount to legislative approval of the methods so far used by the Interstate Commerce Commission of determining "present value" of land since it would constitute a virtual reenactment of that portion of the Valuation Act with the knowledge of Congress of methods so far used and reported to it by the Interstate Commerce Commission.

It is expected that the bill will be reported out of committee for vote by the Senate before the close of the month. It is sponsored by Director Prouty, of the Bureau of Valuation, and by John E. Benton, general solicitor, National Association of Railway and Utilities Commissioners.

John Fritz Medal Awarded to Eugene Schneider

The John Fritz medal board of award has awarded its gold medal and diploma to Charles Prosper Eugéne Schneider, the distinguished French engineer, scientist and man of affairs. The following cable has been sent to his home in Paris: "John Fritz medal board of award representing national societies of civil, mining and metallurgical, mechanical, and electrical engineers, has awarded you the Jonh Fritz gold medal for achievement in metallurgy of iron and steel; for development of ordnance, especially the 75-mm. gun; and for notable patriotic contribution to the winning of the war."

Mr. Schneider heads the great Creusot engineering and steel works and shipbuilding plants of France, which, with their subsidiaries, have 100,000 employees. No industrial establishment in the whole world, the board of award states, made a greater contribution to the defense of liberty or showed more wonderful resourcefulness under the stress of war from 1914 to 1918.

Not only did Mr. Schneider and members of his family fill leading places in the industrial and scientific defense of civilization, but his three sons also fought and received honors. Two were in the aviation service, and one in the artillery. The eldest was killed in an air fight in 1918.

Railroad Committee to Work With New York Port Authority

A board of eleven engineers, representing railroads terminating at the port of New York, was appointed June 16 by the presidents of the railroads to co-operate with the Port of New York authority in developing a plan to solve the railroad terminal problems of the port. This action was determined upon at a meeting of eastern railway presidents in New York, June 10, called by Samuel Rea of the Pennsylvania system. The board of engineers consists of: H. A. Lane, chief engineer, Baltimore & Ohio R.R.; A. E. Owen, chief engineer, Central Railroad of New Jersey; G. W. Kittridge, chief engineer, New York Central Lines East; G. J. Ray, chief engineer, Delaware, Lackawanna & Western R.R.; G. T. Hand, chief engineer, Lehigh Valley R.R.; R. C. Falconer, assistant to the president and chief engineer, Erie System; L. V. Morris, chief engineer, Long Island R.R.; E. Gagel, chief engineer, New York, New Haven & Hartford R.R.; J. H. Nuelle, general manager, New York, Ontario & Western Ry.; E. B. Temple, assistant chief engineer, Pennsylvania System, and S. T. Wagner, chief engineer, Philadelphia & Reading Ry.

Amendments Made in Dowell and Townsend Bills

Proposed Federal Commission Reduced From Five to Three Members—66-Ft. Width Eliminated

(*Washington Correspondence*)

In recommending last week that the Phipps bill, with the Dowell rider, be passed, the House committee on roads explained that the measure has been amended so as to give states whose constitutions and laws might have to be changed as much as three years to meet the requirement as to the state's being the unit for dealing with the federal government and for attending to highway maintenance by the state.

Another change provides that 50 per cent of the appropriation for forest roads is to be expended on roads embraced in or constituting necessary extensions of the main systems of roads. The remaining 50 per cent of the allotment is to be expended by the Secretary of Agriculture for forest roads as the necessity may require. If at any time the annual appropriation exceeds $6,000,000 the amount in excess is to be used entirely on main highways.

Townsend Bill Changes

The Townsend bill, as finally agreed upon by the Senate committee on post offices and post roads last week, has been amended so as to reduce the proposed federal highway commission from five to three members. Another amendment provides that no salary, except that of the chief engineer, shall exceed $5,000 per annum and that the salaries to be paid other employees shall not exceed those paid in other departments for similar service.

In an effort to meet the objection that the state highway commissions would have too little voice in the selection of the roads, the bill was amended so that the federal commission would select these roads "in co-operation with the several state highway departments."

In providing for the situation which will arise if a state should refuse to co-operate in the construction of secondary highways, the committee adopted a proviso as follows: "If any state highway department fails, neglects or refuses to so co-operate or agree with the commission, the commission may then determine the selection, designation and establishment of the route or routes."

So as to make the maintenance clause stronger, the commission is given the additional authority to refuse approval of projects in any state until a proper condition of maintenance has been established. If it should be necessary for the federal commission to place the highway in proper condition, the cost is to be charged against the funds allotted to the state. At that point this provision was added: "Upon the reimbursement by the state of the amount expended by the federal government for such maintenance, said amount shall be paid into the federal highway fund for the benefit of said state in the construction of other roads under this act, and the commission shall then approve further projects submitted by the state."

The committee struck out the section of the original bill providing for a right-of-way not less than 66 ft. wide and inserted the following language: "That all highways in the interstate system constructed after the passage of this act shall have a right of way of ample width and a wearing surface of an adequate width which shall not be less than 20 ft., unless in the opinion of the commission it is rendered impracticable by physical conditions, excessive costs, probable traffic requirements or legal obstacles."

Ideal Highway Section to Be Built in Indiana

The State of Indiana, through its state highway commission, has entered into a contract with the Lincoln Highway Association to provide $33,000 per mile to aid in the construction of an ideal section of the Lincoln Highway, to be built in Lake County, Ind. The association's plan provides for the construction of two miles of the ideal road. The specifications call for a 100-ft. right-of-way and a pavement 40 ft. wide of 10-in. reinforced concrete. Sub-surface drainage and the beautification of the outer 25 ft. of the right-of-way on each side. The ideal section will also be lighted for night traffic in accordance with plans now being prepared by the illuminating experts.

N. C. Licensing Board Meets

The North Carolina board of registration for engineers and land surveyors, created by the General Assembly at its 1921 session, held its initial meeting in Raleigh on May 23. Charles E. Waddell of Asheville was elected chairman, Gilbert White of Durham, vice-chairman, and Prof. Harry Tucker of Raleigh, secretary-treasurer. The board hopes to send out application blanks to the engineers in the state in the course of the next few weeks. The other members of the board are Prof. P. H. Daggett of the State University and N. S. Mullican of Mocksville.

Chief Engineer of Doherty Co. Is New N. E. L. A. President

Milan R. Bump, since 1910 chief engineer of Henry L. Doherty & Co., in charge of all engineering and of the construction and operating departments of the public utility division, was elected president of the National Electric Light Association on June 3. The convention of the association was held in Chicago. Mr. Bump, for four years vice-president of the association, succeeds Martin J. Insull.

Idaho License Examination

The next examination for Idaho civil engineers and surveyors seeking licenses will be held in Boise Sept. 13. Application blanks and full information may be had from the Bureau of License, Capitol Building, Boise, Idaho.

Colorado Floods Again Threaten Imperial Valley

The annual flood waters of the Colorado River are threatening the dikes and levees that constitute the first line of defense of the Imperial Valley in Southern California. Although the flow this season has not been as large as that of last year, the gage height is above last year's maximum due to the silting up of the channel. Several hundred men have been strengthening the Saiz and Ockerson levees with sand bags, but on June 14, according to press reports, efforts to save the Saiz levee were discontinued after it had been submerged by back water coming around the lower end of the Ockerson levee. The latter might hold, it was believed, although it had become well saturated, and there was danger that the levee might "sugar away" in several places.

Directors of the Imperial Irrigation District are stated to have voted $20,000 to construct a railroad two miles long from an old quarry to the Ockerson levee to deliver rock for strengthening the levee. The present danger is believed to be chiefly to land south of the international line. The Volcano Lake levee protecting land north of the line was intact on June 14, at which time, however, the water was not believed to have reached its highest level. The Volcano Lake levee has had a free-board of more than 3 ft. on previous floods, its water face has been well rip-rapped and a railroad has been laid on top for practically the full length.

Five New Engineer Colonels

The following engineer officers were nominated in May by the President to be promoted from the rank if lieutenant colonel to colonel: James A. Woodruff, William Kelly, Lewis H. Rand, Edward M. Markham, Thomas H. Jaskson.

The following engineer officers have been detailed as instructors at the General Service Schools at Fort Leavenworth, Kansas: Major Richard C. Moore, Major Mark Brooke, and Major Warren T. Hannum.

Engineering Educators to Meet

The Society for the Promotion of Engineering Education will hold its annual meeting at New Haven, Conn., June 28-July 1, 1921. The discussion will be divided into three general topics, namely, the curriculum, the student, and the faculty. Following the address by President Hadley of Yale, William H. Burr, professor emeritus of civil engineering, Columbia University, will speak on "General Studies in the Engineering Curriculum," to be followed by Dr. W. F. M. Goss, on "Engineering Teaching and Practice." Included in the discussion under the second topic is a paper, "Some Results of the Co-operative System," by J. W. Hallock, director of co-operative work, University of Pittsburgh. Discussion of "The [illegible]" and [illegible] of a symposium on the training of engineering teachers.

A. A. E. and F. A. E. S. Confer

Informally and unofficially, June 3, at St. Louis, previous to the meeting of the executive board of the American Engineering Council, representatives of that body conferred with officials of the American Association of Engineers for the purpose of finding a way to develop closer relations between these two national organizations.

Unanimous conclusions were reached to the effect that: (1) there should be unity in the profession; (2) duplication of effort is undesirable and an economic waste; and (3) it is desirable to create a conference committee to consider closer co-operation. At the meeting of the executive board of the council a committee consisting of the presiding officers, C. W. Townley, L. W. Wallace, secretary and D. S. Kimball, dean, mechanical engineering, Cornell University, was appointed to confer with the A. A. E. representatives.

Alameda Naval Base Rejected

By a non-partisan vote of 40 to 30 the Senate, on May 23, voted out of the naval bill an appropriation for $1,500,000 for development of the $100,000,000 naval base recommended by the joint Congressional naval committee for Alameda, Cal. The relative advantages of this site and two others on San Francisco Bay—one at San Francisco and the other at the existing navy yard at Mare Island—were noted in *Engineering News-Record,* Dec. 30, 1920, p. 1290. The Alameda site won out in the report of the committee which investigated the sites, but the current action of the Senate postpones, at least the prosecution of the project.

Kimball Named for A. S. M. E. Head

Dexter S. Kimball, dean of the college of engineering, Cornell University, was nominated president of the American Society of Mechanical Engineers in the report of the nominating committee for 1921, submitted to the society's council May 24 at the spring meeting of the society held in Chicago May 23-26. Dean Kimball has been active in the work of the society, having been chairman of the committee on meetings and programs and member of the committee on organization. He is a vice-president of the Federated American Engineering Societies.

Endorse Completion of U. S. Maps

The board of direction of the American Society of Civil Engineers, at its meeting June 6, passed a resolution endorsing House bill 5230, now pending at Washington, D. C., which provides for the completion of the topographic surveys of the United States. The preamble to the resolution states that with the completed topographic maps the saving in cost of public and private works constructed in the next decade will more than offset the expense involved.

Michigan Legislature Passes Port District Resolution

The resolution which aims to form port districts of cities in Michigan on the Great Lakes was passed by the House of Representatives of the Michigan Legislature June 7, by a vote of 69 to 16. This action provides for submitting the question to the voters at the next regular election. The purpose of the measure is to create means of administration for the development of ports in connection with the proposed St. Lawrence waterway.

Federal Commission for Waste Elimination Proposed

A federal commission to study waste elimination in industry is proposed in a bill which has been introduced by Senator Calder. The bill is intended to continue and to amplify the survey made by the Federated American Engineering Societies at the instigation of Herbert Hoover, who at that time was president of the organization.

Senator Calder's bill provides that the commission is to be known as the United States Industrial Waste Commission. It is to be composed of seven commissioners "of eminent attainment," appointed by the President. The bill specifies that the Secretary of Commerce is to be the chairman of the commission. The commission is directed by the bill to make a final report on or before Sept. 21, 1922, covering waste in "timber, power, transportation, oil, coal, essential minerals and other basic raw materials," and to recommend improved methods and means of eliminating intermittent and seasonal production. The commission is to serve without salary.

Favor Cape Cod Canal Purchase

Congress is to be asked by the Secretary of War to approve the purchase of the Cape Cod canal by the government for $11,500,000. The canal company was taken over by the Railroad Administration during the war and administered by it until Feb. 25, 1920. The canal company declined to take back the property, claiming that it had been purchased by the government. It has been operated by the War Department since control was relinquished by the Railroad Administration.

Some time ago the Secretary of War tried unsuccessfully to reach an agreement as to the price which should be paid by the government for the property, and condemnation proceedings were later instituted by the Attorney-General. The District Court approved the valuation of $16,651,000. This judgment was not sustained by the Circuit Court of Appeals, which was of the opinion that various errors existed in the method of computing and ascertaining the value of the property. The price of $11,500,000 was agreed upon by the Secretaries of War, Navy and Commerce.

Engineers Before Labor Board

The Southern Pacific Railroad cited the Southern Pacific Section of the American Association of Engineers to appear before the U. S. Labor Board June 6 for the adjustment of railroad compensation and working conditions. This appearance was brought about in connection with an effort of the company to reduce salaries of engineers and at the same time a request of the engineers for an increase. C. E. Drayer, national secretary, R. C. Bailey, in charge of chapter activities, and W. H. Phelps of the A. A. E. section, represented the engineers.

The argument cited the differential in compensation operating against the technically-trained professional men and the application, on the part of the railroads, of decision 2 of the U. S. Labor Board which did not specifically mention the professional engineer. The engineers did not appear before the board and were apparently not in its mind when decision 2 was drafted. Exhibits were presented to show that an increase rather than a decrease should be put into effect to bring the present schedule to the minimum schedule of the A. A. E. A decision is expected by July 1.

Would Establish Department of Mines

A determined movement has been launched looking to the establishment of a new federal department which will administer matters pertaining to mines and the mineral industries. Two bills have been introduced in the Senate, one by Senator Nicholson of Colorado, and the other by Senator Shortridge of California. The Nicholson bill provides that the proposed department be composed of the U. S. Geological Survey, the Bureau of Mines and the General Land Office, and absorb the functions of the War Minerals Relief Commission. The Shortridge bill is more comprehensive, in that it would include in the department, in addition to the agencies mentioned by the Nicholson bill, the Federal Power Commission, the California Débris Commission, the Alaskan Engineering Commission and the Bureau of Explosives of the Interstate Commerce Commission. In addition, that portion of the work if the Bureau of Standards and of the Indian Office which deals with mineral raw materials or mineral lands would be transferred to the department of mines. The Shortridge bill takes over only the mineral land work of the General Land Office.

Film to Picture Road Changes

A film designed to portray the evolution of road construction and administration and entitled "The Changing Road" is being produced by James W. Brooks of the American Highway Educational Bureau, Washington, D. C. It is intended for use by state highway departments, good road associations, engineering colleges and civic organizations.

Secretary Fall Against Yellowstone Park Dam

An adverse report has been made by the Secretary of the Interior on the Walsh bill in which permission is asked to build a dam across Yellowstone River at a point not more than 3 miles below the outlet of Lake Yellowstone. The object is to regulate the waters of the lake for irrigation purposes. In his report, Secretary Fall says, in part:

"I cannot favor the enactment of the measure. I do not believe it would be advisable for Congress to permit private interests to develop irrigation or power sites within the limits of existing national parks. These parks were created by Congress for the preservation of the scenery, forests and other objects of beauty and interest in their natural conditions and they are created and maintained for general and national purposes, as contradistinguished from local developments.

"If cases be found where it is necessary and advisable in the public interest to develop power and irrigation possibilities in national parks and it can be done without interference with the purposes of their creation, I am of the opinion that it should only be permitted to be done, whether through the use of private or public funds on specific authorization by Congress, the work to be constructed and controlled by the federal government."

Syndicate Buys New York Barge Canal Equipment

A large part of the New York State Barge Canal equipment previously operated by the Inland and Coastwise Waterways Service of the War Department has been purchased for $1,000,000 by a New York syndicate. The bid of the syndicate covered the purchase of the entire remaining equipment, on a deferred payment basis over a period of seven years. The initial payment is $75,000 with subsequent payments of $100,000 on Jan. 1, 1922, and $75,000 on July 1, 1922. The balance will be paid in equal monthly installments over the remainder of the period of seven years, deferred payments bearing interest at 5 per cent. The government is protected by insurance of the vessels carried by the purchaser and by bonds to cover maintenance and the first four payments. The syndicate is composed of Edward S. Hughes, E. G. Warfield, W. L. Williams, George Kern, and James G. Trainer. Its offices are at 1270 Broadway, New York City.

Reclamation Measure Progresses

The Senate committee on public lands has reported out and recommended the prompt passage of the rural homes bill, authorizing the Secretary of the Interior through the Reclamation Service to make contracts, first for the investigation and later, if found feasible, for the construction of projects for the reclamation and development of lands in private ownership located throughout the United States.

Governor of Pennsylvania Vetoes Grade Crossing Bill

The bill passed by the legislature providing for the elimination annually of 2 per cent of all of the grade crossings in Pennsylvania was vetoed by the Governor May 26. It provided that one year after the passage of the act every railroad company operating within the state should remove "at least two per centum of the total number of grade crossings on its *main* lines . . . and shall each year thereafter remove at least two per centum of the total number of grade crossings remaining upon its lines within the Commonwealth." In vetoing the bill the Governor said that its purpose was commendable, but its enforcement would be impracticable, if not impossible. It would cost one railroad, with 3,000 crossings, from $6,000,000 to $10,000,000 a year, which the Governor said would bankrupt the weaker lines.

Trestle Collapse Due to Freshet

Failure of a timber trestle under a passenger train on the Chicago & Northwestern Ry., near Whitney, Neb., June 15, was due to undermining of a few bents by a heavy freshet which occurred about two hours before the accident. Some large trees lodging against the bents caused the current to scour out the channel. The trestle had twenty-one spans about 16 ft. long and seven or eight of these failed under the train. The engine crossed safely but most of the cars were wrecked, four or five persons being killed and several injured.

Health Association Plans Fiftieth Annual Meeting

The tentative date of the fiftieth annual meeting of the American Public Health Association has been set as Nov. 13-18. The meeting will be held in New York City where the first meeting of the association for organization was held April 18, 1872. It is expected that Dr. Stephen Smith, founder and first president of the association, who is now in his 99th year, will take part in the semi-centennial celebration. Another feature of the meeting will be reviews of progress in various branches of public health work within the last fifty years. Besides the general meeting there will be the usual sectional meetings devoted to sanitary engineering, laboratory work, vital statistics, public health administration and other subjects. The secretary of the association is A. W. Hedrich, 169 Massachusetts Ave., Boston, Mass.

Adams Leaves Research Council

Prof. C. A. Adams has decided definitely to give up his work as chairman of the division of engineering of the National Research Council and to return to Cambridge, Mass., to give his full time to his work as professor of electrical engineering at the Harvard Engineering School.

Agree on New $9,000,000 Conduit for Washington Water Supply

The conferees on the Army appropriation bill have agreed to an appropriation of $200,000 to begin work on a new conduit for the conveyance of water from Great Falls on the Potomac River to Washington, D. C. This action provides for work on the project along the lines recommended in the recent report by Major Max Tyler, Corps of Engineers. At the same time the conferees agreed to strike out the Senate amendment to the bill providing another $200,000 with which to begin work on the Great Falls water-power project. It was held that since this latter development involves the ultimate expenditure of some $50,000,000, it should receive the consideration incident to a separate bill, rather than commit the Government to the project by means of a rider on a supply bill.

Washington's water supply now is dependent upon a single conduit from Great Falls. The city's water requirements have become so great that the reservoir system is inadequate to supply the needs long enough to allow the unwatering of this conduit for inspection and repair. It will require at least three years to build the new conduit. The total cost is estimated to be $9,000,000.

Falsework Failure Wrecks Large Highway Bridge

Failure of the piles supporting the falsework for a new 330-ft. riveted steel highway span across the west channel of the Connecticut River at Brattleboro, Vt., on June 16, caused the collapse of the span. The structure was under erection by the American Bridge Co. It was to replace a span destroyed by ice pressure in March, 1920, as described in *Engineering News-Record* of May 6, 1920, p. 902. A long series of bridge failures distinguishes this particular crossing, as recounted in the same article.

Flushing Bay Project Approved

Approval of the Flushing Bay improvement, projected by the Department of Docks of New York City, was voted by the Sinking Fund Commission June 9. However, the approval carries no appropriation nor does it commit the city to any particular plan of development. The plan of the dock commissioner calls for twenty-four piers, each 1,150 ft. long, 290 ft. wide, with 360-ft. slips. The estimated cost of the entire development is in the neighborhood of $50,000,000.

West Pointers Go to Rensselaer

Thirty-two officers of the Corps of Engineers of the United States Army, graduates of the class of 1920 of West Point Military Academy, have been ordered to report June 6 at the Rensselaer Polytechnic Institute for a course of study, fifty-one weeks in duration, in the department of Civil Engineering in that institution.

Am. Soc. C. E. Supports Employment Bureau of Federation

The board of direction of the American Society of Civil Engineers, at its meeting June 6, on invitation from the American Engineering Council of the Federated American Engineering Societies, decided to continue its support and receive the service of the employment bureau. The action was made retroactive covering the fiscal year from Jan. 1, 1921. Participation requires $3,000 per year, the same sum paid by the other three founder societies.

Survey Site for Colorado River Power Project

Several members of the engineering staff of the Southern California Edison Co., with G. C. Ward, vice-president of the company, have just returned from an inspection of power sites on the Colorado River. Attention was given to sites covered in the company's recent application to the Federal Power Commission for permission to develop 2,500,000 hp. at Diamond Creek and Marble Canyon. Survey parties have been sent out to obtain field data on which final plans will be based. Studies are also being made of a high voltage transmission system to convey the power from these sites into Arizona and adjoining states, as well as to points where connection can be made with existing transmission lines of the company. Early in June the company filed its application with the Arizona State Water Commission for a permit to appropriate the waters of the Colorado River for power and irrigation purposes.

Utah Water Commission Organized

The Utah Water Storage Commission recently appointed by Governor Mabey has effected an organization. The law recently passed makes the commission a board of investigation to compile data in co-operation with various counties looking to the more complete utilization of the water possibilities of the State of Utah. The commission will now endeavor to obtain enough money from the Legislature to start an investigation of the water resources of the state.

Eastern Engineers to Advise on San Francisco Bay Crossing

J. Vipond Davies, of the engineering firm of Jacobs & Davies, and Ralph Modjeski, consulting engineer and chairman of the board of engineers for the Delaware River bridge, have been retained by the San Francisco Motor Car Dealers' Association and a group of newspaper publishers to go to San Francisco and study the bay crossing problem, with a view to advising as to the best solution. According to present plans they will reach San Francisco during the coming week and will begin their studies immediately.

Proposes Colorado River Compact

In a bill introduced by Majority Leader Mondell, Congress is asked to allow Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming to negotiate and enter into a compact providing for an equitable division and apportionment among those states of the water supply of the Colorado River and of its tributaries. A condition of the bill is that the President of the United States is to participate through a representative who would look after the interests of the United States in the transaction.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Assistant Sanitary Engineer, U. S. Public Health Service, $3,225 per annum plus increase of $600 per annum effective July 1, 1922.

Junior Sanitary Engineer, U. S. Public Health Service, $2,320 per annum plus increase of $420 per annum effective July 1, 1922.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Engineers' Club of Seattle, Wash., at its weekly luncheon May 31, was addressed by Col. Riley H. Allen of the American Red Cross on "Experiences of a Red Cross Colonel in Soviet Russia."

The Washington Society of Engineers plans to expand into an engineers' club to be made up of all engineering and technical societies in the District of Columbia.

The Western Society of Engineers, at its annual dinner in Chicago, Ill., June 8, was addressed by the retiring president, Frederick K. Copeland, the incoming president, Charles H. MacDowell and by Dr. R. A. Millikan, professor of physics, University of Chicago, on "The Organization of Research in a Democracy."

The Rochester (N.Y.) Engineering Society, at its annual meeting June 10, elected the following officers: Harold O. Stewart, president, Charles C. Evans, first vice-president; Waldo G. Wildes, second vice-president; Gloster P. Havenor, secretary; Louis J. Summerhays, treasurer.

PERSONAL NOTES

JAMES W. COSTELLO, an engineer in the department of streets and public improvements, Newark, N. J., has been appointed to have general supervision over the bureau of docks.

JOHN HORRIDGE of Philadelphia, Pa., has been appointed supervising engineer in the division of street cleaning, department of public works, Philadelphia.

JOSEPH G. SHRYOCK, designing engineer, Belmont Iron Works, Philadelphia, Pa., has received the honorary degree of master of civil engineering from the Pennsylvania Military College, Chester, Pa.

MAJOR CHARLES R. PETTIS, Corps of Engineers, U. S. A., has been assigned to duty in the office of the Assistant Secretary of War.

H. L. LEVENTON, superintendent of the Placerville-Lake Tahoe unit of the Lincoln Highway, has been appointed assistant engineer and assigned to the Sacramento division, California State Highway Department.

M. C. HENGST has been appointed engineer of the Barry County, Mich., road commission.

R. W. TORRAS, formerly on construction work with the Atlantic Refining Co. at Brunswick, Ga., is now connected with the City Planning Commission, Atlanta, Ga.

I. N. LAMB of Montreal, Canada, has been appointed professor of civil engineering at McGill University, Montreal.

R. A. ROSS of the Administrative Commission, Montreal, Canada. and J. M. R. FAIRBAIRN, chief engineer, Canadian Pacific Ry., Montreal, have received the degree of Doctor of Science from the University of Toronto.

COLONEL MERIWETHER L. WALKER, Corps of Engineers, U. S. A., has been relieved as commandant of the Engineer School at Camp Humphreys and has been ordered to the canal zone to serve as engineer in charge of maintenance and operation.

MAJOR LAWRENCE FRAZIER, Corps of Engineers, U. S. A., returning from the Philippines has been given temporary station at Kansas City prior to his entrance in the School of the Line at Leavenworth in November.

FRANK P. CARTWRIGHT has resigned from the staff of the Rochester Bureau of Municipal Research to become technical secretary of the newly appointed Department of Commerce building code committee, of which Prof. Ira H. Woolson is chairman.

MAJOR THOMAS B. LARKIN, Corps of Engineers, U. S. A., has been designated as one of the representatives

on the technical committee of the War Department.

COLONEL SHERWOOD A. CHENEY, Corps of Engineers, U. S. A., has been detailed as an instructor at the General Service Schools at Fort Leavenworth for a period of four years.

COLONEL E. H. SCHULZ, district army engineer, Seattle, Wash., has been authorized to make a survey of the Lake Washington canal system, with a view to widening and deepening the canal.

DR. ERNEST F. NICHOLS, past president of Dartmouth College, and, for a year, director of physical science at the Nela Park research laboratory of the National Electric Lamp Association, Cleveland, whose election as president of Massachusetts Institute of Technology was noted in the April 28 issue, was formally inaugurated on June 8.

DR. PHILLIP WOODWORTH, since 1917 executive secretary of the National Council of Defense, has been appointed president of Rose Polytechnic Institute, Terre Haute, Ind. He was graduated with the degree of B.S. from Michigan State Agricultural College in 1886 and received the degree of master of engineering from Cornell University in 1890. In 1892 he became professor of physics and engineering in the Michigan Agricultural College and in 1899 he entered Lewis Institute, Chicago, Ill., as professor of engineering and later became dean of engineering. He has served, in a consulting capacity, the Peoples Gas Light & Coke Co., the Chicago surface lines, the Chicago Elevated Ry., the Chicago Telephone Co., and the Commonwealth Edison Co. He has written a number of text books, including "Engineering Principles."

M. R. KAYS, formerly assistant engineer for the U. S. Reclamation Service and for eight years vice-president and general manager of the Idaho Irrigation Co., Ltd., at Richfield, Idaho, and who during the past ten months has been associated with A. L. Harris of Los Angeles as one of the consulting engineers for the Paradise-Verde Irrigation District at Phoenix, Arizona, has joined the staff of the Beckman & Linden Engineering Corp. of San Francisco, as chief irrigation engineer and has been placed in charge of their southwestern branch office, recently established at Phoenix, Ariz. The office will specialize in irrigation and hydroelectric power engineering in the southwestern states and is now retained by a number of projects, including the $15,000,000 project of the Paradise-Verde Irrigation District, adjoining the Salt River reclamation project, for which the firm is making final surveys and preparing plans, estimates and specifications.

LIEUTENANT-COLONEL ALBERT E. WALDRON, Corps of Engineers, U. S. A., has been relieved from his assignment with the Fifth Engineers at Camp Meade, Md., and has been detailed for duty as instructor with the engineer division of the Pennsylvania National Guard.

F. M. CLARK, formerly engineering superintendent for the Barrett Co., in Canada, in charge of the construction of streets and pavements, is now construction engineer for the Maine highway commission.

CLEMENT E. CHASE, recently in charge of the New York office of Ralph Modjeski, consulting engineer, has been appointed principal assistant engineer of the Delaware River Bridge Joint Commission with headquarters in Philadelphia, Pa.

JAMES E. MALONEY, for a number of years engineer of the old state highway department, has been appointed assistant highway engineer in charge of the engineering division.

HARTLEY ROWE, manager of the Detroit branch office of the firm of Lockwood, Greene & Co., Boston, Mass., has been made manager at the Boston office.

KENNETH MOLLER, manager of the Boston office of Lockwood, Greene & Co., has been made a member of the firm.

DONALD D. SNYDER, for the past two years commissioner of public works of Rutland, Vt., has become associated with the Frissell Engineering Co., Gardner, Mass.

MAJOR DANIEL D. PULLEN, Corps of Engineers, U. S. A., has been ordered to report to the Panama Canal department for assignment as department engineer, *vice* Colonel C. S. Rich, U. S. A., retired.

OBITUARY

WARREN C. TUDBURY, expert aid, U. S. Navy Yard, Mare Island, Cal., died May 18. He was born in Salem, Mass., in 1877, and after graduation with the degree of S.B. from Massachusetts Institute of Technology in 1900 he entered the employ of the New York Central & Hudson River R.R. and served from 1900 to 1905 as draftsman, rodman, transitman. After a year or so with Westinghouse, Church, Kerr & Co., engineers, he became instructor in railroad engineering and surveying at Lafayette College, Easton, Pa. Leaving that institution in 1908 he became assistant engineer with the N. Y. C. & H. R. R. R. on construction work. He also worked on special railroad problems with Barrows & Breed, and C. M. Spofford of Boston, Mass., and had full charge of subdivision work in the foothills, Sierra Madre, Cal., for A. B. White. In 1916 he became connected with the Navy Department, Bureau of Yards and Docks, Washington, D. C.

BUSINESS NOTES

W. D. STRAYTON has resigned as assistant construction manager of the J. B. McCrary Engineering Corp. to become associated with the Wood-Rucker Construction Co., Atlanta, Ga.

THE HELTZEL STEEL FORM & IRON CO'S plant at Warren, Ohio, was partly destroyed by fire June 2. The steel fabricating department suffered mostly from the damage. The company besides manufacturing steel forms for various construction purposes, are fabricators of general plate construction.

THE HERCULES POWDER CO. has recently purchased the Aetna Explosives Co., Inc. By the purchase the Hercules Co. acquires high explosives plants in Alabama, Pennsylvania, Michigan and Illinois, black powder plants in Ohio and Alabama, and plants for the manufacture of blasting caps in New York and Canada.

THE NEW ENGLAND CONSTRUCTION CO., Boston, Mass., will henceforth be known as the William T. Reed Co.

J. M. DAVIS has been made president of Manning, Maxwell & Moore, New York City.

THE POST WHITNEY COMPANY of Cleveland, Ohio, is a consolidation of the Post Tractor Co., Cleveland, and the Whitney Tractor Co. of Upper Sandusky, Ohio. This company will continue the manufacture of the Post tractor and the Whitney tractor. The officers of the organization are: President, E. B. Cassatt; vice-president, A. B. Whitney; treasurer, C. B. Post; secretary, F. R. LePage.

M. F. NORMOYLE & SONS is a new organization with offices at Roanoke, Va., which will engage in building construction, excavation and masonry work, erection of all classes of public and municipal buildings, apartment houses, churches, etc.

THE BROWN HOISTING MACHINERY CO., of Cleveland, Ohio, announces the opening of a southern office at New Orleans, La., with Charles H. White as manager.

THE TUCKER-DAY MACHINERY & SUPPLY CO., Cleveland, Ohio, has been organized by George Day, formerly with the Browning Co., Cleveland, and recently sales manager of M. Beatty & Sons, Welland, Ont., and by D. S. Tucker, recently district sales manager of the Elliott Co., Pittsburgh, Pa. The company will specialize in drop forgings, general contractors' and power plant equipment.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Wage Differential for Building Trades Mechanics

From E. T. Thurston, secretary of the General Contractors of San Francisco, comes a memorandum on wage differentials, taking into account the relative skill and responsibility of the various trades involved, the hazards of employment, and the personal equipment of tools required. For the purpose of emphasizing the inequities of prevailing differentials he takes the carpenter as the most essential, skilful and responsible, as well as the most expensively equipped workman in the building trades and refers all other workmen to the carpenter as a base, as indicated in the accompanying table.

An index number set opposite any craft is intended to indicate in rate per cent the relative position of workmen in that craft to the carpenter, with respect to the considerations noted above. Thus,

WAGES IN THE BUILDING TRADES TAKING INTO ACCOUNT SKILL, RESPONSIBILITY, HAZARD AND EQUIPMENT

Trade	Skill and Responsibility	Hazard	Equipment	Combined Ratio	Scale of Wages
Bricklayers	80	72	12½	55	$3 85
Carpenters*	100	100	100	100	7 00
Cement finishers	80	60	12½	51	3 57
Concrete labor	10	100	0	37	3 50
Electrical workers	80	19	25	41	3 50
Elevator constructors	80	93	0	58	4 06
Engineer, hoisting	50	53	25	43	3 50
Hod carriers, brick	10	72	0	27	3 50
Hod carriers, plaster	15	53	0	23	3 50
Housesmiths, ornamental iron	90	65	25	60	4 20
Housesmiths, reinforced concrete	50	100	5	52	3 64
Laborers	0	100	0	33	3 50
Lathers	50	53	5	37	3 50
Marble-setter	75	11	25	37	3 50
Painters and glaziers	75	120	5	67	4 69
Plasterers	60	53	12½	52	3 64
Plumbers	80	27	12½	40	3 50
Roofers, composition	10	60	0	23	3 50
Sheet-metal workers	80	83	25	63	4 41
Steel workers	50	252	5	102	7 14
Stone cutters	80	25	25	43	3 50
Stone setters	80	72	25	59	4 13
Tile setters	75	11	5	30	3 50
Teamsters	10	30	0	13	3 50

*Carpenter used as base with per cent of 100

the required skill and responsibility of the common laborer is nil; that of the bricklayer 80 per cent of that of the carpenter.

Ratings as to skill and responsibility and equipment are based upon a brief inquiry into the information and experience of members of the contractors' association. The ratings as to hazard are based on the experience of insurance companies as reflected in the current premium rates for workmen's compensation insurance, except in the case of composition roofers, who are not distinguished in the insurance rating manual from plate and tile roofers, whose work is far more hazardous.

The fourth column of the table shows the combined averages of the ratings for each craft, and the fifth column a scale of daily wages based on $7 for the carpenter, but recognizing a minimum of $3.50.

The table above is merely a tentative one, based upon as complete information as was at hand at the time of the compilation.

Highway Projects in Pennsylvania Under Way Total $51,731,524

The state highway department of Pennsylvania has completed approximately 160 miles of durable thoroughfare during the present season. During the week ending June 15, the department broke all previous records by completing 29.13 miles of highway in which concrete entered in some form. Its previous record was 27 miles in one week. So far during the 1921 season, nineteen road-building projects have been completed. These total 68 miles. A dozen other projects are rapidly nearing the completed stage.

On June 15 there were under way in Pennsylvania 231 construction jobs. These involved a total length of 4,946,011 lin. ft., or 934.73 miles; and the total contract price is $51,731,523.54.

Increase in Car Loadings of All Commodities but Ore

An increase of 18,907 in the number of cars loaded with revenue freight during the week which ended on May 28, compared with the previous week, was shown by reports from the railroads throughout the United States just received by the car service division of the American Railway Association. The total for the week was 787,237 cars. This was 110,970 cars under that for the corresponding week in 1920 but 23,476 more than were loaded during the corresponding week in 1919.

Increases compared with the previous week were reported in the loading of all commodities except ore. The largest gain was made in the loading of grain and grain products, the total being 46,337 cars, or 9,085 more than the previous week. A total of 164,870 cars were loaded with coal which was 6,358 cars greater than during the preceding week but 9,700 less than during the corresponding week last year.

Brindell Aides Get Prison Terms

Peter Stadtmuller and Joseph Moran, associates of Robert P. Brindell, convicted head of the Building Trades Council of New York City, were recently sentenced to serve indeterminate terms in the penitentiary of from six months to three years each. They had been found guilty of extortion and coercion, and their indictment resulted from investigations of the building industry in New York City made by the Lockwood joint legislative committee on housing.

Adjustments Made in Building Trade Wage Problems

During the past week several adjustments have been made in building trades wages that will tend to offer stabilization to building conditions in the respective communities. Though Newark, N. J., contractors have been operating on an open-shop basis for the past few weeks new conferences were held last week looking toward a reemployment of union labor in the principal skilled trades. Many union skilled trade mechanics have returned to work at the old scale pending the decision of the arbiter. Bricklayers, iron workers, carpenters and laborers, involved in the new conferences, were the first to return to work. Members of one of the local mason's unions of Rochester have returned to work, having accepted a 15 per cent reduction in pay. Such a reduction was included in the decision reached by the board of arbitration considering the matter.

The strike in Cleveland has virtually ended in the unions and contractors acceptance of an average wage reduction of 17 per cent, contained in the award announced by the general committee of twenty-one which arbitrated the controversy. The question of working rules and conditions is still to be settled. The award covers all classes except electrical workers, plumbers and bricklayers who submitted their disputes to independent arbitrators. Although several conferences have been held between representatives of the employer and employee in Cincinnati no decision has been reached which was considered equitable to both sides. The deadlock continues in Trenton, N. J., with the city commission taking a hand in an attempted settlement.

At a recent conference of the master builders' association of Baltimore decision was taken that commencing July 1 the standard wage of carpenters will be 75 cents per hour instead of 90 cents, the present wage. A similar step toward reduction was taken in the cases of several other crafts some time ago.

Calder Housing Bill Revised

By changing the wording of one of the items providing appropriations for the Bureau of Standards, the Calder bill proposing to set up a separate division of housing in that bureau has been superseded by a plan thought to be better adapted to meet the situation. It was demonstrated to the satisfaction of Senator Calder that housing involved so many studies that it would be impracticable to attempt to consolidate them into one division. Much of the Bureau of Standard's work has a bearing on constructional activities. Better results will be accomplished, it is be-

lieved, by allowing those activities to remain undisturbed as they are grouped, which will interfere in no way with the correlation of the results from each of the activities. This will be possible under the provision of the appropriation for continuing the investigation of structural materials by the inclusion of a separate clause which was added by the conferees on the second deficiency bill.

Contracts Must Be Awarded in Ten-Day Period After Bids

Judge E. B. Kinkead in the common pleas court of Franklin County has handed down a decision to the effect that the ten-day period within which the Ohio Highway Commissioner must award a contract is mandatory and not directory. This decision was handed down in the case of Henry P. Streicher, a contractor, suing as a taxpayer against Richard H. Shaffer and W. E. Dorsey, contractor, and State Highway Commissioner Leon C. Herrick. Mr. Streicher who was the low bidder on a stretch of road in Wyandot county, filed suit charging fraud in depriving him of the contract. His bid at that time was $134,104 when opened last August. In October the highway commissioner threw out all bids and readvertised the work. In November bids were opened and Mr. Streicher was found to be low at $102,941, on amended specifications. At the hearing Streicher abandoned his contention of fraud and went to trial upon his request for an injunction against the second contract claiming that it had to be awarded within 10 days according to law. His contention was upheld.

London Builders Initiate Dilution Plan of Government

(London Correspondent)

The London Master Builders and Allied Industries Association is endeavoring to assist in carrying out the government's dilution scheme which purposes to take into the building trades approximately 50,000 ex-service men. The master builders have posted notices wherever building operations are in progress which read:

"Notice is hereby given that on and after June 1, 1921, these works will be open so far as bricklayers, plasterers, slaters and tilers are concerned only to men who are willing to work with and assist ex-service men to learn the trade."

The dilution scheme has been approved and adopted by building trade employers throughout the country in order to help redeem the pledge given by the nation to ex-service men.

Southern Pine Shipments Exceed the Production

Shipment of lumber reported by the Southern Pine Association for the week ended June 10 exceeded production by 2.3 per cent. Orders however were 7.35 per cent below production which was 24.63 per cent below normal. The decrease of orders on hand during the week amounted to 2.57 per cent.

Seattle Street Program to Cost More Than $3,000,000

In the city of Seattle fifteen street improvements now under way, about to be let on contract, or in contemplation by the councilmen, mean the expenditure of at least $2,869,095 of the $3,384,813 called or by the general program. King County's local program calls for the expenditure of $530,087 on eight projects. The most important of the city's project is Elliott Avenue, estimated to cost, when paved, $600,253. Contract for the grading at $190,253 has been let. The improvement was demanded by the Port Commission, steamship companies and manufacturing plants in the district, but violently protested by the property owners, who assert that it amounts to confiscation of their properties.

Lubrication of Creeper Mounting Feature of New Erie

Erie steam shovels and cranes manufactured by the Ball Engine Company, Erie, Pa., are now being built with continuous-tread mounting that is fully lubricated. The new Erie mounting is an improvement arrived at after three years of experiment and tests. On the mounting every bearing is protected against wear by a film of special heavy oil, a lubricant which works equally well in hot or cold weather. The link bearings are not allowed to run dry and "cut" but are fully protected. The Ball Engine Company states that most of the trouble with various continuous-tread-type mountings for steam shovels has been directly due to lack of lubrication. Greater endurance and higher traveling speed and climbing power are claimed for the new Erie as a result of the reduction of friction in the gear

ERIE STEAM SHOVEL WITH CONTINUOUS-TREAD MOUNTING

mounting. The continuous-tread Erie travels at more than a mile an hour on high gear and climbs grades up to 25 per cent.

The lubrication is taken care of by filling the oil reservoirs which provide at least a month's steady supply. Once a month the operator spends an hour in going over all the mountings with a squirt gun. The continuous tread Erie is interchangeable with ordinary traction wheels or standard-gage car wheels of the same truck frame.

Would Investigate Cement Makers

In urging an additional appropriation of $35,000 for the study of certain products entering largely into building operations, the Secretary of the Interior, in a letter to Congress, states that there is the greatest necessity for investigating certain conditions in the cement trade. In his letter he states that his personal experience has led him to understand that there is undoubtedly an agreement between many of the cement producers for non-competition among them in certain territories. Since the government is a large purchaser of cement he suggests that it would be helpful to ascertain costs at different points in the United States. "This matter has been before the public in other forms," says Secretary Fall, "and you are aware that many of the cement manufacturers are under criminal indictment. We have been informed that a civil suit also has been filed against them."

Construction Analyzed by United States Chamber of Commerce

In a special report issued June 17 by the committee on statistics and standards of the United States Chamber of Commerce the total national wealth of the United States is estimated at $288,464,000,000, of which $77,321,000,000, or 26.8 per cent, is represented by the construction industry. The report presents an analysis of the relationship of construction to the basic industries of the nation, including manufacturing, mining, transportation, agriculture, trade and finance, and concludes that construction as a key industry should be classified separately as one of the nation's basic industries.

The report shows that in 1914 one-quarter of the 276,000 manufacturing concerns employing 10,658,000 workers, with an annual payroll of $5,368,294,000 and an annual output worth $25,000,000,000, was devoted to construction products.

In 1920, 90 per cent of all iron ore, copper and zinc, and 95 per cent of all lead mined was consumed by construction. Twenty per cent of the bituminous coal and 5 per cent of the anthracite coal mined was used by manufacturers of construction materials, by the railroads in transporting these products, and by traction lines and public service corporations in service to construction workers. A rough estimate of the value of these minerals is $4,400,000,000, engaging more than 1,000,000 workers at an annual wage of approximately $1,000,000,000.

Twenty-two per cent of the freight transportated by the railroads is construction materials.

Eleven million persons, either as workers or as members of workers' families, are estimated to derive their living from construction, either directly or through manufacturing and mining products used in the construction industry. The support given to agricul-

ture and to trade by the annual expenditures of this great number of persons is estimated at more than $5,000,000,000 for rent, fuel, food, clothing, furnishings, recreation, etc.

New capital issues during 1920 so far as reported totaled $4,545,000,000, consisting of state, municipal, railroad and industrial securities, of which it is estimated 50 per cent were issued for construction in one form or another.

The report concludes with the statement that construction is the barometer of conditions in all industry, is the first to be hit by depression and the first to be carried along on "the rising tide of prosperity." For that reason the plea is made for a better understanding of the industry's position.

Contracts Let for Four Weeks in June 8 Per Cent Over 1920

The value of contracts let, as reported in *Engineering News-Record*, for the first four weeks in June is $125,209,788, or $10,468,129 more than for the corresponding period of last year. This takes no account of the decrease in the cost of construction within the year, which decrease would make the 1921 figure at least $140,000,000. The greatest activity of this year is noted in street and road work and in miscellaneous building construction, the four-week figures in each of these classifications far exceeding last year's figures. The figures of 1920 were largely sustained by industrial work.

In street and road building this year's contracts for June so far have totalled about $53,000,000, whereas the figure for the same period of 1920 was approximately $31,000,000. In miscellaneous building work the respective figures were about: 1921, $36,500,000; and 1920, $31,000,000. The value of industrial contracts let in June, 1920, totalled in excess of $40,000,000, though this class of work this year has yielded a contract value only slightly in excess of $5,000,000.

In public works construction the value of contracts let shows much more stability than during last year. There appears to be a disposition to carry out well-defined programs of sewer and water-works projects.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 2, the next, on July 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4 00	$4.50	$3.23	$3.51	$4.65	$4.35	$4.60	$5.00
Structural rivets, 100 lb	4.85	5.25	—5.75	4.88	5.50	—6.00	6.40	5 50	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.00	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	47½%	5%
Cast-iron pipe, 6 in. and over, ton	54.00	59.22	65.00	54.10	62.80	70 00	85.90	65.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80(del.)	2.60	2.60	2.17	2.46	3.10	3.09	3.10	3.40
Gravel, ¾ in., cu.yd	2.50	—2.35	—3.00	2.25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	—1.40	—2.50	2.25	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	—2.25	2.80	2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	43.00	40.00	50 00	55.00	—36.00	47.00	27.00	28.50	110.00
Lime, finishing, hydrated, ton	21.00	—21.00	—25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	—1.50	— 2.75	1.65	1.50	3.10	2.25	2.75	1.00
Common brick, delivered, 1,000	18.40	11.50	—12.50	12.00	17 00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	.092	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	1196	.15	+.98	.096	.092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	.78	.90	.87	.91	.95	.96	.79	.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.35@ 45	.45	.50	.37½@.50	.50@.55	.50	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quote at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco, ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

The construction materials market is quiet, with no price changes in New York, Chicago, Montreal or San Francisco. The South, however, reports a number of price recessions. Sand and gravel are down in both Atlanta and Dallas, as are also hydrated and lump lime. Brick is off $2 in Dallas, the present quotation being $12.50. Crushed stone is down 25c. in Atlanta. Denver reports structural rivets down 25c. per 100 lb.

As to labor—In Chicago, on June 14, Judge Landis, arbitrator in building labor controversy, heard arguments from both sides and took the case under advisement. A decision is not expected before June 24. All construction that had been at a standstill is now going forward, with probably 20,000 working. The carpenters have refused to be bound by the arbitration, and open shop for carpenters is being considered.

In its last session, the Illinois legislature extended indefinitely the life of the commission which is investigating graft in Cook County, and appropriated $50,000 for the commission and $25,000 for the Attorney General.

Unemployment seems to be decreasing slowly but steadily in Denver. The strike and lockout in San Francisco has brought work almost to a standstill though builders claim resumption on several large projects and the return to work of 1,000 under the open-shop plan.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren Editor

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Engineering College Registration

RESULTS of the census of engineering college registration by *Engineering News-Record*, presented elsewhere in this issue, are interesting chiefly because they show that attendance has again become about normal after the violent fluctuations caused by the World War. This year's gain of 4 per cent indicates conditions of healthy, but not of abnormal, growth. The unusually large freshman registration in the year following the armistice has not been repeated. In fact, every course during the 1920-21 term shows a decrease in freshman registration as compared with 1919-20, but in spite of this condition the total registration has gained, due, among other things, to the return to collegiate work of men formerly in the military or naval service. Undoubtedly the war stimulated the desire for an engineering education, but many of the men aspiring to be engineers were found, soon after their entry into college, unqualified for the work and dropped out. The figures indicate that mechanical engineering is the most popular course, with electrical engineering running a close second. Civil engineering comes third in volume of registration, followed in order by chemical and by mining engineering. Massachusetts Institute of Technology, with a registration this year of 2,747 students, is the largest of our engineering institutions, although there are 14 colleges with a registration exceeding 1,000 engineer students. With the exception of three these are state universities. Nothing startling is revealed by a study of the figures. They are negative rather than positive. They indicate a condition which is summed up well by Dean Turneaure, of the University of Wisconsin, when he says that the war merely made a deep notch in the registration curve. This year has brought registration back nearly to the normal line.

The Joint Committee Reports

TWENTY-FIVE men have the responsibility for the standard specifications for concrete which the Joint Committee will issue in final form inside the next eighteen months, but every engineer interested in concrete will have an opportunity to have a part in their formulation. Last week at the meeting of the American Society for Testing Materials the preliminary report was made public and in the form now written it will be circulated among the members of the five contributing societies, which means about 16,000 engineers. For a year it will be the subject of discussion among those engineers and then the committee will proceed to the writing of the final specifications in the light of its own deliberations and of the discussions. Such procedure is common for committee reports but in this case it takes on added interest because of the number of societies involved and the importance of the subject matter. The accepted specifications finally prepared by this committee will govern concrete design in this country for many years. Here and there will be some independent spirits who persist in their own views regardless of the dicta of the Joint Committee, but by and large the authority for the specifications will be rarely disputed. For this reason a great obligation rests on the committee's members to consider and to study the preliminary draft and the comments on it which they will receive. That draft is now only a "trial balloon" and is to be accepted as such, but the profession looks for a finished piece of work which will stand until something radically new is discovered about concrete.

The Construction Industry

IT IS a common failing for individuals, associations, and institutions to exaggerate their own importance. That failing, however, cannot be charged against the construction industry. It has done its work year in and year out without making demands for recognition as one of the chief activities in American industrial life. Yet a special bulletin of the United States Chamber of Commerce advises that one-fourth of our national wealth is represented by the structures and projects built by the construction industry. Of course, this is past production, but the current importance of the industry is indicated by the fact that one-fourth of the persons engaged in manufacture are working on materials and products that the constructor will use. The reason that construction is not ordinarily visualized in this big way is that we have heretofore considered it made up of many industries and have not tried to think of these industries as a group. We speak of the cement industry, the lumber industry, the clay products industry, etc., without visualizing their relation to the construction whole. Much good will undoubtedly come to every one concerned with construction if the public can be brought to an appreciation of the importance of the industry as a whole. First, however, we must have a proper appreciation ourselves, and that must come through a closer relationship between the various factors—engineers and architects, contractors and builders, and manufacturers of materials and equipment.

Relief from National Agreements

IN APRIL the Railroad Labor Board decided that the working agreements on the railroads would cease July 1, and directed the railroads and their employees to negotiate new agreements. The decision was widely heralded as sounding the death knell of the onerous and unreasonable conditions that were forced upon the railroads during the war. However, the progress to date in the negotiating of the new agreements has been very unsatisfactory. The employees have been holding out, in negotiations with individual roads, for individual agreements which would duplicate exactly the terms of the present national agreements. Obviously, the country will gain nothing by the perpetuation,

through a lot of individual contracts, of the present working conditions. It looks as though the whole matter will be thrown back to the Railroad Labor Board, which will then have to go into the whole situation for a determination of rules that are reasonable. This is much to be regretted, since, as has been pointed out repeatedly in these columns, the railroad situation is the key of the whole labor problem. Over-payment of railroad labor is demoralizing to every industry in the land. Public welfare demands the rewriting of the agreements not only on reasonable grounds, but with a view to labor conditions and local living costs.

Regulating Trade Associations

IN CLOSING the work of the Lockwood Committee, Samuel Untermyer, its chief counsel, recommended, among other things, that trade associations be put under rigid federal supervision and that those who participate in trade organizations not supervised or sanctioned by federal authority be subject to criminal prosecution. Mr. Untermyer has uncovered flagrant combinations that might have been prevented had there been such supervision as he favors. We may have to come to such supervision, despite the fact that it will be costly and further increase our governmental machinery. As a first step we might try a more intelligent functioning of the Federal Trade Commission, by making its duties advisory and helpful rather than inquisitorial. There are many functioning associations which are anxious to keep within the law but which cannot find out what the law actually means. To safeguard the public resort to strict supervision may be necessary, but we should like to see the advisory method tried.

The Prize-Fight Stadium

THE Dempsey-Carpentier prize-fight cannot last longer than forty-eight minutes. It may last only ten—but this is not a sport editorial. The stadium in which the fight is to be held, the construction of which is described on p. 1112 of this issue, cost $250,000 and was constructed primarily for the fight. It is to be torn down within a few months, and its salvage value is small. While industrial establishments that produce household articles of every-day need have not a dollar for new construction, such amusement places as the stadium spring up almost over night. Not a week passes but it brings news of the construction of a score of new theaters. Practically the only industrial building being done now is in garage construction. It is a universal human trait that man economizes little where his pleasure is involved. An exercise of the same generous spirit where his real needs are concerned would precipitate a building and business boom that would be prodigious.

High Freight Rates

Freight rates on most construction materials are in relatively high proportion to their cost. Therefore, the construction industry has taken an active part to bring about reductions, following the percentage increases that have somewhat more than doubled railroad rates since 1913. It has been often urged that consideration be given to relieve many low-grade commodities, in short haul, of the additional horizontal increase of 40 cents per ton, established by the famous order No. 28 of the Director General, the effect of which was magnified by last summer's percentage increase. Meantime representatives of the construction industry have met with the carriers with a view to reduction or adjustment of rates on construction materials. Following this discussion, the carriers declined to grant the reductions requested, but it was admitted that the percentage increases in many cases have thrown rates out of line. It was also admitted that there are instances in rates on roadbuilding materials, and other traffic, which should be considered as emergencies. This journal and its predecessors have always favored sufficiently high rates to permit the railroads normally to earn a fair return on the value of their properties. It begins to be clear, though, that with the present level of railroad rates many materials have become marginal commodities, hard hit in competing for markets by the addition in transportation cost that must be included in selling price. Revision of the rate structure to adjust such inequalities appears to be an urgent matter. Before it can be accomplished in a comprehensive way, "emergencies" will have to be dealt with. But it should not be lost sight of that the process of going over the whole rate structure to correct even the most serious inequalities is an exceedingly intricate and tedious undertaking that will require months of time.

Paving Research Results

FURTHER results of its program of research work are announced this month by the U. S. Bureau of Public Roads. Since Nov. 13, 1919, accelerated wear tests on sections of granite block, brick and concrete pavement have been in progress at the Arlington (Va.) experiment station, where a device carrying five 1,000-lb. cast-iron wheels, each 2 in. wide, has operated back and forth over a runway 400 ft. long, made up of 48 strips of pavement of different materials and types of construction.

Impact again looms up as one of the highway engineer's arch-enemies; in the case of granite paving this causes the need for smoothly cut block to be stressed. The results show that when accurate cutting is obtained the so-called softer granites, which have been under the ban in many localities as a paving material, are as resistant to steel-tired traffic as the harder variety. It would appear, therefore, that discrimination against certain quarries in the past has not been justified and that their products should find a more extended use in municipal paving programs, provided, of course, that requirements as to careful cutting and laying are enforced. Another significant disclosure is the serviceability of the bituminous filler, which, it is shown, acts as a cushion against impact stresses—a feature lacking in the rigid cement-grouted type. It is stated definitely, in fact, that under the practical conditions approximated by the Arlington tests bituminous filler are, in general, as satisfactory as cement-grout fillers, especially when there is any tendency of the block to settle unevenly, thereby increasing the impact force exerted by moving wheels. In the cases of both granite block and brick the sand-cement cushion was more satisfactory than plain sand.

Due to space limitations it has been impossible for this journal to present more than the general conclusions of the tests; the full report, however, has been published by the U. S. Bureau of Public Roads and its findings constitute a substantial addition to the all too meagre supply of paving research data.

Inspiration to New Activity

IN THE REPORT of the meeting of the American Society for Testing Materials, elsewhere in this issue, appears the statement that the society passed approval on some forty or fifty steel specifications in as many seconds, by a blanket vote. This, we believe, represents an achievement exceeding all prior records. No such highly routinized procedure of turning out results has been witnessed in the deliberations of this or any other technical society. Perhaps the term "deliberations" is inappropriate; there cannot be much deliberative procedure in such wholesale voting. Yet the action reported is not to be criticized offhand, but on the contrary represents a noteworthy achievement. It marks the culmination of twenty years of progress, a generation of growing strength and confidence-inspiring quality of committee work.

In the face of this achievement, however, the question presents itself whether the time has not come for turning back to greater deliberation in the society, truer joint thinking concerning the common purpose. In the opinion of *Engineering News-Record* this question is intertwined with that raised a year ago in the presidential address of J. A. Capp: Shall the society give more conscious attention to study of the properties of materials and their suitability to various uses? The society is in need of an intellectual incentive, an inspiration, equally with respect to its specification work and with respect to its technical papers.

Recent years have brought to view an increasing formalization of the society's meetings. In the language of some members, the meetings have often been oppressively "dead." A growing lack of discussion of committee recommendations has been observable; unquestioned acceptance of reports came to be a habit. This is not a healthy condition.

At bottom of this development there were two factors, if we appreciate the situation rightly: first, well-established confidence on the part of the members in the judgment and representative character of the committees; second, a more or less conscious inclination to discount or even frown down opposition in open meeting, on the sound theory that much hard work and honest purpose may be defeated by one or two ill-informed objectors able to impress their audience. In the light of these reasons the resulting machine-like system appears justified; and yet it is necessary to say that the effect is deadly. The society has become a machine—a highly perfect one, yet a machine.

With this perfection of machine-like operation of the society's committee system, exemplified in the smooth acceptance of the steel report, further progress is likely to be toward deterioration. The committees have grown strong, but the society has grown weak and listless. Even now there is legitimate question whether the general society retains sufficient vigor to cope with its committees, or whether the tail does not sometimes wag the dog; and if the results hitherto have all been safe and commendable it is in spite of, not because of, the control of real work by committees.

It is pertinent to suggest—though this is somewhat aside from the present purpose—that the time may have come to transfer all committee work of the society from private to public status. It is a long-standing tradition that committees should work in closed sessions, but the functions of the American Society for Testing Materials and its committees are much too important to be bound by tradition if it threatens the soundness of the results.

So long as a committee is not all-inclusive but is merely representative of the interests involved, its work may safely be done in private; the open meeting of the society can be counted on to scrutinize, question, and check up the committee's reports. But when, as has come to be the aim in this society, all interested parties are brought together in the committee, the power to check up the results in open meeting is paralyzed. There is unlikely to be any thorough detail knowledge of the subject outside the committee, and the society is therefore powerless to go behind the returns. Under such conditions no supervision of committee work is possible unless the work is done in open sessions.

Effective co-operation of all elements of the society would be promoted by such a system, we venture to suggest, and therewith the society's easy and rapid progress toward dull lifelessness would be checked. But the mere change of system would do little toward supplying a new vital force, and it is only by such a force that the present perfected machine can again be transformed into a living thing.

The proposal that the study of materials be cultivated as a distinct major phase of the society's work contains the promise of new vitality for the society. This proposal has been under consideration for a year. Much thought has been given to it, apparently, but no active conclusion has been reached. The importance of bringing into action a new inspiration for fruitful activity within the society warrants the hope that a conclusion may soon be reached.

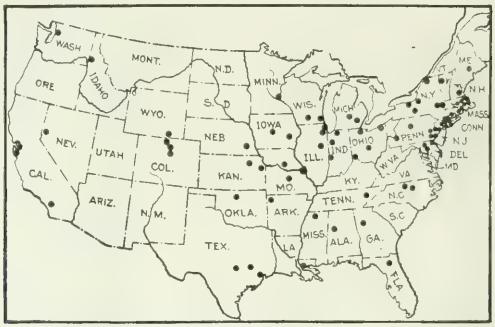
Active work in the technical field with no reference to specifications would give to the general meetings of the society a purpose and direction which they now lack. Through its inspiration, we may hope, thought in the field of testing and materials would again attain such a growth that specification-making would appear in its true light as a by-product rather than an end in itself. An inexhaustible wellspring of life for the society would be created. But only specific initiatory steps on the part of the governing authorities of the society can enlist the membership in the larger field of work: mere suggestion, though it be a president's, is ineffective.

Already a realignment of the society's work has been initiated, in most promising manner. Co-ordination of the study of testing methods and control of terminology have been placed in charge of central committees so constituted as to work by co-operation rather than dictation. Through this and perhaps further co-ordination, the specification committees can be relieved of much of the formal detail in which they are now involved, and they will then, with attention solely to the technical tasks entrusted to their care, be able to work yet more efficiently than hitherto. At the same time steps have been taken to draw the society membership and the committees into a closer circle, by the inauguration of a quarterly bulletin of the society for the avowed purpose of keeping the membership more closely informed on committee work. These several steps all tend to strengthen the technical spirit, both of the committeeman and of the general member.

With improvement of the society's mechanism, thus initiated, there should now be joined the inspiration of a new purpose. Its vitalizing force is needed. Its influence would surely recall the society from its threatened lethargy, and would cause productive activity to displace the dull routine of some of the past sessions.

Engineering College Registration Shows 4-Per Cent Gain

Census by "Engineering News-Record" Covers 48,312 Students in 81 Institutions Located in 36 States—Mechanical Engineering Most Popular Course



THE GEOGRAPHICAL DISTRIBUTION OF ENGINEERING COLLEGES IN "ENGINEERING NEWS-RECORD'S" CENSUS

"Engineering News-Record" presents herewith the results of a census which it has made of the registration at engineering colleges throughout the country. The chief objects of the inquiry were to compare the figures for the collegiate year just ended (1920-21) with those of the preceding year (1919-20), with a view to determining whether the general demand for engineering training is increasing or decreasing, and to what extent, and which of the several specialized courses of study—civil, mechanical, electrical, mining, and chemical engineering—are attracting the most students. In other words, the census aims to present figures which indicate the general status of technical education as regards college attendance.

THE statistics of engineering college registration in this article are based upon returns from 81 institutions in 36 states, and show a total registration for the college year 1920-21 of 48,312 students in all engineering courses as against 46,395 for the previous year—a gain of 4.1 per cent. This gain is noteworthy in view of the fact that this year's freshman classes totaled 18,073 students as against 20,357 last year—a loss in freshman registration of 2,284 or 11.2 per cent.

War's Influence Felt

The apparent paradox presented by a gain in total registration in spite of a decline in the number of men entering college in the freshman class is accounted for by a combination of circumstances all growing out of the war. Many undergraduates who discontinued collegiate work to enter the military or naval service returned to their universities this year to complete their courses, so that the three upper classes at the beginning of this year received more than the normal number of "new" students, most of whom had a year or more of college training to their credit.

Another fact worth emphasizing is the war's effect in stimulating interest in engineering education. Reports of the activities of our technical troops overseas apparently fired the imaginations of a large number of young men, who decided to become engineers. The result was that at the beginning of the college year 1919-20, following the armistice, the freshman classes in many institutions were abnormally large.

The following comment from Dean Douglas S. Anderson, of Tulane University, New Orleans, where the freshman class this year numbered 69 as against 113 for 1919-20, is significant: "We account for the rather abnormal increase in the freshman class in 1919-20 by the sudden great stimulation given to technical education from the experiences of the war. Our experience indicates, however, that many of these men who just came in, were not at all adapted to engineering and soon dropped out." Dean Anderson's explanation, therefore, if it can be applied generally, would account for the freshman increase last year and also for the decline this year. The general process of after-war deflation, apparently, is operative in our engineering institutions as well as in industry.

How Statistics Were Compiled

Blank forms requesting the student registration statistics were sent to 118 engineering institutions, of which 81 colleges, or 69 per cent, replied. The geographical distribution of the colleges sending in returns is indicated on the accompanying map. Before the figures were compiled it was necessary to make certain adjustments to bring them to a common basis, due to the fact that in some institutions freshmen are not classfied according to the five specialized courses listed in the questionnaire, but are grouped into one general body and after the first year assigned to civil, mechanical, or other specialties. In such cases the procedure was to allocate the freshmen to the several specialties and to "miscellaneous" engineering courses in the same ratio as obtained for the three upper classes. Another adjustment of the figures was required in the cases of those institutions where, for example, the electrical and mechanical courses are combined. In such instances half the men reported were arbitrarily assigned to mechanical engineering and half to electrical engineering. This assumption seemed reasonable because the total figures for this year disclosed a registration of 12,159 students in mechanical engineering and 12,118

in electrical engineering—practically an equal division.

An effort was made to confine the statistics to purely engineering courses. Some of the colleges, for example, included in their returns registrations in courses of agriculture, commerce, forestry, etc. The returns under these headings were eliminated. There were included, however, under a column of "miscellaneous" courses, such subjects as architectural engineering, industrial management, fire protection engineering, commercial engineering, textile engineering (an important course in one of the Southern colleges), naval architecture, and similar strictly engineering specialties.

Mechanical Engineering Most Popular

Table I gives a summary of the registration statistics for the 81 engineering colleges reporting for the years 1919-20 and 1920-21. It will be noted that, with respect to the *total* registration, all courses except chemical engineering showed a gain this year over last year. In the case of the *freshman* registration, on the other hand, a loss is shown in every column. During 1919-20 the freshman registration amounted to 43.8 per cent of the total college registration, while this year the freshman were 37.4 per cent of the total.

The figures show that mechanical engineering is the most popular course in our technical colleges. This

TABLE I. SUMMARY OF RETURNS FROM 81 ENGINEERING COLLEGES, SHOWING BOTH TOTAL AND FRESHMAN REGISTRATION

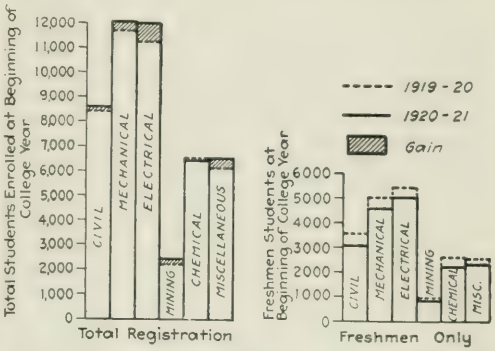
Year	Civil	Mech	Electr	Mining	Chem	Misc	Total
1919-20 (total)	8,469	11,693	11,285	2,252	6,588	6,108	46,395
1920-21 (total)	8,592	12,159	12,118	2,431	6,486	6,526	48,312
Gain (+) or loss (—)	+123	+466	+833	+179	—102	+418	+1,917
1919-20 (Freshmen only)	3,612	5,089	5,487	903	2,652	2,614	20,357
1920-21 (Freshmen only)	3,046	4,607	5,089	780	2,249	2,302	18,073
Freshman Gain (+) or loss (—)	—566	—482	—398	—123	—403	—312	—2,284

year 12,159 students were registered in this specialty and last year 11,693, a gain of 466. Electrical engineering runs mechanical engineering a close second, the figures for this year and last year being, respectively, 12,118 and 11,285, or a gain of 833. Civil engineering comes third with 8,592 undergraduates this year and 8,469 last year. Chemical engineering, with about 6,500 students for the past two years, takes fourth place, while the mining engineering course, in fifth place, shows a considerably smaller registration than any of the others—2,431 this year as against 2,252 last year. A reference to Table 2 indicates the percentage relation of the registration in the several special courses to the total, and also the freshman percentages.

Of the 81 institutions sending in returns, 51 reported gains in total registration, 29 losses, and 1 no change. In freshman registration alone, however, 49 colleges reported losses as against 30 reporting gains, figures for two institutions not being available.

Fourteen Pass 1,000-Mark

Fourteen of the colleges are giving engineering instruction to 1,000 or more students. The highest registration figures are reported by the Massachusetts Institute of Technology, Cambridge, Mass., with 2,747 students. Next in point of size comes the University of Michigan, Ann Arbor, Mich., with 2,212; third, Purdue University, Lafayette, Ind., with 1,845; fourth, Cornell University, Ithaca, N. Y., with 1,825, and fifth, the University of Illinois, Urbana, Ill., with 1,818. The other nine institutions above the 1,000-mark are, in order of size, as follows: Ohio State University, 1,473;



TOTAL AND FRESHMEN REGISTRATION AT BEGINNING OF COLLEGE YEARS 1919-20 AND 1920-21

University of California, 1,323; Georgia School of Technology, 1,307; University of Minnesota, 1,284; Pennsylvania State College, 1,233; Texas Agricultural and Mechanical College, 1,169; University of Wisconsin, 1,150; Rensselaer Polytechnic Institute, 1,039; Iowa State College, 1,011.

The largest gain in registration this year is shown by Cornell, with 395 more students than in 1919-20. Massachusetts Institute of Technology comes next with an increase of 367. The greatest loss in total registration was suffered by the Carnegie Institute of Technology, with 246 less students this year than last. The next greatest loss was sustained by the University of Minnesota, with 162. The University of Mississippi, with 48 engineering students this year, showed the smallest total registration.

The curriculum of the Massachusetts Institute of Technology is the most highly specialized of any of the colleges. In addition to the five basic engineering courses listed in the questionnaire, there were reported courses in the following specialties: Architecture, chemistry, biology and public health, physics, general science, general engineering, sanitary engineering, geology, naval architecture, electro-chemical engineering, engineering administration, aëro engineering and mathematics. At the Stevens Institute of Technology, Hoboken, N. J., on the other hand, a single course, mechanical engineering, is offered.

TABLE II. PERCENTAGE RELATION OF SPECIAL COURSES TO TOTAL AND TO FRESHMAN REGISTRATION

Course	Per Cent of Total Registration 1919-20	Per Cent of Total Registration 1920-21	Per Cent of Freshman Registration 1919-20	Per Cent of Freshman Registration 1920-21
Civil	18.2	17.8	17.8	17.0
Mechanical	25.2	25.2	24.7	25.6
Electrical	24.3	25.1	27.1	27.8
Mining	4.8	5.0	4.5	4.3
Chemical	14.2	13.4	13.1	12.5
Miscellaneous	13.3	13.5	12.8	12.8
Total	100.0	100.0	100.0	100.0

For 1919-20 Freshman registration was 43.8 per cent of the total and for 1920-21 it was 37.4 per cent.

At a few institutions engineering is a post-graduate course requiring, in the case of Columbia University, three years of college work for admission. At Harvard

students may register in the college for the first two years of the engineering program and transfer, without loss of time, at the end of either the first or second year to the engineering school, provided they have chosen courses with this end in view. At Yale students in the freshman and sophomore years are not divided into specialized groups, but are classified under the head of "engineering science." At the State University of Iowa segregation of the students into special courses occurs only in the senior year. In fact, there are fifteen or twenty returns indicating that classification in the special courses does not occur until after the completion of the freshman year.

At some colleges it has been found necessary to limit the number of entering students, due to the lack of facilities for handling more than a specified number. At Lehigh University and elsewhere the enrollment in 1919-20 was abnormally large, due to the presence of students returned from war service. When it appeared that the freshman enrollment at Lehigh would be equally large for 1920-21, according to Raymond Walters, registrar, the university limited the freshman class to 400 in all courses, including art, science, and business administration. No more applicants were accepted after Aug. 11, 1920. The definite policy of Lehigh University has been to limit the entering class to a number for which adequate facilities are afforded.

Selecting Students at N. Y. U.

New York University is going a step further by "selecting" its new students. Every candidate must be ready from the academic point of view; otherwise he is not considered. He must also pass personnel and psychological tests on the basis of which, according to Dean Charles H. Snow, a large number of men are refused admission. This course has been found necessary because the university wishes to reduce freshman mortality and to restrict the size of the undergraduate body to the facilities provided.

Commenting upon present conditions in the engineering college at the University of Wisconsin, Dean F. E. Turneaure has summarized the situation in these words: "The upper classes are now feeling the effect of the large increases in the lower classes of last year and our facilities are taxed to the limit. The entering class this year is slightly less than last year, numbering about 400 and the total attendance at the college is about 1,200. This is an increase of 70 per cent over the pre-war average and represents a total attendance which just about corresponds to a freshman class of 400. It is likely, therefore, that the attendance will remain about stationary at the present figures for the next three or four years."

Dean Turneaure finds that the present attendance at the University of Wisconsin is about what would have been predicted by an extension of the curve of growth prior to the war. That is to say, the effect of the war was merely to make a deep notch in this curve and recovery since the war has brought the registration back nearly to the normal line.

Pennsylvania State College, Dean R. L. Sackett reports, refused entrance to 1,100 students in September, 1920, about 400 to 450 of whom would have been freshman engineers. In 1919 the college was unable to receive between 300 and 400 because of lack of facilities. At Leland Stanford, Jr., University, California, Prof. Charles D. Marx reports, the number of first-year students is limited to 450 for the autumn quarter and 50 additional for the winter and spring quarters. At this institution all first- and second-year students are registered in the lower division and not in any special department.

Statistics from 14 Representative Colleges

Conditions in our technical colleges were so disarranged during the war that a comparison of this year's registration figures with those of 1917 and 1918 are of little value except as an index of an abnormal and temporary state of affairs. As a matter of passing interest, however, Table III, containing composite

TABLE III FIGURES FROM 14 REPRESENTATIVE COLLEGES SELECTED GEOGRAPHICALLY—1917-1921

No and Location of Colleges	1917-18	1918-19	1919-20	1920-21	Per Cent Gain 1917-1920
Four, East	3,756	4,199	5,753	6,444	72
Three, Middle West	2,000	2,643	3,976	3,979	99
Three, West	708	1,583	1,739	1,757	148
Two, Pacific Coast	828	1,466	1,463	1,482	79
Two, South	978	1,317	2,216	2,169	122
Total	8,270	11,208	15,147	15,831	91
Yearly gain per cent	.....	35.5	35.2	4.5	...

registration figures for fourteen colleges, selected so that all geographical divisions of the country might be represented, are given for the four college years beginning in the fall of 1917. Representing the East, in Table III, are the Massachusetts Institute of Technology, Cornell, Pennsylvania State College, and the University of Pennsylvania; for the Middle West, University of Illinois, Iowa State College and University of Wisconsin; for the West, University of Idaho, Colorado School of Mines, and Texas Agricultural and Mechanical College; for the South, Georgia School of Technology and University of Alabama; and for the Pacific Coast, University of California and University of Washington.

The foregoing list is balanced, geographically, and includes large and small institutions as well as private and state universities. On the basis of these figures this year's registration is 91 per cent greater than that of the college year 1917-18. Starting with the college year 1917-18 the yearly increases are 35.5 per cent, 35.2 per cent, and 4.5 per cent. The latter figure, based on the returns from the fourteen selected colleges, agrees closely with the 4.1 per cent gain computed from the returns of the 81 institutions this year.

A marked difference in the percentage gains from 1917 to 1920 is shown by the geographical groups above noted. The four Eastern colleges increased 72 per cent, while the three Western institutions increased 148 per cent, with the others between these limits. These figures, however, should be interpreted as showing an abnormal condition of affairs four years ago. In other words, the percentages are high, not because an unusually large number of students registered this year, but because there was a decided slump in the year 1917.

Reverting, finally, to this year's statistics for the 81 colleges, it would seem that conditions have again become stabilized as shown by the 4 per cent gain this year over last year. In conclusion it should be pointed out that this year's registration of 48,312 students represents only the 81 engineering institutions answering this journal's questionnaire; the total number of students studying engineering through the country is considerably larger than this figure.

Indian State Builds a Power and Irrigation Dam

Dam Now Under Way on Project in State of Mysore One of Large Masonry Structures of the World

By E. W. T. Slater
Hassan, Mysore State, India

INDIA has long been famous for its irrigation developments. In the State of Mysore, particularly, a great deal of attention has been paid to this subject, and in the two great projects, the Marikanave Dam and the Krishnaraja Sagara Project, are two splendid instances of what can be accomplished by engineering skill. These schemes have made cultivable large districts which would otherwise have been continually threatened by a famine.

The river Kaveri, which runs through the Mysore

KRISHNARAJA SAGARA DAM ACROSS THE KAVERI RIVER IN INDIA
Ramps built for workmen during construction.

State and then through the Madras Presidency, is looked upon by the people of South India as endowed with great sanctity, in fact it is called "The Ganges of the South," for there are millions of people who are entirely dependent on its supplies for their livelihood. Every year the rains come in the monsoon season and the river becomes a mighty life-giving power to the farmers whose lands lie in the vicinity. Yet for six months of the year, the flow of water will hardly suffice to irrigate a fraction of the land that could be cultivated were it possible to conserve the heavy monsoon flow. By means of anicuts something has been done, but the government of Mysore, realizing the great advantage of a huge dam across the river, prepared several schemes, but the one finally decided on was that now known as the Krishnaraja Sagara Project, after the ruling prince of Mysore. The work has now reached an advanced stage, though it is estimated that it will require two more years to complete the whole scheme.

The objects for which the dam has been raised are two. In the first place, the Mysore Durbar was anxious to increase greatly the area of cultivable land, and to assure the farmers of an unfailing supply of water throughout the year. In the second place, it was necessary to increase the supply of water for the large electrical power works situated at Sivasumudrum, lower down the river, as there were periods of the year when this supply was in danger. The Kolar gold fields are consumers of large quantities of electrical power, and their increased demands have placed a great strain on the capacity of the present available supply of water. With these two objects in view the Mysore government felt justified in beginning a scheme which would involve the expenditure of large sums of money, and prove a strain on the finances of the states.

The storage reservoir, when the dam is complete, will be 41,500 million cu.ft. The lake thus formed will be over forty miles in circumference. Such a wide area of water will seriously affect a considerable number of villages, for the total acreage of submerged land is nearly thirty thousand acres. About twenty villages will be wholly or partially submerged, and over ten thousand persons rendered homeless. It was therefore necessary in considering the scheme to see what provision could be made for these people, and a careful survey of the whole resulted in a plan for their emigration to other lands, each family receiving a just compensation for its losses. Houses have been erected in the new districts by the farmers with the assistance of the government, and the government is taking advantage of the opportunity thus afforded of building model villages which ought to serve as a useful object lesson to the surrounding villages.

The final height of the dam, which is of rubble masonry, with cut stone faces, will be 120 ft., but it is proposed to build this in two stages, the first sufficient to store 80 ft. of water. When the full height is reached, the water supply will be enough to guarantee all the demands made for electric power, and provide also irrigation for over half a million acres of land. The excavation and clearing of the foundations for the masonry dam was complicated by the fact that no work could be executed

ROCK CUT FOR THE FOOTINGS OF THE KAVERI RIVER DAM

in the river bed for at least six months of the year, during which the river carried a discharge varying roughly from 6,000 to 150,000 cu.ft. per sec. Sound rock, particularly at the northern bank of the river, was found at much deeper levels than was originally contemplated, with a necessary increase in cost and labor. The first stage length of the masonry dam was 4,200 ft., but the length of foundations actually laid was 5,150 ft. It is estimated that the completed dam will contain nearly thirty million cu.ft., over two-thirds of which has been completed.

In order to pass the required amount back into the river, a number of sluices, 12 ft. x 6 ft. in section have been built in the body of the dam in the southern half of the river bed, at 12 ft. above bed level. This low level

WOMEN WORKING ON THE KRISHNARAJA SAGARA DAM

enables the Mysore Durbar to pass the requisite quantity through no matter how low the lake may be. In addition to these sluices others have been made with the object of passing the water through into the long irrigation channels which are being built to irrigate Mysore lands. Already three large channels have been cut and are now in use. One of the proposed canals is a somewhat large undertaking, for it is proposed to take the canal across the Hulikere-Karighatta range of hills by means of a tunnel nearly two miles long. After crossing the ridge the canal will extend about 70 miles and command a large tract of country.

On the left bank of the river four power lines of 6 ft. diameter have been built in the body of the dam. The head of water available for power generation will vary according to the water level of the reservoir. It is contemplated that in addition to supplying the necessary water for the larger power station at Sivasumudrum, it will be possible to generate a supply at the dam itself, which would be available for the city of Mysore and other places not touched by the larger lines.

There has also been made provision for a large weir which will partly consist of rectangular openings fitted with automatic gates and partly of sluices to be worked by gearing. The spillway will be 1,800 ft. long.

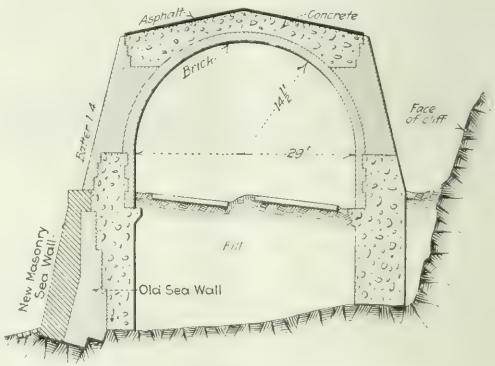
The Krishnaraja Sagara Project compares favorably for size with the other large reservoirs constructed in India. The principal reservoirs already constructed are the Periyar in the Madras Presidency, the Marekanave in the Mysore State, Lake Whiting at Bhatgarh which supplies the Nira Canal in the Bombay Presidency, the Tansa Reservoir which is the principal source of water supply for Bombay and Lake Fife near Poona. The maximum height of the Kaveri Dam will be 143 ft., the corresponding height of the Periyar Dam is 173 ft., of the Marekaneve Dam 167 ft., of Tansa 118 ft. The total capacity of the Krishnaraja Sagara Reservoir will be 41,000 million cu.ft., that of Marekanave 30,145 million cu.ft., and of Periyar 6,185 million cu.ft.

The scheme was conceived many years ago, when the British engineers contemplated some such project but it was left to Sir M. Vishveshvarayya, who came to the state as chief engineer, to have the honor to begin the work. Most of the work has been carried out during the time he has been employed in the state, but he has been ably seconded by Mr. Karpur Srinavasarav, Mr. K. Krishna Iyengar, Mr. B. Subba Roa, Mr. B. Garudaharya and others to whom great credit is due. The labor is exclusively native and many women are engaged in the heavy work, as is shown in one of the views herewith.

Protective Gallery on Tunnel Approach

A PROTECTIVE gallery built as a 440-ft. extension of a double-track tunnel, in order to protect the approach against rocks falling from cliffs, is an unusual piece of work undertaken recently by the Great Western Ry., England, at the Parsons tunnel, near Teignmouth. At this point the line, built along the seashore, is on a fill at the base of a cliff rising 200 ft. above the rails, the fill being faced with a masonry sea wall. Concrete foundation walls for the new work are carried down to rock and extend up to the springing line, the upper portion being faced with brick.

This double-track gallery, conforming to the tunnel section, is 29 ft. wide and 22 ft. high, with a semicircular five-ring brick arch. Concrete is filled in over the crown and haunches, sloping from the center to each side and covered with ¾ in. of asphalt. The exterior faces of the gallery have a batter of 4 to 1, corresponding to that of the sea wall.



COVERED APPROACH TO RAILWAY TUNNEL

In construction, a steel shield 20½ ft. long formed the arch centering, being composed of five ribs shaped to the contour of the arch and having vertical legs seated on timber stringers. Two sets of stringers were used, separated by wedges to provide for adjustment, the lower stringer resting on a concrete base. The ribs were made of double-head rails, laid flat and connected by struts and diagonal braces. Transverse members about 5½ ft. below the crown carried king posts and knee braces and formed a support for gang planks. At the forward end of the shield a working deck was formed level with these planks.

For moving the shield it was supported by jacks while blocking was removed between the stringers and was then lowered about 6 in. onto iron rollers placed on the lower stringer. A wire cable was hitched to chain bridles attached to the posts of the ribs and was operated by a hand winch or hoist. These particulars are taken from an article in the *Engineer*, of London. The work was under the direction of E. G. Matheson, resident engineer, and W. W. Grierson, chief engineer, Great Western Ry.

Ethical and Practical Considerations Regarding the Engineering Corporation

Development Led Naturally to Association with Non-Engineers—Ethical Questions Not Essentially Different from Those Confronting Individual Consultants

FOLLOWING the approval by the Governor of New York of the amended engineers' licensing bill, which permits engineering corporations to practice engineering provided those in charge of the work which constitutes such practice are licensed engineers, Gano Dunn, as the representative of the group which prepared and presented to the Governor the petition favoring the bill, has reported back to each of the individual signers of the petition the action of the Governor. Opportunity is taken at the same time to present to these signers a lengthy brief in defense of the engineering corporation, under the title, "Why Limit the Opportunities of the Professional Engineer?"

The brief points out certain differences between the practice of engineering and of law and medicine, describes the development of the engineering corporation and its advantages to the client and to the profession, and discusses ethical questions which have been brought up in the recent controversy regarding engineering corporations. (Previous discussions of the same subject will be found in *Engineering News-Record* of March 24, 1921, page 518, and April 28, page 724.)

Mr. Dunn's brief is, in part, as follows:

Development of Construction Function

It used to be that "purely professional" engineering was considered limited to the function of design, the preparation of specifications, the negotiating and letting of contracts and judicial supervision.

The execution of design—that is, the function of construction—was let to a "contractor," who in competitive bidding named a unit price or a lump sum for which he would do the work and take the risk. Then, under the oversight of the engineer, who served in a judicial capacity, the contractor would execute the contract at his own expense as cheaply as he honestly could in compliance with the specifications, with the legitimate object of making a maximum profit out of the job.

The engineer represented the client's interest, the contractor represented his own, and once the contract was signed, these interests were strongly opposite. The client paid the engineer a stipulated fee, usually a percentage on the construction cost of executing his designs.

As the engineering field broadened and developed and particularly as it came to involve more of the mechanical, electrical, chemical, and in general the physical sciences, projects took on an increasing complexity during construction, far exceeding that of the earlier days when civil engineering principally covered the field. The work of the contractor as well as the work of the engineer had to broaden and become more scientific and complicated.

The greater complexity of projects and the necessary correlation of all parts made it increasingly difficult to harmonize the separate interests and interrelations of groups and types of contractors on a job, and especially to foresee and fix in advance in the designs and specifications in a manner to stand the strain of oppositeness of interest, all the details that are necessary before work can be let under contract at a lump sum.

In cases where special capability was desirable or where the work was extremely difficult so that a contractor would not take the risk without profit that was regarded as inordinate; or where the work involved so little risk it was not considered desirable to pay a contractor's profit on account of the overhead costs it contained; or where there was necessity that the design should be subservient to new conditions that might develop as the work progressed and therefore had better not be determined completely in advance; or where urgency required work to be done while plans were completing; it became the custom for the client to have the engineer not only design the work but carry it out in a manner that was termed "by administration."

This merely meant that instead of letting the work to a contractor with opposite interest, the engineer having the same interest as the client and with the client's funds would for the account of the client, engage engineers, foremen and laborers, purchase materials and plant, and administer, organize, supervise and execute the work as the client's agent.

The client in this case took the risk and the engineer earned for the client what would have been the contractor's profit. The engineer received none of this profit for his extra services and effort, but did receive a larger stipulated fee.

In this way and with the growing demand for the carrying out of work "by administration," engineering offices added to their staffs the engineers and other of the personnel that were formerly employed by the contractor and assumed an increasing number of the contractor's functions, but never his status in relation to the client.

Non-Engineer Associates.—When the engineer did an increasing amount of work "by administration" he found he needed more capital and sometimes would take in a non-engineer partner or associate who would help to supply this capital and who would also perform certain essential but non-engineering parts of the work, such as the function of treasurer, office manager or purchasing agent.

The non-engineer would usually be selected for his commercial instinct and skill in these functions—in other words would be a better business man than the technically trained professional engineer—and the combination of the two types made for strength, economy and increasing satisfaction to the client on account of more successful conservation of his interests.

Enlarging Opportunity for Engineers

The interests of the worker and the owner being unified, the judicial function of the engineer was no longer exercised as to the work as a whole because there was no longer any opposite interest against which to protect the client. It was shifted back to a new point of opposite interest, the relation of the client with the manufacturer or the supplier of material. Thus was the area of the engineer's field enlarged.

The work and responsibility of an engineer grew therefore not only because of the addition of new branches beyond the capacity of an individual to practise but also because of the addition of new functions to engineering activities. With these enlargements in two directions the individual consulting engineer even if he had many employees, was not as much used by clients for certain classes of work as responsible groups of engineers who formed themselves into what has been termed "unrestricted partnerships" or engineering corporations, and who were prepared to assume the responsibility of executing their own designs.

Besides the advantages it offers to the client, the group form whether it be unrestricted partnership or corporation, offers much to engineers, especially to those with their professional careers largely before them. Irrespective of his proficiency, the work of a single consulting engineer is often a feast or a famine because of the greater narrowness of field. The work of the engineering group is steadier—has

a better load factor—on account of the range and diversity of its activities.

In a group the young engineer is given an opportunity for broad experience that he often lacks when associated with an individual engineer and on account of the usually greater magnitude and importance of the projects carried out by the groups, the young engineer has opportunity either to specialize intensively in branches which particularly interest him, or by going from one branch to another to gain a rounded experience.

In this way the engineering groups give opportunity for the development of special aptitudes, for the freer growth of engineers along lines for which they show exceptional talent and serve as schools and opportunities for very high types of engineers who in smaller fields could not reach such effective development.

Function of Non-Engineers.—The non-engineering work of the groups is performed by non-engineers who are as necessary, as expert and almost as much specialized in their lines as the engineers are in theirs. They bring vision and knowledge to bear and perform such non-engineering work better than engineers would perform it.

There are also numerous groups which do not carry out construction. Their work is largely done in the fields of investigating and reporting, including the valuation, planning, operation and management of industrial and utility enterprises.

Their personnel covers a wide range of specialists and, sometimes, of necessity, many non-engineers. The usefulness of these groups is indicated by the importance of the work entrusted to them, which very often is the basis of large financial commitments by banking, industrial or other interests.

If prevented from cooperating in the group form, their effective organization would largely be destroyed.

Combined Counsel

There comes about a very healthy resolve and balance of judgment, which augments the success and the prestige of the engineering profession when engineers call to their aid in the consideration of the financial, commercial and legal, as well as other contacts of engineering, men from these fields to participate in the engineer's group. The client knows that he may put a broad utility or industrial project involving very many branches of engineering into the office of a skilled and competent group with confidence that it will be comprehensively and intelligently carried out, not only in respect to its purely engineering questions but in respect to the relations which these bear to other fields in interested contact with them. In such counsel there is wisdom and safety.

There is no reason why an individual consulting engineer should not—and he in fact often does—perform on a smaller scale all the functions performed by the groups, including the function of construction, but it is not as convenient for him to do it. The other professional engineers of distinction whom he needs for covering the larger fields are not for reasons that have been stated, as ready to enter his employ as they are to work in a larger organization, enter a partnership or become the officers of a corporation. Both the engineers and the non-engineers whom he needs to employ are less confident of their future with him than in a group. He usually can not command the confidence of capital for the larger field to the extent that it is commanded by a group because the group form provides for a certain continuity or succession in the event of death or incapacity, and capital is reluctant to merge itself with the private fortunes of an individual.

The larger projects and the more complicated work tend towards the partnerships and corporations not because they are partnerships and corporations, but because they offer greater facilities and safeguards against failure in such work. Here and not in the form of practise is the deep cause of the contention.

It is acutely recognized by all that engineering can include the function of construction to the dignity and ethics of the engineering profession and to the honor of engineers only when no divided allegiance—no oppositeness of interest—is introduced.

Is there an opposite interest in a percentage fee for construction? For many years, it has been customary for engineers and architects without criticism to accept such fees for design. If there be no oppositeness of interest in accepting a percentage fee of say 6 per cent for design, how can there be an oppositeness of interest or divided allegiance in accepting a percentage fee of say 10 per cent for design and construction?

The sole difference is the quantitative one of greater variety of duties and larger and more valuable service.

Arithmetically, it is true that under a percentage fee an increased cost to the client means a slightly increased fee to the engineer, but if true, it is as true of design as it is of construction and the temptation to earn a larger fee by extravagant construction is no greater than the temptation to earn a larger fee by extravagant design.

While it is arithmetically true that in a percentage fee there is a small element of oppositeness of interest, it is untrue in the total aspect of the relation because the reputation of an engineer is based upon the economy of his results. While if extravagant in design or in construction, he may increase a particular fee to a small extent, his work will not compare favorably with the work of his fellows, and he loses not a part but the whole of the next fee he otherwise would be likely to receive from the client or from other prospective clients who consult that client.

The slight arithmetical oppositeness of interest in a percentage fee is an absolutely different matter from the essential oppositeness of interest of the speculative profit of the contractor which profit consitutes his whole reward.

Engineers who perform both design and construction sometimes style themselves Engineers and Constructors, or Engineers and Contractors, but they do not thereby mean that they execute lump sum contracts under their own designs. This would make them judges of their own performance which would not only be unethical but would show a lack of business sagacity in the client.

The criterion of oppositeness of interest is the infallible test in each case. It is to the honor of the engineering profession that disregard of this criterion is rare, although such disregard when it does occur is not confined to the partnership or corporation forms of practice.

Ethical Questions

Some conceive that under the law "organizations are to be expected in which the engineer shares with his non-engineering associates in the distribution of his purely professional fee, and in addition shares in the bankers, manufacturers or contractors profits flowing from the execution of the work which he initiates, investigates, plans and directs."

Do not such professional engineers as are employed by a consulting engineer share in his purely professional fee, and do not such non-engineers as he employs to do the non-engineering part of his work, also share in his fee, and is this sharing wrong?

If it is not wrong in the office of a consulting engineer, what makes it wrong in the office of a partnership or engineering corporation?

If an engineer in a group should share in manufacturer's or contractor's profits except with the full knowledge and approval of his client, he would be taking pay both ways and violating every principle of honor and ethics. He would be in the same position as the consulting engineer who for a secret commission specified the apparatus of a particular manufacturer or favored a particular contractor in the letting of work. The way to stop the latter fortunately rare abuse, is not to abolish consulting engineers any more than the way to stop the former equally rare abuse, is to abolish corporations and partnerships.

An engineer in a group might own stock in a manufacturing corporation and might thereby be inclined, perhaps unconsciously, to specify the apparatus of that company when it was not for the best interest of his client, but he

would be equally so inclined if he were an individual consulting engineer.

He ought not to own the stock or before engagement, he ought fully to advise the client that he does own it.

An important holding, by a manufacturing or contracting organization, of stock in an engineering corporation might tend towards a favoritism of that organization, perhaps unconsciously by the engineers in the group. If it were not known to the client, it would be unfair to him for he has a right to disinterested service guarded against even unconscious tendencies.

But it is conceivable that the particular manufacturing or contracting organization might be one of such high standing that knowing of the existence of its interest the client would tolerate it and in some cases might even regard it as an advantage; but he should know of it.

The engineer in a group might share in the profits of outside organizations in the indirect way of securing increased practice by their influence in bringing other clients to his group in return for which he might be expected to depart from his position of disinterestedness and favor such outside organizations at the expense of his clients in the placing of purchasing orders or the letting of work.

Bankers' Influence

The group engineer is under no greater temptation to do this than the individual engineer and possibly is under less. The remedy lies as in all questions of this kind, in the character of the individual and in an investigation of records and reputations by clients.

A consulting engineer or a group which enters into secret alliances is sooner or later discovered, isolated and limited in clientele or work, and ultimately pays the penalty for such loss of disinterestedness.

It is charged that there exists the possibility that an engineering group "may have bankers, manufacturers and contractors on its board who may so dominate its policy as to influence its management, including its engineering employees, in the preparation of reports, plans, contracts and specifications, and in the supervision of work, in such a manner as to favor the outside interests of such directors, to the injury of the client."

This arraignment might be made as a possibility against any board of directors, but with the least likelihood of being true of the board of a corporation of professional engineers. Such a board even if it tried would have a hard time accomplishing the self interest of its individuals by the betrayal of the interests of its clients because in engineering matters it can work according to the law only through professional engineers who have a very high standard for the honor of their profession and who, in addition to responsibility to their profession, now have a penal responsibility to the State.

Irrespective of the law the fate of an engineering corporation so misusing the confidence of its clients would be promptly sealed.

High Grade Financial Management

Scrutiny of the directorships of corporations will reveal that because of the professional character of engineering corporations, great care is used in selecting only men of the highest standing whose interest may not even be under suspicion of being adverse to the interests of clients, and clients almost invariably thoroughly investigate these matters. Certain types of interest when represented in an engineering partnership or corporation make for an upholding and conservation of client's interests instead of the reverse.

Within the ranks of an engineering corporation or partnership there is a professional solidarity, partly the result of number and partly the result of [illegible] that makes it probably more difficult for the engineer in a group to be coerced or to violate professional ethics than an individual. If one passes from what "may" happen to what does happen, it will be found that an engineer in a group is usually under greater discipline to avoid errors and breaches of ethics than an individual engineer because the directors or the partners know that such breaches wreak in proportion to the responsibility of the organization, disproportionate damage to its reputation and its resources.

Where engineering partnerships and corporations as well as individual engineers have a relation to banking institutions, the sense of professional responsibility is invariably increased rather than diminished. Usually the banker is identified with the client and his incentive is to guard jointly with the engineer the expenditure of the client's funds.

When an engineer is acting as a client's agent with identiy of interest, there is no reason mhy he should not if he chooses, take part of his compensation in the client's securities or invest in them. It would be to the client's interest to have him do so. This applies equally to partnership and corporation practice.

In Conclusion

Analysis and experience both indicate that there are constantly arising in individual as well as in group practice situations that prove the honor and the character of the professional engineer. These must all be tried by the infallible test of identity or oppositeness of interest, and honorable conduct under them depends primarily upon the standards of the individual. For this reason also engineering is in fact as well as in law, a profession.

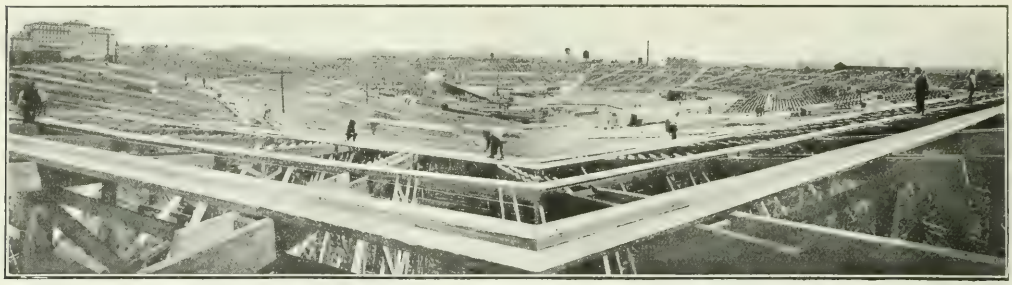
To argue, however, that it must be cast in the same mold as law or medicine, and that it is therefore unethical to perform construction or to practise through partnerships or corporations is absurd, at is is also absurd to call it not a profession but a business because the engineer necessarily works in field of economics and has to associate business men with himself for the best accomplishment of his results.

The engineering profession should preserve equality of opportunity for all—an equal chance to every engineer to win his position in accordance with his character, ability and efforts.

To limit the broadening of his field by restriction of group association would be detrimental to public interests and necessities, would prevent the development of the best that is in him and would narrow the future of large numbers of ambitious men who have chosen the profession of engineering as their life calling.

Mortar Tests in Brick Piers

Tests of a series of 8 x 8-in. brick piers, built up some of face brick and some of common brick, with various mixtures of cement and lime mortar ranging from straight 1:3 cement-sand to a 1:3 lime-sand mix, were carried out some time ago by Prof. J. S. Macgregor of Columbia University for the National Lime Association. Their results are summarized in a pamphlet (Bulletin 300) just issued by the association, and some interesting facts are shown. Both the face brick and the common brick piers showed higher strengths with mortars containing some lime than with straight cement mortar, the highest strength (by about 30 per cent increase) being shown by mixtures containing 15 to 25 per cent of lime. In the case of the face brick piers, moreover, the modulus of elasticity was higher for the piers laid up in part time mortar than for the cement-mortar piers, while with common brick the cement-mortar piers showed the higher values by a slight margin. Prof. Macgregor explains the result by the more perfect bedding secured with the lime-mixed mortar on account of its higher plasticity, and by the decrease of the "suction" effect of the brick on the mortar.



STADIUM UNDER CONSTRUCTION
Photograph taken June 4, twenty-nine days after work started

Building the Jersey City Prize-Fight Stadium

Materials Delivery Essential Feature—Octagonal Structure Covers Eight Acres and Contains 2,000,000 Ft. B.M. of Lumber

IN THE construction of the timber stadium at Jersey City, in which the Dempsey-Carpentier championship prize fight is to be held on July 2, the contractors had but two months in which to prepare the site and finish the structure. The time element was, therefore the prime consideration and affected not only construction methods but materials delivery. The structure is situated on what was an ash dump, and about 60,000 cu.yd. of material were moved before the site could be made available for construction. The first steam shovel began operating on April 28, two days after the contractors were told to start work, and actual construction of the stadium began May 6. Four steam shovels operated in the interim to make the site ready for construction.

The structure is octagonal in shape, the base of each of the triangles forming the octagon being 256 ft. in length with an altitude of 300 ft. The stadium rises from the ground level at the ring center to a height of 34 ft. at the circumference. It is estimated that the seating capacity is from 60,000 to 80,000.

The stadium is of simple design, essential parts being vertical supporting posts resting on timber sills, diagonal, lateral and longitudinal bracing, floor joists and flooring. Vertical supporting posts are generally of 6 x 6-in. timbers with the exception of the outer four rows, which are of 8 x 8-in. material. These timbers are carried on 4 x 4-ft. sills of 2 x 10 and 2 x 12-in. planks laid in two or three courses. Bracing is of 1½ x 5-in. stuff. Longitudinal bracing connects vertical posts at the sills and directly beneath floor joists, and for the outer third of the distance from the center of the ring additional bracing is put in at approximate vertical intervals of 10 ft. Posts are braced laterally at the sills and by diagonals that connect each pair of posts.

FIG. 2. SILLS FOR TWO SECTIONS BEING SET

The ring is 24 ft. square and elevated about 4 ft. From the center of the ring out along the altitude of any triangle a distance of 138½ ft. the stadium is entirely floored over, accommodating about 12,000 ringside seats and a row of boxes 10½ ft. wide. Behind

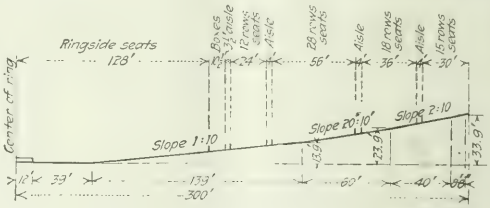


FIG. 1. PROFILE, SHOWING SEATING ARRANGEMENT

the boxes is a 3½-ft. aisle and then come successively bench-seat sections 24 ft., 56 ft., 36 ft., and 30 ft. in width, separated by 4-ft. aisles. In these four sections the 2 x 12-in. floor planks are not laid continuous but on 24-in. centers, and the bench seats, elevated about 14 in., occupy these spaces between floor planks. Though not included in the original plans, 4 x 4-in. timbers are used to stiffen the floor, being laid midway between floor joists. The 2 x 12-in. floor joists are nailed on either side of vertical posts, and so arranged that the joints come on alternate posts.

The vertical posts are set on 10-ft. centers in a direction perpendicular to the base of a triangular section and on 8-ft. centers in a direction parallel to the base. The center lines of sills therefore are perpendicular and parallel, respectively, to the base of a triangular section.

Three pitches are found in the profile of the stadium, the breaks coming 51 ft., 190 ft. and 250 ft. from the center of the ring. The first 51 ft. are level. The pitch in the first section is 1 ft. in 10; in the second

Findings of Los Angeles Sewage Disposal Commission

A BRIEF summary of the preliminary report of the Special Sewage Disposal Commission of Los Angeles, Cal., was printed in *Engineering News-Record*, May 5, p. 784. In more detail the commission, the members of which were George W. Fuller, New York City, Prof. George C. Whipple, Cambridge, Mass., and William Mulholland, Los Angeles, summarized their findings, conclusions and recommendations substantially as follows:

The discharge of the Los Angeles sewage into the ocean at Hyperion is now causing a nuisance along the beach for more than a mile in either direction from the outlet. Other cities along the coast also discharge into the ocean the flow from their sewer outlets under such conditions, in some instances, as to cause objectionable results, thus pointing to a general need for improving the conditions along the coast in the interests of health and cleanliness. The present dispersion facilities at Hyperion for mixing the sewage with an adequate portion of ocean water are much inferior to modern arrangements at other large cities.

The sewage flow averages about 35 m.g.d. but at intervals approximates the rate of 55 m.g.d., which approaches the safe capacity of the present outfall sewer. This is shown by the fact that in some portions of the outfall sewer there is at times an overflow from the manholes.

Strong Sewage High in Grease

The analysis of Los Angeles sewage, which averages about 55 gal. daily per person connected with the sewers, shows it to be stronger than that found at most cities where the waste water is removed in sewers separate from storm drains. Its content in grease, mineral oil and dissolved mineral matter coming from the ground water is particularly high. In each day's sewage there are 198 lb. of suspended matter, 24 lb. of nitrogen, 70 lb. of grease, and 6.5 lb. of mineral oils per 1,000 population. Of the total suspended matter 3 per cent is organic nitrogen and 3 per cent is mineral oil. Bacterial action in the sewage as it flows through the long outfall sewer forms decomposition gases which are injuring the existing masonry above the flow line.

The demand for irrigation water in the Los Angeles district is such that the amount used during the three summer months approximates the capacity of the Owens River Aqueduct (400 sec.-ft.) but during the three winter months the demand falls to less than 20 sec.-ft. During the spring and fall months the demand ranges from 20 to 150 sec.-ft., depending on rainfall. This water is available for distribution through existing pipes from an elevation of 1,450 ft. above sea level. For half the year water from the hydro-electric plants on the Owens River Aqueduct to the extent of about 200 sec.-ft. is wasted in the Los Angeles River because of lack of irrigation demand.

Although the ground water levels are said to be falling there is as yet no serious depletion of the ground water level in the Los Angeles district, where individual ranchers in many instances secure irrigation water by means of their own pumping plants. There is some demand for an additional supply of irrigation water outside of the immediate Los Angeles district, but the city would require further legislation to deliver purified sewage to such localities and would have to develop a system of pumping and distribution works.

Sewage Irrigation Feasible Only Half the Year

In the event that purified sewage is used for irrigation it would be necessary to get rid of it by some other method than land disposal for more than half of the year. Suitable locations for building reservoirs in which to store the purified sewage during the rainy periods for use during dry weather do not exist in this locality. The discharge of surplus water from Owens River into the Los Angeles River is causing complaints from property owners in the lower valley on account of drainage conditions. A depletion of the ground water level in the future should it occur, would, of course, lead to a lessening of this complication and the discharge of purified sewage into the river gravels might be a benefit.

The fertilizer demand in the Los Angeles market might provide a market for the sewage sludge produced by treating the sewage, but, according to available analyses, the sewage contains so much grease and mineral oil that the commercial success of a sludge utilization project would be uncertain.

We conclude that the Los Angeles sewage, after it has been fine-screened, can be dispersed in the ocean without nuisance for many years to come through a modern arrangement of deep multiple outlets designed to bring about a thorough mixing of the sewage with the sea water. With the growth of the city and larger volume of sewage, and with an increased use of the beach for bathing and recreation purposes, the dispersion arrangements will require extension from time to time. Chlorination of the screened sewage may be required at intervals in later years. It is essential that a new ocean outfall be constructed as soon as possible. Even if the sewage of the city should be used for irrigation, the new outfall sewer would be required, for reasons above mentioned. The new outfall should be of sufficient capacity to serve, in conjunction with the existing outfall, the area tributary to it when this area is completely built up, namely for a population of about 2,500,000. A total capacity of 270 m.g.d. will afford reasonable provision for future commercial and industrial developments. A systematic program should be adopted for preventing the entrance into the sewers of substances which will injure the structures or which will needlessly complicate the treatment of the sewage for irrigation or fertilizer purposes.

Availability and Cost of Activated-Sludge Process

The activated-sludge method of sewage treatment is the most advantageous one to consider in preparing the Los Angeles sewage for irrigation and the sewage solids for use as a fertilizer. There are no precedents either in this country or Europe to show definitely just what would be the best detailed arrangement for Los Angeles to adopt for utilizing the irrigation and fertilizing properties of its sewage. Milwaukee has conducted investigations for over seven years and has developed many advances in the art, but has not yet begun to install its permanent treatment plant. Houston is now installing presses and driers for preparing as a fertilizer the sludge from a plant which was built four years ago. Los Angeles should adopt a systematic and orderly program for demonstrating the best arrangements for treating the local sewage and utilizing its irrigating and fertilizing properties.

In designing the new outfall sewer and its principal branches, due regard should be given to facilities for delivering the sewage to suitable locations where treatment plants can be built for operation during a part or all of the year, depending upon experiences to be developed later.

From the best available information the activated-sludge process at Los Angeles would involve: (1) An investment of about $60,000 per 1,000,000 gal. of daily capacity, exclusive of the cost of land and arrangements for delivering sewage to and from the plant. (2) Operating costs (exclusive of preparing the sludge for use as a fertilizer) amounting to $6 to $14 per 1,000,000 gal., depending upon the size of plant and cost of power, a probable figure for a large plant being about $10. (3) Operating costs for pressing and drying the sludge, ranging from $10 to $20 per ton of fertilizer, a probable average figure being about $15. (4) Possible operating cost for degreasing.

From the best information now available the activated-sludge process at Los Angeles would produce about 1.5 tons of fertilizer (dry basis) per 1,000,000 gal. of sewage treated. This would contain about 4 per cent (units) of organic nitrogen, as compared with 3 per cent in the untreated sludge. On the assumption that purified sewage has the same market value for irrigating purposes as the present charge for Owens River water ($6 per acre-foot) this would

be $18.50 per 1,000,000 gal. If used at considerable distances from and elevations above the treatment plant, its value might be more than this, but the cost of delivering it would have to be taken into account. The sales would be limited to the irrigating season as before mentioned. The purified sewage would contain some nitrate, and this would have a fertilizer value, but there is no adequate basis for estimating what this would be. The value of the dry fertilizer in sacks at the plant would be about $4.50 per unit, or $18 per ton, provided the quantity of grease and mineral oil is not too high for successful use. If too high, the cost of degreasing would become an operating expense. In view of the foregoing evidence it is doubtful whether net proceeds would result from the activated-sludge process at Los Angeles at the present time; but future conditions may make its application much more favorable than now.

RECOMMENDATIONS

We recommend: (1) That all reasonable steps be taken to exclude from the sewers all substances which can be otherwise disposed of and which, if discharged into the sewers, would complicate the utilization of the sewage for irrigation, and more particularly, as a fertilizer. (2) That a new ocean outfall be constructed of a capacity of at least 210 m.g.d. (3) That a plant for the fine screening of the sewage be installed. (4) That arrangements be provided for dispersing the screened sewage at Hyperion by means of deep multiple outlets. (5) That the outfall sewer be built in such a manner as to resist disintegration from sewer gases, so far as this is practicable. (6) That an activated-sludge plant having a capacity of at least 2.5 m.g.d. should be built at once in order to carry out the investigation referred to above. This plant should be so arranged that additional units may be advantageously installed in the future if desirable or necessary. (7) That the proposed bond issue be increased from $12,850,000 to $14,000,000 in order to provide for improved deep multiple outlets at Hyperion, to insure the outfall sewer being of acid-resisting construction as far as practicable, and to enable a start to be made at once on sewage purification and utilization.

Road Experiment with Concrete Slabs

The borough engineer of Taunton, Somerset, England, has recently been experimenting with concrete slabs for road construction. The slabs used were 3 ft. 6 in. long by 2 ft. wide by 5 in. thick, with smaller slabs to break the joint. Some of the slabs were reinforced and others not. As a test, these slabs were laid to cover a length of 20 ft. of the main highway of Taunton, where a considerable amount of traffic passes. The length of highway was excavated and a foundation of sand and cement in the proportion of 6:1 laid. The slabs were laid on this with ⅛-in. joints left open and subsequently finished with a pitch and tar filling. The cost worked out at £1.1.9 per square yard. The object of the experiment was to minimize traffic obstruction and to facilitate the repair to the city's sewers. These slabs have been in for three months, are wearing well and, so far, show no sign of working loose on the bed.

Maintenance of Paving by Street Railway Companies

Distribution of Maintenance Cost—Headers Isolate Track Strip from Street at Toledo—Removable Special Sections

By A. Swartz
Superintendent of Transportation, Community Traction Co., Toledo, Ohio

When street railways were operated by animal power the traffic had a tendency to wear the railway strip of paving, but with operation by electric power it does not seem that any such wear can be attributed directly to the method of propulsion. Arguments against relieving street railway companies from the responsibility of construction and maintenance of the paving between and just outside their tracks are given in *Engineering News-Record* of Oct. 21, 1920, p. 795, but these arguments appear to be in many ways unfair toward the railways. As street railways are necessary it devolves upon the city to grant them the right to use the streets. The railway and the public have mutual interests.

After the original pavement is laid, the greatest share of its renewal is chargeable to the city as a whole, rather than to the contiguous property owners. Since the city as a whole pays for and receives the benefit of this renewal, why should the street railway be further hampered by additional cost of paving renewals outside its own track strip? On the contrary, it would seem that after the railway company has once paid for its original pavement the city should stand its share of the renewal of the track strip, as this would reduce the cost of operation to the railway and would lessen the cost of a ride.

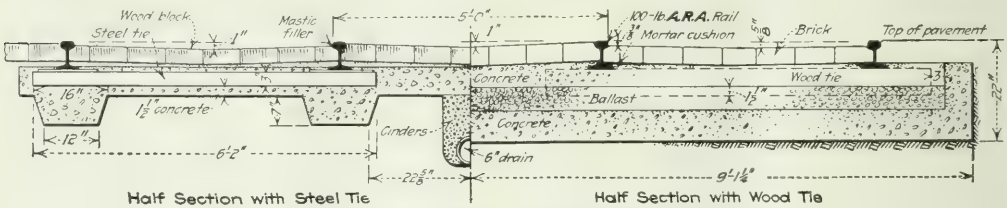


FIG. 1. STREET RAILWAY TRACK CONSTRUCTION AT TOLEDO

Drainage of pavements where there are railroad tracks is not much more difficult than that of other pavements and the contour of the streets need not be altered materially to take care of the drainage. If the subgrade is poor, a tile drain can be laid. With a concrete foundation, water seeping through the pavement may be taken care of by track drains placed at street intersections and connected with the sewer inlets.

Track construction does not necessarily affect maintenance of paving outside of the track strip, even if the track is light and flexible. As to additional cost for heavy track construction, Mr. Capes presents arguments to the effect that the community should not be required to stand such cost, but that they should be borne by the street railways and the people who use them. My feeling is that the entire community is benefited in proportion to the efficiency of the transportation system, and should share in its expenses.

In Toledo we have a type of street railway track con-

FIG. 2. PAVING OUTSIDE HEADER NOT DISTURBED BY TRACK VIBRATION

struction which counteracts some of the objections raised in the article mentioned above. This construction is shown in Fig. 1. A 6- to 8-in. concrete foundation is laid on a subgrade which is drained by tile wherever necessary. On the concrete is a 2-in. cushion of crushed stone ballast, this ballast being carried up to within 3 or 4 in. of the top of the tie. Above the ballast is another layer of concrete, about 5 in. thick, to support the paving, which is of brick or creosoted wood block. Recently we have floated the surface of the top layer of concrete to a smooth finish, covering this with a coat of pitch to make the concrete as impervious as possible and laying the wood block upon this coating. Drainage in each track strip is provided by drains at street intersections, connected with the sewer inlets. Where steel ties are used they are embedded in the concrete, making a monolithic concrete structure from the bottom of the paving block to the top of the subgrade, as the crushed stone cushion is omitted.

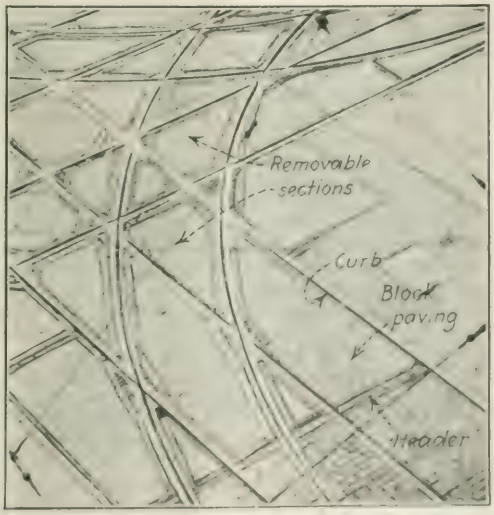


FIG. 3. TRACK INTERSECTION PAVED WITH REMOVABLE SECTIONS

The main point is that we have constructed our track strip in such a manner that it is entirely separated from that portion of the paving outside of the railway tracks which is paid for and maintained by the city. This is done by a creosoted wood-block header about 12 in. deep and 4 in. wide, laid at the outside edge of the track strip and acting as a curb for the city portion of the paving. With this construction there can be little vibration in the city's portion of the paving due to traffic over the railway strip. Fig. 4 shows the laying of the header and Fig. 2 shows a street with paving in poor condition along the tracks but in good condition outside of the header.

This separating system was used eight or nine years ago where the city wished to lay asphalt and permitted the street railway company to lay brick. The company could not afford a concrete foundation, so it placed a layer of stone ballast on the subgrade and as settle-

FIG. 4. LAYING HEADER BETWEEN TRACK AND PAVEMENT

ment of the railway strip was expected the strip was separated from the city's portion by these wooden headers. At present the track strip has settled into the subgrade as much as 3 in. It may be admitted that this is not a good condition, but the city's portion of the street has not been affected and outside of the ordinary paving defects it has retained the original surface. No complaint has been made by the city or the property owners that their paving has been injured by our type of construction. As this method was so successful we have applied it on streets where the track is on a concrete foundation.

In the *Proceedings* of the American Wood Preservers' Association for 1920, the committee on wood block floor and paving (p. 280) suggests that a proper construction under street car tracks is such as to separate the two parts of the pavement. Municipalities should insist upon street railways separating the track strips from the balance of the pavement construction, and in this way place definite responsibility for maintenance.

Removable sections of pavement at special work and crossings constitute another arrangement of interest to municipalities, the paving being constructed in units

which fit into the peculiar shapes of the paved areas between the rails. Each unit has a floor of 3-in. creosoted plank to which wood paving blocks are secured by toe nailing, together with bolted curbs to fit against the straight or curved rails. The regular paving adjacent to the unit is retained by a transverse header of creosoted timber. As the units rest on the flanges of the rails they retain their relation to them and cannot settle independently of the track. For the removal of bolts in a crossing of two double track lines where this paving was used the work was done in two nights at a labor cost of $55, as compared with five to seven days and a cost of $300, which ordinary conditions would have required.

Further Power Development at Niagara

Extract from Paper by John L. Harper and J. A. Johnson, Annual Meeting, American Institute of Electrical Engineers, Salt Lake City, June 21-24, 1921.

ONE of the first acts of the Federal Power Commission was to give approval to the plans being carried out by the Niagara Falls Power Co. and to issue a license to the company for all the water permitted to be diverted from the American side of the Falls in accordance with the terms of the existing treaty (20,000 cu.ft. per sec.). At the same time it recommended an increase in the allowable diversion and the construction of remedial works to preserve the beauty and grandeur of both the American and the Horseshoe Falls.

This license gave formal federal approval to the plans of development already begun and authorized their completion. These plans included the placing in reserve of the present Niagara plant above the Falls, the construction of a new waterway from Port Day to carry the water now being used in the Niagara plant to the canal basin, below the Falls, the maintenance of Station No. 3 with its thirteen efficient 10,000-hp. units operating under a mean gross head of 217 ft., the extension of this station to the southward, and the construction of new units to utilize the 4,400 cu.ft. per sec. of water that had not been specifically allotted under the treaty and the water now being used by the Niagara plant. Plans were made so that subsequently the water used by these plants may be re-collected at the most favorable point and carried by tunnel past the lower rapids to a power house in the lower river, where the remaining head may be developed.

The first step of this general plan has already been carried out, namely, the construction of what is known as Station No. 3 Extension (see *Engineering News-Record*, Sept. 23, 1920). This extension contains three units, the combined rating of which is 100,000 hp. and together with the other plants of the company uses all the water allowed by the treaty. The second step has just been authorized, namely, the construction of a new tunnel, the installation of the remaining units, and an addition to Station No. 3 Extension. Another step has also been initiated by the granting of a preliminary permit to the Lower Niagara River Power & Water Supply Co., which allows two years for the presentation of plans for the development of the lower river stage. The details of this plan have not been worked out and the date of construction has not been fully decided upon.

Much has been said about the desirability of using the diverted water up to the full head of 314 ft. from the upper river to Lewiston, and when the field is entirely without complication, as in the case of the development of water in excess of the present treaty allowance, a one-stage development will undoubtedly be advisable. The reason for the apparent rejection of this plan for the present diversion may be of interest. The scheme of development now being carried out does not contemplate utilizing the full 314-ft. head in one plant with a long new waterway involving the abandonment of the efficient plant already built. Instead it will be utilized in two successive stages, the first stage utilizing a gross head of 220 ft. and the second stage a gross head of 94 ft.

Broadly speaking, the commercial power capacity of the two-stage development is practically the same as that of the single stage. The problem has been to decide whether the interests of the power consumers and indirectly of the public will be best served by an eventual total abandonment of all the plants that have already been built and the construction of a new plant to utilize in a single drop under the full 314-ft. head the total quantity of water permitted to be diverted under the treaty, or, by conserving as much of the old work as could be conserved without impairing the general efficiency of the use of water and by the construction of new works to supplement the old.

As no further water is at present available, the only source of additional power is the use of some of the present water under increased head. Naturally, the least efficient of the existing plants would be the first one selected for obsolescence, which in this case is the Niagara plant which, operating under an effective head of 140 ft., obtains but 12.1 hp. per cu.ft. per sec. as compared with 21 hp. per cu.ft. per sec. in station No. 3 Extension.

The power will be developed in the further extension to Station No. 3 along similar lines to those followed in the already completed extension. The water will be brought from Port Day through a 32-ft. horseshoe-shaped tunnel at a depth of about 100 ft. below the surface of the ground. From this tunnel the water will be taken to the penstock through a forebay similar to that provided for Station No. 3 Extension. The construction of this tunnel was started on Apr. 25, 1921, and work is now proceeding rapidly from both ends and two intermediate shafts. It is expected that the first unit will be started on or before May 1, 1923.

Rubber Paving in London

London Correspondence

THE Rubber Roadways Co., Ltd., and the Rubber Growers' Association inform me that satisfactory experiments have been carried out in the Southwark Borough of London using rubber for carriageways. Eight years ago 3 sq.yd. of rubber-capped hardwood blocks were laid at the junction of two roads which carry the heaviest traffic in south London. This rubber capping was ½ in. thick and fitted into the hardwood blocks by dovetail connections running longitudinally. Two years later these blocks were taken up for examination and it was found that the major portion of the wear had taken place on the underside of the rubber and on the wood surface; the wear on the upper rubber surface was comparatively negligible and consisted chiefly of scratches. The traffic to which these blocks had been subjected averaged 190 tons per street width yard per hour.

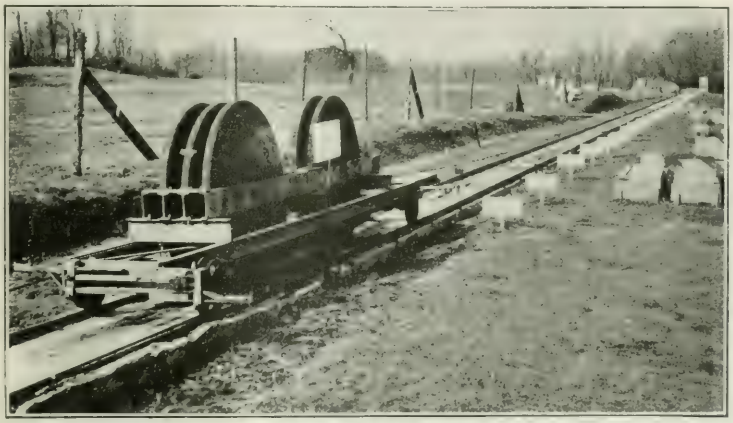
Three years later another experiment was undertaken. The blocks used consisted of rubber slabs $\frac{3}{16}$ in. thick, 9 in. long by 3 in. wide and vulcanized to steel plates. These plates were cut so as to produce lugs for holding to a concrete surface. The foundation consisted of reinforced concrete with a surface of concrete made up of grit in the proportion of cement 1 to sand 4. In this latter the lugs of the steel plates were set. The traffic load was about 240 tons per street width per hour. When this type of paving had been in use for several months the rubber blocks worked loose and about 15 per cent became completely detached. The whole area was then taken up and the condition of the slabs and plates showed that this type of paving was not satisfactory for fast and heavy traffic.

Subsequently the steel plate was replaced by a plate of expanded metal imbedded in vulcanite, lugs being added. These blocks have been in use now for about five months and are, so far, behaving satisfactorily.

Wear Tests Show Service Qualities of Paving Materials

Impact a Big Factor—Bituminous Fillers Show Up Well—Rattler Reliable—Sand-Cement Bed Best

THE U. S. Bureau of Public Roads has recently completed at the Arlington (Va.) experiment station a series of accelerated wear tests upon granite block, vitrified brick and concrete pavement surfaces, the results of which are embodied in a report by F. H. Jackson, senior assistant testing engineer, and C. A. Hogentogler, highway engineer, just made public. The tests, which were made under the general direction of Thomas H. MacDonald, chief of the bureau, and A. T. Goldbeck, engineer of tests, consisted of operating a carriage carrying five 1,000-lb. cast-iron wheels, back and forth over a runway 2 ft. wide and 400 ft. long, containing 48 sections of pavement of different types. The conclusions, as given in the report (which will be published in full in the June issue of *Public Roads*) follow:



TESTING MACHINE CARRIED FIVE 1,000-LB. CAST-IRON WHEELS
View shows 48 test sections of pavement forming runway 400 ft. long and 2 ft. wide paved with granite block, brick and concrete.

Granite Block Tests

Although certain limiting conditions, such as the small size of the test sections and settlement at certain points must be taken into account when interpreting the results of these tests, the following general conclusions may be drawn:

1. Bituminous-filled granite block pavements will resist the impact produced by heavily loaded steel-tired traffic as well as cement-grouted pavements.
2. Bituminous mastic fillers are as satisfactory for this type of traffic as straight bituminous fillers.
3. The effect of impact is tremendously increased by irregularities produced by poorly cut blocks.
4. Irregularities of surface or other factors producing impact are more serious with grouted than with bituminous-filled pavements.
5. Slight variations in resistance to wear, such as occur among the commercial granite block from the Atlantic coast quarries, are of much less importance in judging the probable resistance of the block to the action of traffic than has commonly been supposed.
6. Cement-sand bedding courses are more satisfactory than sand or bituminous-sand bedding courses.

Conclusions From Brick Tests

1. The edge protection offered by bituminous and cement-grout fillers is considerably greater for vertical fiber and wire-cut lug than for repressed bricks.
2. The adhesion of bituminous fillers to wire-cut lug and vertical fiber bricks protects surface and reduces wear.
3. With cement-grout fillers the surface becomes a rigid slab and failure occurs because of the breaking of this slab under load and consequent loosening and shattering of the bricks.
4. With cement-grout fillers and sand-cushion construction the bricks must be so thick as to make a slab which will resist without excessive distortion the impact produced by the load moving over it. In such cases the cement-grout filler offers excellent support to the wire-cut lug and vertical fiber bricks. The above results indicate that for sand and sand-cement cushions and for such loads as were had at Arlington thicknesses under 4 in. are impractical.
5. For bricks of sufficient thickness to form a beam which will not be broken under impact, cement grout offers better support to the edges than bituminous fillers. The bituminous fillers cushion the edges, but under certain kinds of traffic (steel tires) allow the edge to be crushed even while the filler remains intact.
6. Tar and tar-mastic fillers form more rigid slabs in cold weather than asphalt and asphalt mastic, and consequently bricks filled with the former tend more toward shattering than those filled with the latter.
7. For the same conditions of brick and type of construction, bricks with rounded edges offer less resistance to wear than those with square edges.
8. Sand cushions are subject to more compression than sand-cement cushions, and the greater compression results in a more uneven surface.
9. Elastic fillers considerably reduce the effects of impact occasioned by steel-tired traffic, and the destructive effect increases with increased rigidity of the fillers, the maximum destructive effect occurring with such fillers as have greatest rigidity. The shattering of the brick and the additional settlement noted on the cement grout sections warrant this conclusion.
10. The resistance to wear of the various pavement sections, as shown from the wear test, is the same as that indicated by the standard rattler test for the bricks comprising the above sections.

Observations on Concrete Paving

The failure of several of the concrete sections was due to transverse cracking and settlement, accompanied by increased impact. Observations would indicate that slag, sandstone, and limestone do not offer as much resistance to cracking as do gravel, trap rock, and gneiss. This conclusion, however, is questionable in the absence of further experiments.

From the tests on the concrete sections there are indications that neither the resistance to wear nor the resistance to cracking are dependent upon the compressive strength of the concrete as determined by 6 x 12 in. test cylinders, that more resistance to wear is afforded by dry concretes than by wet, and that the harder aggregates offer more resistance to wear than the softer. Whether this greater resistance offered by the harder materials would warrant securing them for a road at much additional expense when softer materials are at hand must be left to the judgment of the engineer with full knowledge of the traffic conditions.

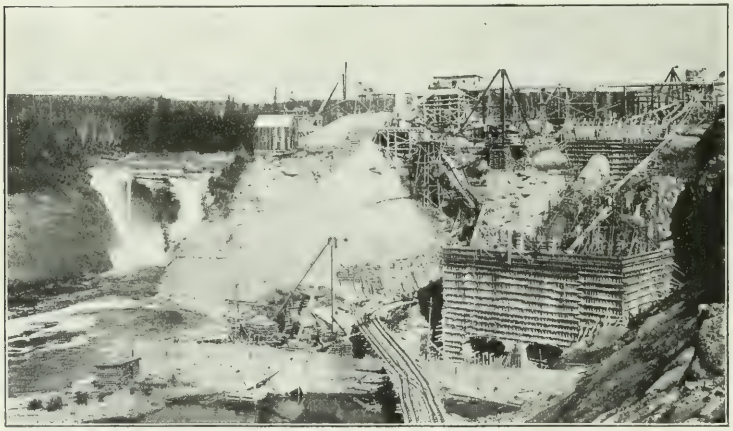
Winter Work on a Quebec Water-Power Development

Dam Construction Near Chicoutimi Required Long Hauls Over Snow Roads and Special Provisions for Camp Sanitation in Cold Weather—Fire in Camp Impeded Operations

CONSTRUCTION work on a paper-mill power project in northern Quebec during the past two winters was complicated by the remoteness of the site from the source of materials and by the cold weather common to that country. The methods employed and the layout of the plant should be of value for reference for future operations under similar conditions. The development, known as the Chute aux Galets Power House and Dam, is located on the Shipshaw River about 23 miles north of Chicoutimi, Quebec, and about 20 miles from the mouth of the Shipshaw. It was built to afford additional power to the Kenogami Pulp & Paper Mills and the Jonquiere Pulp Mill, both owned by Price Bros. & Co., Ltd.

Owing to recent additions to the Kenogami plant additional power was required and the construction of the dam and power house was started in September, 1919, and completed in January, 1921, except for the installation of the two generators, the delivery of which has been delayed.

The dam is 1,185 ft. long with an average height of 24 ft., upon which are erected flashboards 6 ft. high, the purpose of which is to take the pressure of the ice which will form behind the dam, thus saving the concrete from damage. At each end of the dam are concrete core walls built on ledge rock and terminating in the hillsides each side of the river. The power house is of reinforced concrete, built below the falls in a bend of the river and is 55 x 88 ft., with a total height of 94 ft.



LOOKING UPSTREAM AT THE CHUTE AUX GALETS DAM AND POWER HOUSE UNDER CONSTRUCTION

Camp Construction.—The contract for the work was let the latter part of August, 1919, and the contractor immediately started work, which was carried on continuously during the winter. The building of camps was immediately started, the first of these being of logs cut at the site, but later, when a sawmill had been installed, the camps were built of sawn lumber. They were built as far as possible so as to segregate the men according to nationality and occupation. Various sizes of camps were used, as certain classes of men are satisfied to live in larger buildings containing fifty to sixty men, whereas with others this condition causes discontent and smaller camps accommodating from twelve to twenty men were also provided. A "camp boss" with a few helpers and working under the direction of the company's doctor kept the camps in a clean and sanitary condition. All of the camp rubbish and kitchen refuse was burned in an incinerator. A disinfector, consisting of a tight wooden tank built strong enough to take 15 lb. of steam pressure, was erected near one of the boilers and piped to it. Used blankets and clothing of a suspicious nature were subjected to treatment under this steam pressure. A central wash house was provided with hot water heated by a coil running through a large camp stove.

Special attention to the matter of sanitation as well as the general comfort of the men in camp was found to be a small investment, bringing in large returns in the saving of replacement of men and consequent costs of transportation and shortage of help. Two large dining halls, each accommodating 230 men, were provided, with one central kitchen serving both. A separate dining room was provided for the staff.

While the camps were being built the plant was transported to the job and installed, cofferdams were erected and excavation started for the power house, penstocks and headworks.

Transportation.—The matter of transportation was one of the most serious problems in connection with this work. The nearest railroad was at Chicoutimi and to get material to the job it was necessary to transport it across the Saguenay River and haul it 22 miles to the work. Two gasoline-driven scows were built by the contractor for the river transportation. These scows are 80 ft. long and have a capacity of about 55 tons. Forty-horsepower heavy-duty marine gasoline engines were installed and proved satisfactory against a very heavy flow of tide, the Saguenay River being subject to a tide variation of from 15 to 20 ft. During the winter teams and sleighs were used for transporting across the Saguenay.

A stiff-leg derrick and a warehouse were installed on the wharf at Chicoutimi and material was unloaded from cars to the scows by this derrick or stored temporarily in warehouses. Cement and small material were loaded in skip boxes which were set on the scows or sleighs.

On the opposite side of the river in the village of St. Anne and about one mile upstream were installed

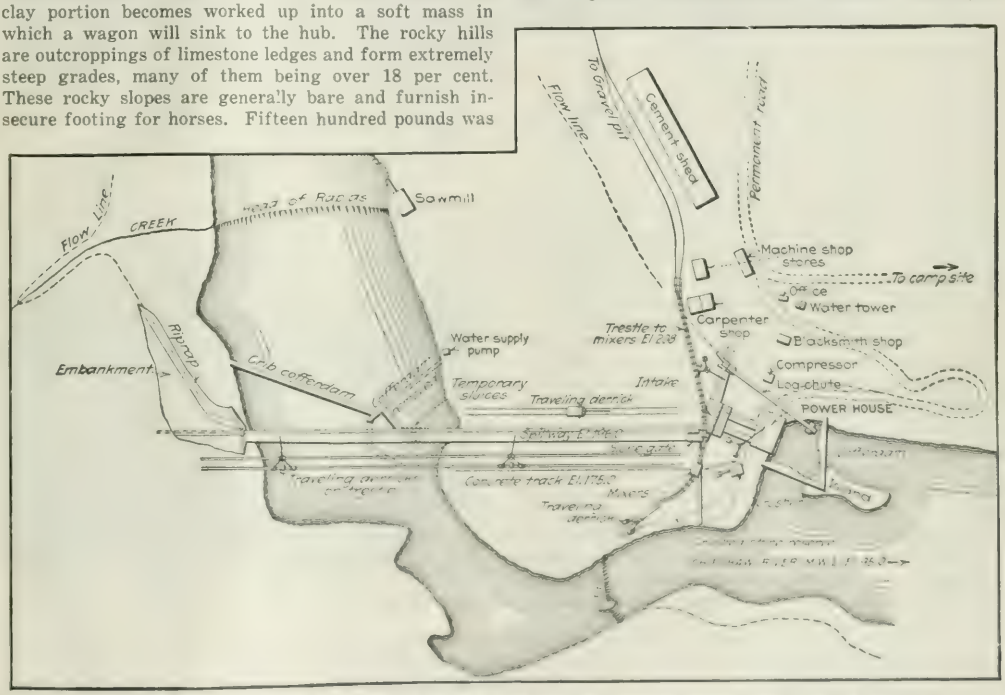
another derrick and warehouse, shown in the view. The base of this derrick is about 210 ft. above the river level at low water and is located on the edge of a steep cliff. The boom is 85 ft. long and loads can be lifted directly from scows and set on wagons or sleighs. By the installation of this derrick a hill leading up from the existing pier, about three-quarters of a mile long with gradients up to 20 per cent, was eliminated from the hauling route.

The road from St. Anne to the Chute aux Galets is for the most part through an unproductive section and practically no work has been put on it to improve the natural condition of the roadbed or the profile. A large part of the road is simply a right-of-way cut through the woods with no ditching or grading attempted. About two-thirds of the route is through clay and the balance is over rocky hills. During the spring and autumn and a large part of the summer months the clay portion becomes worked up into a soft mass in which a wagon will sink to the hub. The rocky hills are outcroppings of limestone ledges and form extremely steep grades, many of them being over 18 per cent. These rocky slopes are generally bare and furnish insecure footing for horses. Fifteen hundred pounds was a difficult load for a team on these hills and during the spring a team had difficulty in hauling 1,000 lb. over the clay portion of the road.

It was decided to transport as much of the required material as possible during the winter months on snow roads and during the fall of 1919 only such supplies and plant as were immediately necessary were hauled.

A winter road was located in the fall, the right-of-way arranged for and cleared. This cut off about four miles from the distance and was located so that the steepest grade was only 5 per cent and there were only four grades of more than 2 per cent. The road was located for a large part through a swamp which would have rendered it impassable in summer, but provided a very firm and level road when frozen and when there was sufficient snow. About 10 in. of snow was required to make the road sufficiently even for hauling. Hauling on the winter road was started on December 15 and during the winter months about 7,000 tons were transported to the job, of which 5,300 tons consisted of cement. The contractor used generally four-horse teams with heavy logging sleighs, and in addition to this from 50 to 100 hired teams were employed on the job a large part of the winter. Two snow plows were used to keep the road clear. These were hauled by six horses and were sent over the road one from each end after a storm. No attempt was made to ice the roads owing to the heavy drifting of snow to which they were subjected.

A 10-ton Holt caterpillar tractor was found to work satisfactorily on the snow road under winter conditions. By the use of kerosene in the radiator and the use of special lubricating oils no difficulty was experienced in operating in temperatures as low as 42 deg. below zero.



LAYOUT OF CONSTRUCTION PLANT ON CHUTE AUX GALETS POWER HOUSE AND DAM IN QUEBEC

All the plant and cement and as much of the stores as could be anticipated were hauled during the winter. The winter road broke up on April 10 with the spring thaw and was then abandoned.

Construction Operations.—An 18-mile transmission line from an existing power house was started in the fall as soon as material for it could be secured. The steel poles were all erected and concrete bases poured for same before very cold weather set in, but owing to slow delivery of some of the material the stringing of conductors was delayed considerably and was done in temperature as low at times as 46 deg. below zero. Thermometers were carried by the linemen and the tension regulated

DERRICK LIFTING MATERIAL 210 FT. FROM THE SAGUENAY RIVER BELOW

for the existing temperature. While the transmission line was being erected wood-burning boilers were used on the job for steam power.

The cofferdam for the power house consisted of a log crib filled with rock from the penstock excavation and sheathed with 2-in. tongue-and-groove lumber on outer face and toe-filled with earth excavation from the headworks. The maximum depth of the cofferdam was 28 ft. Two 10-in. centrifugal pumps easily pumped out the cofferdam and one 10-in. pump later kept it unwatered. The north cofferdam for dam excavation was built in two sections, the south half of the river first being enclosed and the dam containing the five temporary sluices was built across one-half of the river; later the north half of the cofferdam was built, forcing the water through the temporary sluices. No pumping was found to be necessary here as the grade of the river was such that the small amount of leakage through cofferdam was easily taken care of by a small interior dam.

The earth and rock excavation for power house and penstock was loaded into skip boxes, the earth being dumped on spoil bank in river and the rock hoisted directly to crusher platform by means of a stiff-leg derrick. The crushed stone was elevated by a bucket conveyor to the stone storage pile. The excavation from the headworks and south core wall was also handled with stiff-leg derricks.

Excavation for the dam was removed by a traveling steel derrick, with 96-ft. boom and equipped with a 1½-yd. clamshell bucket, the excavated material being simply deposited in the spoil bank below the dam.

The concrete was mixed with two electrically driven mixers, fed from overhead hoppers. Two of these hoppers contained gravel and the other two crushed stone. A trestle ran over the top of these two bins. Gravel obtained from a pit about 3,000 ft. from the mixer plant was loaded into cars with a traveling derrick and clamshell and hauled by four-ton oil-burning locomotives to the bins. The crushed stone was loaded into cars with a traveling derrick and orange-peel bucket and also hauled to bins by cars and locomotives. Cement was hauled out to the mixer plant and dumped into a chute from the trestle.

A concrete track ran between the two mixers and flat cars with 1-yd. concrete buckets hauled by locomotives conveyed the concrete to the dam, where it was deposited in the forms by two traveling derricks on tracks parallel with the dam. The concrete for power house was conveyed in a similar manner, except that V-shaped, 1-yd. side dump cars were used, which were dumped into a hopper, the concrete then being deposited in the forms by means of chutes.

Fire in Camp.—On June 20, 1920, after a prolonged dry spell, a forest fire which started several miles west of the job spread to the work before a high wind and jumped 800 ft. across the river to the camps and other structures on the job. All of the buildings, including the camps and dining rooms, stables, cement shed, office, storehouse, compressor house, blacksmith shop, machine and carpenter's shops and sawmill were destroyed, as well as the electric wiring, a large part of the plant and all of the stores. The destroyed plant included most all of the motors, two locomotives, one electric hoist, six transformers, compressor, machine-shop and carpenter-shop equipment, sawmill equipment, wagons and sleighs. At the time of the fire about 350 men were in camp and of this number about 120 remained and saved the balance of the plant.

The cement shed contained at the time of the fire 105,000 bags of cement which had been hauled to the job during the winter. The cement shed, together with the bags containing the cement, was a total loss.

GRAVEL TRAIN PULLED BY OIL BURNING LOCOMOTIVE

As the cement was then left exposed to the weather every effort was made to get it covered before rain could complete its destruction. All of the canvas that could be secured in the vicinity of Chicoutimi, as well as several tons of dryer felt from the paper mills at Kenogami and several hundred rolls of roofing paper, were rushed to the job and the pile of cement, which was about 350 ft. long and about 65 ft. wide, was covered twenty-four hours after the fire took place. Although no rain had fallen for 30 days previous to the fire, showers occurred within 36 hours after. The temporary covering put over the cement consisted of two-ply roofing paper supported on poles. The poles were laid on a slope to a peak over the center of cement pile and down to the ground on each side; a layer of dryer felt or canvas was then tacked over the roofing paper to prevent its being torn off by the wind. A ditch was dug around the pile to prevent water pen-

HEADWORKS CONSTRUCTION IN A CANADIAN WINTER

etrating to the bottom of pile. This roof remained until the cement was finally used in the work several months later and proved very satisfactory. The salvaged cement was rebagged.

About 75 per cent of the salvaged cement was ultimately saved and used in the work, the balance having become hardened by the heat was discarded. It was found from tests of average samples taken throughout the pile that the tensile strength of the salvaged cement was about 18 per cent lower than that found for the same cement when tested from the carload shipment. A larger amount per batch was therefore used.

As a result of the setback due to the fire unusual efforts were required to complete the concrete work before cold weather. The destroyed plant and stores were speedily replaced and tents were provided for temporary camps until buildings could be rebuilt. Most of the men who had left the job at the time of the fire remained in Chicoutimi and were housed and fed there by the company. As the tent camps were installed the men were gradually brought back. The work of excavating was resumed four days after the fire and concrete work started six days later. In about a month the work was being carried on as before the fire.

With the exception of closing the temporary sluice gates and the concrete required around the waterwheels in the power house and a few miscellaneous items all of the concrete work was completed before cold weather so that little heating of concrete materials was necessary. Two of the temporary sluices were closed before cold weather, but it was necessary to close the other three in January, 1921, and this proved to be a rather difficult undertaking. Stop logs were set in the ends of the sluices in grooves provided and calked on the inside. Then the interior was pumped out and cleaned of ice and the sluiceway poured from a shaft up through dam. When the shaft was filled it formed a static head of about 28 ft. of air concrete which completely filled every part of sluiceway.

Owing to the necessity of allowing enough water to pass through to keep a lower power house in operation the stop logs were brought up gradually and some water allowed to pass over them while they were being set. This caused ice to form about the logs and great difficulty was experienced in getting them tight. The concrete in these sluices, which was poured in very severe weather, was heated by running live steam into the sand, crushed stone and water used in the mixing.

The work was designed by George F. Hardy, of New York City, who was represented on the work by F. M. Kuchar, resident engineer. The contractors were Fraser, Brace & Co., Ltd., of Montreal.

A View of "Value for Rate Base" and "Value for Compensation"

DISTINCTION between "value" to be used as a rate base and "value" to be used as a just compensation figure for purposes of condemnation was drawn in the recent decision of the California Railroad Commission in regard to the taking over of the power plant of the Northern California Power Co. by the city of Redding. That portion of the commission's opinon dealing with this phase of the case follows:

It has been a source of confusion quite evident in this proceeding that the distinction was lost sight of between a rate base and a just compensation figure. We have no patience with the argument that in a reproduction cost estimate for rate-making purposes a power line pole should stand at one figure and that in a reproduction cost estimate for condemnation purposes the same pole should stand at another figure. It seems clear to us beyond argument that a given propery item valued according to a given method must have in its estimate of value new and in its estimate of value depreciated, the same figures no matter for what purpose that estimate may be used. To conclude, however, that because of this statement the rate base and the just compensation of a public utility plant must be the same, seems to us altogether erroneous.

The difference in the final result (depending on whether a given public utility property is to be valued for just compensation purposes or for rate-making purposes) will be found to lie not in the value given to different property items under various methods of valuation but rather in the answer to the final question of whether, in a rate case, the basis for the fair return should be "value" or "investment" or "sacrifice." In a rate case, the rate-making authority is concerned with finding the sum on which a fair return should be allowed. The problem involves the determination of what property is reasonably used and useful in the public service, what capital expenditures have been made by the utility even though these expenditures may be on property not owned by the utility, and other similar questions. Also the matter of going concern, in so far as going concern is an element resulting from the actual or prospective ability to realize profits, cannot enter into the rate problem. If it were held otherwise there would follow the absurdity that the higher the rate, the greater the earning power; the greater the earning power, the larger the going concern; the larger the going concern, the higher the rate, *ad infinitum*.

An essentially different problem confronts the Commission when it has to find just compensation. Beyond a question it must, in that case, find a fair value of the property as of a given time with all of the elements making for increase or decrease and for loss or gain attached to it. And what property items are to be valued is settled by the description of the property desired to be taken, by which description the Commission is governed.

If, therefore, agreement can be had on the proposition that it is legitimate to consider various estimates of value on various theories (and with necessarily different results) and that in the last instance these various estimates, elements and measurements must be reviewed by the Commission into "just compensation" and that "just compensation" can be found only if all factors (to the exclusion of those having a bearing on present day value are given their proper weight, then it will be possible to discuss the problem on common ground and with an intelligent vocabulary.

Meeting of American Society for Testing Materials

Many New Specifications Adopted as Result of Active Committee Work — Joint Committee Presents Draft of Specifications for Concrete—Sulphur and Phosphorus Again — Car Wheels Improvement—Prof. Talbot on Proportioning Concrete—Society Declines to Enter Federation

WORKING in its smoothest and most efficient manner as an organization for producing and perfecting technical specifications, the American Society for Testing Materials in its annual meeting at Asbury Park last week achieved a remarkable performance, probably without precedent in its history, by dealing with more than 150 specifications. Of these, 71 were new, being presented for the first time and adopted as tentative standards, while 63 were revised; others were advanced from tentative to standard rank. Of course this required machinelike method of working; some forty steel specification were disposed of in bulk by a single ballot. The flatness of this procedure was relieved in the closing session, however, by a flash of fire reminiscent of the society's liveliest days, in the shape of a hammer-and-tongs set-to over chilled car-wheels, which resulted in proving the need and feasibility of chemical limits for car wheels, and in making wheels safer by requirements superior to those set up by the Master Car Builders and the American Railroad Association, and superior to those which the committee on cast iron was content with.

Committee activity was marked. Evidently a great deal of work was accomplished during the year, for progress was shown in nearly every part of the field on which the society has hitherto entered, while in addition work was begun on a number of new subjects. Even where no specifications resulted, research work was reported.

Concrete and allied subjects played a large part in the meeting. Three important contributions to knowledge were made in this field—the first presentation of the Progress Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, the submission of four tentative methods of test and one tentative specification by Committee C-9, on Concrete and Concrete Aggregates, and a paper by Prof. Arthur N. Talbot on proportioning concrete, which proved to be a remarkable study of the relation of the voids in a mix to the resulting strength and density. There were some significant developments in the field of metals, however, outside of the car-wheel matter just mentioned. The war relaxation of sulphur and phosphorous allowances came up for action again, with a less satisfying outcome than had been anticipated. A decidedly new proposal in rail specifications was prepared by the steel committee, but in the last minute the committee decided to withdraw it, leaving the subject about where it was before.

Some twenty or twenty-five technical papers were read. This part of the program seemed rather weaker than at previous meetings, and was prominently distinguished only by Prof. Talbot's paper.

Society Declines to Enter Federation

The deferred question of affiliating with the Federated American Engineering Societies was placed before the society by the Executive Committee after the latter had given repeated careful consideration to the matter during the year. The committee stated its views *in extenso*, expressing a favorable opinion of the federation plan as a means of consolidating thought and purpose in the engineering profession and as a means of cultivating public relations, but also pointing out the divergence of purposes of society and federation. The deciding question was that of finances: as the required contribution to the F. A. E. S. could not be taken from current funds without curtailing the society's work, and as the committee regarded an increase of dues unwise, it proposed to the meeting the following resolution:

Whereas, the American Society for Testing Materials has received an invitation to become a charter member of the Federated American Engineering Societies; and

Whereas, after thorough consideration the Executive Committee, although believing that the stated objects for which the Federation is organized merit the support of engineering orginazitions and engineers in general, has recommended that the present finances of the Society do not permit the Society to accept membership in the Federation at this time; therefore be it

Resolved, that the American Society for Testing Materials, after consideration of this invitation in annual meeting assembled, regrets to advise the Federated American Engineering Societies that it is financially unable at this time to accept the invitation to become a charter member of the Federation.

This resolution was passed, after considerable discussion of an amendment proposed by Richard L. Humphrey calling for letter ballot of the membership on the joined questions of entering the federation and raising the dues. Following the defeat of this amendment and the passage of the Executive Committee's resolution, Mr. Humphrey moved the substance of his amendment separately, but it was defeated on division by 62 to 32. W. M. Kinney then offered a resolution stating that the meeting is not opposed to the Executive Committee considering joining the F. A. E. S. at the proper time and when in its opinion the step is desirable; the resolution was accepted.

Society's Influence on Public Works

Retiring President George S. Webster addressed the society on its influence upon the execution of public works. Recalling the foundation of the Philadelphia city testing laboratory in the early nineties at his initiative, and its relation to the growth of the society, he described how his experience showed the municipality to profit from the work of the society. Some of the most pointed paragraphs of the address will be reproduced in a later issue.

Joint Committee's Specifications for Concrete

Reporting in a preliminary way after 16 months' work by 25 men (five each from the American Society of Civil Engineers, the American Railway Engineering Association, the American Concrete Institute, the Portland Cement Association and the American Society for Testing Materials), the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete submitted a tentative specification covering all phases of the subject. The committee is a successor of the old Joint Committee which presented progress reports in 1909 and 1912 and a final report in 1916. The present

report is submitted to the constituent societies for discussion limited to not less than six months nor more than one year. Such discussions are then to be referred to the committee for consideration in the preparation of a final report. The report is made public at this time, although it is distinctly to be considered as only a preliminary draft. The committee meanwhile is continuing its deliberations. In fact, it held almost continuous sessions during the meeting at Asbury Park.

The important difference between this and previous reports of the Joint Committee is that it is a specification. The final report of 1916 "is not a specification but may be used as a basis for specifications." The current specification takes up the entire subject of concrete under the headings "Materials," "Proportioning and Mixing Concrete," "Depositing Concrete," "Forms," "Details of Construction," "Waterproofing and Protective Treatment," "Surface Finish," and "Design," which latter includes as subheads the subjects flexure, diagonal tension and shear, bond, flat slabs, reinforced-concrete columns, footings, retaining walls, shrinkage and temperature stresses and working stresses. There are in several cases alternate paragraphs on the same subject, notably in the method of proportioning.

It was announced that in so far as the American Society for Testing Materials is concerned sections of the specifications will be referred to specific committees, which must report inside the year. On that basis the report was received by the meeting and the decision as to printing it other than in its submitted form as a preprint left to the executive committee.

A digest of the specifications will appear in an early issue of *Engineering News-Record.*

Two Steel Questions and Cast-Iron Wheels

When F. M. Waring for the committee on steel reported on 41 revised and two new specifications, there was the usual full attendance, promising a free discussion of the leading questions: (1) removal of the special 0.01 per cent war allowances on sulphur and phosphorus that had been permitted last year to remain in 14 specifications, and (2) a new departure in rails, made in order to come nearer to agreement with the American Railway Engineering Association, by providing two separate specifications for ordinary and for "special quality" rails respectively. The discussion did not materialize, however, and the action recommended by the committee was approved by a single blanket vote.

Sulphur and Phosphorus—The war allowances on sulphur and phosphorus were not finally abrogated, but were retained as to steel castings and (for sulphur only) as to structural steel for locomotive, car and ship use. By action taken a year ago, the allowances had been removed from over half the specifications originally affected, but had been left in force for bessemer rails, splice bars, reinforcement bars, tie plates, track bolts, and building steel; and for open-hearth rivet steel, tubes, chain, castings, and three grades of structural steel. In this year's report the committee recommended restoring the original low limits for all bessemer steel and for rivet steel, tubes and chain; but, it says, "as against these changes, it is felt the extension in sulphur from 0.05 to 0.06 per cent in the three classes of structural steel must be retained due to the heavy tonnages involved and to the continued difficulties in obtaining low-sulphur fuels and melting stock. It will be noted that the sulphur extension will be removed on the materials which are to be worked hot and allowed on structural material which are to be fabricated cold. The recommendation to continue the extension of both phosphorus and sulphur in steel castings is made in the belief that the same difficulties with fuel and melting stock exist in this industry."

Tests carried out by the Bureau of Standards joint committee on the effect of sulphur and phosphorus were reported in a meeting of that committee held during the week, but have not yet been made public. They represent only a small part of the full program, and deal only with sulphur in rivet steel. Their general indication is that static qualities are not affected by high sulphur, but impact resistance is seriously lowered.

When this investigation was begun, nearly two years ago, fears were expressed in some quarters that it would operate to keep up the high sulphur and phosphorus limits. Only a limited verification of these fears has developed, for the steel committee says: "Our society is looking to that investigation [of the joint committee] for final advice as to suitable limits, but until the work is completed it is believed that the changes now recommended may be made with safety."

Rails—Fundamental divergence between the rail requirements of the American Railway Engineering Association and the "market" specifications of the American Society for Testing Materials and of the rail makers resulted in continuous effort during the past two years toward harmonizing the two views. It has developed, however, that a compromise is not feasible. One solution of the problem was proposed recently by G. J. Ray, chairman of the rail committee of the A. R. E. A., namely to formulate a basal "market" specification and separate individual clauses each covering an element of higher quality, capable of being added to a particular rail contract on the basis of the extra cost entailed.

Another course was taken by the A. S. T. M. steel committee in a proposal made ready for presentation to the society but withdrawn just before the meeting. This involved the establishment of two separate specifications, for ordinary and for special quality rails, of equal rank as standards; the former would be the present A. S. T. M. specification, the other substantially that of the A. R. E. A. This recommendation and a "special quality" specification to match were actually preprinted, the committee explaining that "by adopting these two specifications it is thought that the society will make it possible for buyers to choose the specifications best suited for the service for which their rails are intended. This course, in our judgment, is necessary, because the requirements of rail buyers are by no means uniform. Where the amount of traffic and general service conditions are more severe, a buyer might well want to purchase rails subject to more rigid requirements than would be the case if the service conditions were more severe."

But this explanation as well as the "special quality" specification were withdrawn before presentation, on reconsideration by the steel committee at a session held early in the week. When the subject came up in meeting, the society did not trouble to inquire farther into the matter.

A specification for car wheels, without chemical requirements, was submitted to the meeting by Dr. R. Moldenke for the committee on cast iron; and imme-

diately afterward a strong argument for limiting sulphur, phosphorus and combined carbon to reduce the risk of wheel breakage was advanced in a paper by H. J. Force (Lackawanna R.R.). Mr. Force's statistics indicated an alarming number of cracked and broken wheels, and his analyses showed that the elements just named are high in wheels that crack in the plates or break under traffic. He proposed limits of 0.32 per cent P, 0.17 S, and manganese at least three times the sulphur, with combined carbon not over 0.85; such wheels, he said, will not fail in the thermal test, and indeed this test should be made longer so as to detect all thermal weakness. G. E. Doke (New York Central) supported this argument.

Four or five representatives of car wheel makers discussed the chemical-limit problem. They declared their readiness to work to the limits suggested, and stated that they favor any step toward wheel improvement. C. D. Young (Pennsylvania R.R.) questioned the need for chemical limits, and C. A. Ripley (Santa Fe) reported that on his line the trouble with wheel breakages on mountain grades, where long brake application has to be made, was overcome by adoptng the arch plate design of wheel and by putting heavier wheels on refrigerator cars, which generally were equipped too light; chemical content appeared to be without influence on the case, but he nevertheless favored chemical limits if shown to be helpful. Robert Job told of the conclusion reached on the Philadelphia & Reading twelve years ago as to the harmful effect of exceeding limits nearly the same as those demanded by Mr. Force, and the subsequent adoption of even closer limits on the Lehigh Valley. All this was in the face of the fact that the M. C. B. and American Railroad Association specifications have continued to ignore chemical composition.

As a result of exceedingly active discussion in the sense of the above, the committee presented a supplementary chemical specification, with phosphorus and sulphur somewhat higher than the above-quoted limits in order to meet the foundry conditions in southern and western territory without excessive cost. The amended specification was adopted by the meeting.

Talbot on Proportioning Concrete

Prof. A. N. Talbot (University of Illinois) presented his paper on proportioning under the title, "A Proposed Method of Estimating the Density and Strength of Concrete and of Proportioning the Materials by the Experimental and Analytical Consideration of the Voids in Mortar and Concrete," the title being so detailed, the author explained, in order to express exactly the contents of the paper. It is in effect a return to the old void theory of proportioning concrete, amplified by a consideration of the bulking action of water and reduced to quantitative terms by the intensive study of a number of aggregates. The paper states that density of concrete is a direct measure of its strength, quality and methods of manufacture being equal, and that density is in inverse proportion to the voids, in other words, the space not occupied by cement or aggregate. In most concrete the mortar more than fills the voids in the coarse aggregate, therefore the voids in the concrete are a function of the voids in the mortar. For the same sand the voids in the mortar vary with different amounts of cement and with different amounts of water, and there is a certain water content which will give a minimum amount of voids. For any sand these values may be established by test and curves drawn. At the same time tests may establish the relation between voids in concrete and its strength. The combined use of these data will permit (1) the comparison and acceptance of aggregates, (2) the design of concrete mixtures for definite densities and strengths, (3) judging the influence of a change in the volume of the mixing water, (4) finding the amount of mixing water and (5) estimating the strengths that may be expected with given concrete mixtures.

As in the other recent theories of proportioning concrete, it is stated that the theoretical optimum mix is rarely one that can be used in practice, being either too dry or too harsh, and on that account some measure of flowability is necessary for a complete use of the method. Such a measure being established, however, all of the variables of the mix of the desired flowability are determinable by the method.

In the study preceding the paper Professor Talbot made many tests and examined the data of many others which seem to confirm the theories advanced, but the investigation is continuing. Data on some of the sands and concrete studied are contained in the paper, which will be abstracted in an early issue.

The discussion on the paper was limited, and not directed in specific criticism, either favorable or adverse, except to commend the paper as a return to what seems to be a more rational basis of concrete proportioning.

Study of Concrete Aggregates

After a long period of unproductiveness, Committee C9 at last reported significant results. It has considered its province the study of the material concrete, which involves its make-up and its testing but not its method of design or construction. This year the report outlined the progress it has made in this study, the result mainly of an ordered series of tests made for some years in a number of laboratories. The report says that the committee recognizes "the importance of the aggregate in the make-up of concrete and the necessity for well-defined tests for acceptance and for economical use . . . and the necessity for research in determining the nature of organic matter deleterious to concrete." These two features, according to the committee, have become more and more the prime factors in dealing with materials for concrete. In the abstracts on another page of this issue are given the conclusions of the committee in its work so far. In pursuance of these studies the committee submitted four tentative methods of test—for making compression tests, for testing organic impurities (which is the well-known Abrams-Harder colorimetric test), for sieve analysis for aggregates and for securing specimens of hardened concrete from the structure. Together with these was submitted a tentative specification for concrete aggregates, which differs somewhat, mainly in grading requirements, from the analogous clauses in the specifications of the Joint Committee. All of these were accepted by the meeting.

The committee further reported that it was engaged in the following lines of research:

1. Laws of mechanical mixtures of cement and aggregate.
2. Further researches on impurities in natural aggregates.
3. Investigations of coarse aggregates to determine their relative importance and value for concrete mixers. Included in this study is the use of slag for concrete, with the view to the formation of rules for its acceptance.

4. The best type of specimen for mortar test, whether tensile briquets, or compression cylinders, or transverse bars. Results so far show comparatively little choice between tension and compression, with the transverse test in less favor.

5. The distribution of aggregate materials throughout the country is being studied in collaboration with researches made by the Bureau of Standards.

6. Specifications for concrete are being analyzed and reviewed, but largely in collaboration with the Joint Committee.

7. Testing of field concrete after it is in place is under investigation.

Other Facts About Concrete

The two most carefully developed methods of making consistency tests of concrete—the slump method and the flow-table method—were the subject of two papers and some discussion. In the first W. L. Schwalbe (University of Illinois) gave as the result of tests made in connection with the test of a concrete mixer at Purdue University last year the conclusion that "the relative consistencies are more truly indicated by the flow table for a greater range of consistencies than by the slump test." In the other paper by Watson Davis (Bureau of Standards), the value of the flow-table in examining the set of both cement and concrete is studied and the conclusion reached that the apparatus may be expected to replace the Vicat or Gillmore needle in cement tests and can be used to give valuable constructional information for concrete. The latter paper is to be abstracted in a later issue.

In the discussion, the need for standardizing the flow-table was emphasized and C. M. Chapman (New York) called attention to the fact that the flow-table is covered by a patent (No. 1,233,843, granted in 1917), which at one time was offered to the society for control. The offer was then refused, but Mr. Chapman, in whose name the patent was taken, thinks that the offer would be renewed if the society would consider it. The president stated that the matter would be called to the attention of the executive committee.

Prof. Duff A. Abrams (Lewis Institute) presented in abstract a paper embodying the results of 10,000 tests into the wear of concrete under different conditions of composition and manufacture. The results are stated in the abstracts on another page. They apparently warrant the conclusion that wear is in inverse proportion to strength and that further tests on wear are not necessary, particularly as in the stucture where wear is most evident, the concrete road, it is both uniform and relatively small.

L. G. Carmick (Bureau of Public Roads) reported some tests on the suitability of blast furnace slag for concrete aggregate, in which he found a demarcation in composition between slags which disintegrate and those which do not. He further found that when disintegration did occur, it happened within a week of cooling. The tests were admittedly only preliminary and given for information in further studies. A paper by M. Y. Seaton (Midland, Mich.) pointed out the types of tests which furnish data on the quality of plastic calcined magnesite, which forms a part of the oxychloride cements used in floorings. Prof. F. E. Giesecke (University of Texas) added some data to that he has for some years presented on the efficacy of rodding concrete to increase its strength.

In the report of Committee C-7, on Lime, results were presented of tests in several laboratories on the effect of hydrated lime inclusions on the strength of concrete. One of these, in the laboratory of the State Highway Department of Delaware showed that, with certain sands only, a 5 per cent inclusion slightly increased 28-day strength. Greater inclusions weakened the concrete. Prof. D. A. Abrams, on the contrary, cited a series of tests made in the past year which confirmed his tests reported last year, to the effect that, even for small proportions, hydrated lime reduced concrete strength in proportion to its quantity. The State Highway Department of Pennsylvania showed material loss in strength for 5 and 10 per cent inclusions and that of New Jersey that somewhere between 2½ and 5 per cent there is a return to strength loss.

Major Items of Committee Reports

Paint—For the first time, pigment specifications were presented by the committee on Preservative Coatings. Though they are mere adaptations from government specifications published within the past year, they mark the beginning of the committee's furnishing results directly applicable to the consumer's needs.

Valuable information on the most effective way to prepare steel surfaces for painting was given by a subcommittee as the preliminary result of two series of long-time exposure tests. It shows that generally hand cleaning is equal to that by sandblast or pickling. Further quotation of the findings is made in another column.

Timber—In addition to wrestling with the problem of bringing its new grading rules into practical use, the committee has started on an interesting study, of very direct engineering use, namely the interpretation of timber test records as regards working stresses. This study has already resulted in interesting preliminary recommendations.

Lime—A method of distinguishing between limes of good and poor plasticity has been devised. Panel tests of lime plaster are under way. A means of measuring proper burning is to be sought.

Road Materials.—Extensive work on bituminous materials was revealed by the presentation of eight new specifications; one for calcium chloride for dust prevention was also present. The others include tar and tar cement for surface treatment and repair, cold and hot, and for tar pitch block filler.

Petroleum Products—Lubricants were assigned to the committee during the year, in addition to other petroleum products, and a great expansion of work resulted, covering the range from gasoline to paraffine wax and petroleum tests. The committee reported 13 test methods as new tentative standards.

Corrosion of Iron and Steel—The first definite conclusions yielded by an elaborate series of exposure tests of steels with and without appreciable copper content were reported. The copper-bearing steel has been found distinctly superior in atmospheric exposure, but not in mine water immersion, though the latter tests are less advanced.

Drain Tile—The committee now has road drain tile under study. The main research is concerned with resistance to acids and alkalis in soil, on which five separate investigations are in progress, being coordinated by the committee.

Textile—Specifications for one size of tire builder fabric were worked out, and definitions relating to mechanical fabric were formulated. Much other work

in this field is still uncompleted. Fabric testing machines are under study.

Tile, Brick and Refractories—Less rapid progress was indicated in these fields than in most of the others, but the study of the relation between density and fire resistance that has been begun by the Building Tile committee represents an investigation of advanced purpose. One of the present conclusions is reflected in the abandonment of the absorption test for tile. In brick, a specification for clay sewer brick was reported. The Refractories committee presented a test for spalling action of fireclay brick.

Insulating Materials—A test for mechanical strength of electrical porcelain was a feature of the committee work in this field. Other work dealt with transformer oil and insulating varnish testing. Separate work in the same field by the Rubber Products committee produced specifications for linemen's gloves, cable insulation and the like.

Technical Papers

Of the twenty-five papers presented, the following not previously mentioned are cited: "Secondary Reference Standards in Process Problems of Color Measurement," by H. S. Busby; "Stress-Strain Measurements on Paint Films," by H. A. Nelson (New Jersey Zinc Co.); "Plastic Flow Through Capillary Tubes," by E. Buckingham (Bureau of Standards); "Improvements in Apparatus for Testing Petroleum Products," by T. G. Delbridge (Atlantic Refining Co.); "Some Mechanical Properties of Hot-Rolled Monel Metal," by P. D. Merica, R. G. Waltenberg and A. S. McCabe; "Magnetic Spring Testing," by T. Spooner and I. F. Kinnard; "Impact Tests on Cast Steel," by F. C. Langenberg (Watertown Arsenal); "Comparative Tests on Steels at High Temperatures," by R. S. McPherran; "A Test for Shock Strength of Hardened Steel," by C. E. Margerum; "Tests of Soils with Relation to Their Use in the Subgrade of Highways," by A. T. Goldbeck and F. H. Jackson (Bureau of Public Roads); "Measurement of Impact of Motor Trucks on Roads," by E. B. Smith (Bureau of Public Roads). Abstracts of a number of these papers will appear in later issues.

Reorganization of Committee System

Prayerful consideration given by the Executive Committee during the year to a general realignment of the society's work resulted in two minor items of improvement made known at the meeting: the centralization of study of testing methods in a new representative committee on Methods of Testing; and the similar centralization of work on nomenclature and definitions. Both subjects have given rise to rapidly increasing confusion during recent years, as different technical committees took divergent views of the same detail of test procedure, terminology or definition. No real work has yet been done by either committee, but both have formidable programs ahead of them for the coming year.

Publication of a quartely bulletin of the society was decided upon some months ago. The purpose is mainly to post the membership more fully and promptly on work in progress, specifically the work of specification committees.

New Officers

Charles D. Young (Pennsylvania R.R.) was elected president of the society for the coming year, G. Aertsen vice-president, and F. R. Baxter, E. D. Boyer, F. M. Farmer and W. H. Fulwiler members of the executive committee.

An attendance of over 700 was registered, only 28 less than the record attendance of 1920.

New Facts About Materials and Tests

Abstracts of Some of the Papers and Reports Presented to the Annual Meeting of the American Society for Testing Materials at Asbury Park, June 21-24, 1921

Preparing Steel Surfaces for Painting

Valuable preliminary indications as to the best methods of preparing steel surfaces for painting have been deduced from the results to date of two series of paint exposure tests reported to the American Society for Testing Materials last week by its committee on Preservative Coatings for Iron and Steel. From the results of four years' exposure at Brooklyn and Altoona, subject to correction by the further progress of the tests, the committee concludes:

1. The thorough methods of preparation, i.e. sandblasting and pickling, show no superiority in general over ordinary methods of cleaning the surface by scraping, wire-brushing and wiping, where corrosion has not commenced or has only moderately advanced. This applies to both new steel and old steel which has been in service. Test No. 10 indicates that where corrosion has advanced greatly, ordinary methods do not give satisfactory results.

2. Weathering to permit loosening and partial removing of mill scale, with ordinary methods of cleaning before painting, is detrimental to preservation.

3. Painting in a cold dry atmosphere results in preservation as good as painting in warm dry atmosphere, or on heated steel. (This may be due to the greater thickness of coatings applied in the cold atmosphere). The appearance of the coating may be impaired by shriveling and wrinkling.

4. That sandblast cleaning may give better results than pickling is indicated by the panel exposed at Brooklyn. There is no appreciable difference observable in the panels treated by the two methods and exposed at Altoona.

5. The exposure of sandblasted and pickled surfaces for the development of incipient rusting before painting may be detrimental rather than beneficial, as indicated by the results of test of pickled plate at Brooklyn.

6. The preparation of old painted steel surfaces which have bare rusted spots, by brush-coating with benzine over and around the rust spots, burning the benzine off and then scraping and wire-brushing, gives better results than scraping and wire-brushing without the benzine treatment. Where any considerable amount of surface requires treatment, the comparative cost of this method and of sandblasting should be considered.

7. There is no difference observable in the results of the application of the same methods to old and to new steel.

Wear Tests of Concrete

As a result of 10,000 tests on the wear of concrete blocks under the abrasion of shot in a Talbot-Jones rattler, Prof. D. A. Abrams (Lewis Institute) reports the following conclusions:

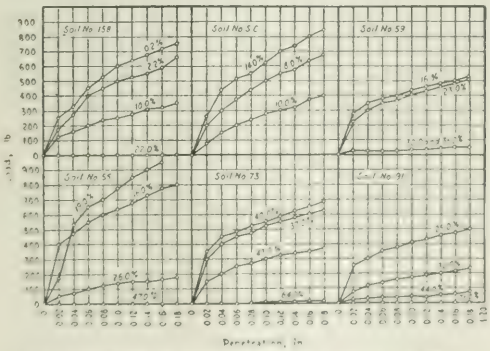
In general the tests showed that the factors that give concrete of a high strength produce concrete of low wear. Increasing the quantity of cement decreases the wear. Increasing the quantity of mixing water causes a material increase in wear. The coarser the grading of the aggregate up to certain limits the lower the wear. One of the most

significant results of the tests was to bring out the importance of curing concrete for a time in a moist condition. The quality of fine or coarse aggregate produced less effect on wear than is commonly supposed. The wear was materially reduced by increased mixing. The wear of concrete was not sensibly increased by the use of hydrated lime or other admixtures used in the tests up to 20 per cent of the volume of cement. Wear was reduced with the age of concrete.

Bearing Power and Other Tests of Road Subgrade Soils

A. T. Goldbeck and F. H. Jackson of the U. S. Bureau of Public Roads described tests of soil bearing power and associated tests by which the character of road subgrade soils is being studied at the Bureau, in a paper read last week before the American Society for Testing Materials. The meaning of the associated tests with respect to bearing power and stability of road foundation soils is not yet known, but data are being accumulated to determine it.

Soil samples are prepared for test by breaking up in a mortar with a rubber-covered pestle, screening through a ¼-in. sieve, and pulverizing the fine material by passing it between rubber rolls. It is then analyzed for mechanical gradation, after sifting out the fraction retained on a 10-mesh sieve, by agitating with a dilute ammonia solution and settling several times in succession, until a clear wash water is obtained after 8 min. settling, and passing the dried residue through 20, 50, 100 and 200-mesh sieves.



BEARING-POWER CURVES FOR SIX SOILS AT FOUR MOISTURE RATIOS

The fine material washed out is classed as clay, the 200-mesh material as silt, and the other four sizes as sands.

Water-holding capacity is determined as the percentage of water absorbed by a struck-off sample of comminuted material in 1 hr. submergence.

Moisture equivalent is determined as the percentage of water retained after centrifuging at 750 times the force of gravity for one hour.

Vertical capillarity is measured as the percentage of water drawn up by a 25-mm. column of earth 20 cm. high through a cheese-cloth closure at the bottom of the tube when the capillary water just reaches the top of the column.

Air shrinkage is measured by drying a sample to constant weight and determining the reduction in volume by filling with mercury. *Time of slaking, cementing value* and *aniline adsorption* (a measure of colloidal content and plasticity) are also determined.

Bearing power is measured in the laboratory on an arbitrarily prepared sample, and thus has comparative value only. The soil is kneaded with a specified amount of water, filled into a brass cylinder; a plunger of 10 sq.in. area is forced down on the top of the soil by the head of a testing machine, this plunger passing through a guide ring which fills the space between plunger and cylinder and confines the soil vertically (this ring is clamped in place when it has been brought down to touch the soil). The load on the plunger is read at various penetrations as read by a pair of Ames dials.

Usually such tests are made after initial compression of the sample at 30 lb. per sq.in. and 50 lb. per sq.in., and for four different moisture contents (1) minimum necessary for kneading, (2) moisture equivalent, (3) the moisture determined by vertical capillarity, and (4) the maximum amount that can be worked into the soil. These four percentages of moisture are represented in the curves herewith reproduced, covering six different soils.

The bearing power under moisture equivalent has appeared to be most significant in the tests made up to now. Varying the moisture percentage up to this point affects the bearing power but little, in all soils, but beyond this point the bearing power decreases rapidly.

An approximate relation exists between moisture equivalent and mechanical analysis of a soil, but some other factors also enter. The moisture equivalent in general increases with the percentage of very fine silt and clay; it is interpreted as a measure of the retentiveness of the soil.

Testing and Proportioning Concrete

Committee C-9 on Concrete and Concrete Aggregates outlined in its report certain facts regarding the testing and the proportioning of concrete which it has brought out through an extensive set of tests in various laboratories.

The cylindrical shape was found to be the best for concrete specimens.

A specimen having a height twice the diameter was selected. Shorter specimens, particularly below a ratio of 1½ to 1, showed great change in strength with slight change in relative height. Beyond the 2 to 1 ratio, that is for longer specimens like columns, the difference in strength was but slight.

The size of cylinder, 6 x 12 in., was recommended in 1914 when the maximum size stone was not greater than 1½ in., that is, one-fourth the diameter of the specimen. For larger stone, cylinders 8 x 16 in. were recommended, in general requiring the diameter of the cylinder to be at least four times the size of the largest stone particles; and for concrete aggregates of small size 4 x 8 in. cylinders were permissible. The advantages of the 6 x 12-in. cylinders over the 8 x 16-in. for ordinary uses are the lighter weight in handling on a job and the smaller quantities of material required in laboratory tests. Tests made under the auspices of the committee showed that within the limitations indicated the size of the specimen has practically no effect upon the strength provided the ratio of height to diameter is the same.

If tests are made on specimens having other ratios of height to diameter than 2 to 1, correction must be made for this difference in shape of specimen. With cubes or cylinders having a height equal to the diameter, it was found that the strength of the standard cylinder would be approximated by multiplying the cube strength by 0.73. Specimens with a height one-half the diameter, were 50 per cent stronger than the cube. To convert the strength to standard cylinder the strength of the half-cube must be multiplied by 0.48.

Specimens of concrete stored in dry air from the time of mixing were found by tests of A. N. Talbot to gain but slightly in strength from 28 days up to a period of several months or even years.

The decrease in strength through the addition of excess water is shown conclusively in the laboratory tests referred to.

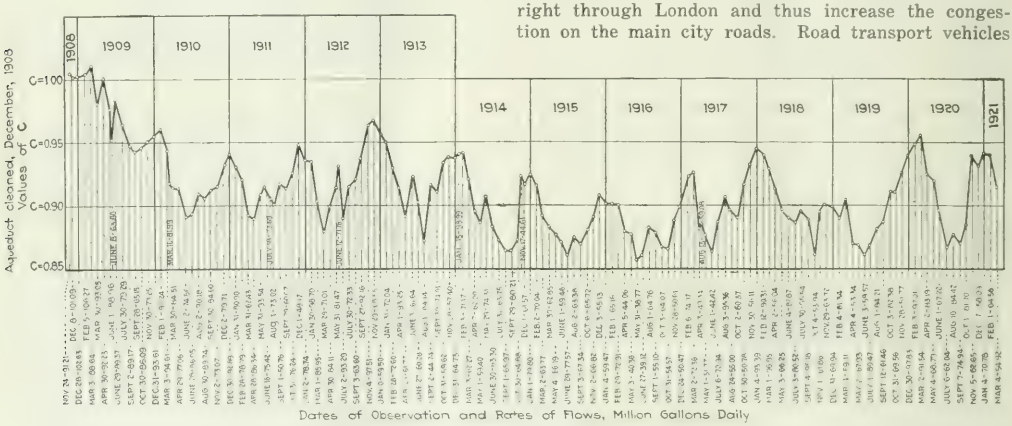
The committee is not yet prepared to present well-defined recommendations for the most economical grading of aggregates. However, individual members of the committee have worked out methods that have been adopted under many conditions in practice with large resulting economies in the use of cement. The methods of fineness modulus, water ratio, and surface areas have thus been used satisfactorily. It remains for the committee to go a little further into the science to clearly demonstrate the best practical rules to follow.

Changes in Cleanness Coefficient of Sudbury River Aqueduct

By Frederic I. Winslow
Division Engineer, Metropolitan Water Supply, Framingham, Mass.

MONTHLY changes in the coefficient of cleanness of the Sudbury River Aqueduct of the Metropolitan water supply for some 13 years past are shown by the accompanying diagram.

The basic formula used in making up the tables for the flow in the Sudbury aqueduct, as given by A. Fteley in "Additional Water Supply" (Boston 1882) is $V = 127R^{.62}I^{.5}$. This formula, in which I indicates sine of inclination, applies when the aqueduct is moderately clean. As a check, current meter measurements are made once a month and the correction thus derived is employed until the next reading of the current meter. The term "coefficient of cleanness is used to denote the percentage that the meter reading is of the value given by the formula quoted above.



VARIATIONS IN THE COEFFICIENT OF CLEANNESS OF THE SUDBURY RIVER AQUEDUCT, METROPOLITAN WATER SUPPLY, MASSACHUSETTS

Based on current meter observations of flow taken once a month since latest cleaning of the aqueduct in December, 1908. Measurements made at Station 59 and compared with tabular flows as measured at Station 0 + 49. All measurements made are platted. The aqueduct was built in 1875. It is of brick, of horseshoe section, 7.58 ft. high and 9 ft. wide. The daily flow ranges from 50 to 100 million gallons.

About the only deduction to be made from the curve is that the coefficient is at its maximum some time in the winter and at the minimum some time in the summer, and varies from 86 to 109 per cent, the latter figure having been observed directly after the conduit had been cleaned. The diagram also shows a gradual lowering of the coefficient as the years pass, due probably to the growth of vegetation along the sides of the conduit. This growth, while being partly checked as winter approaches, probably still adheres to the sides of the conduit until spring, when the growth of plant life due to warm weather increases.

It would be interesting to know the effect on the coefficient of a longer or shorter period of flow, as the amount of water sent through the conduit is frequently changed, sometimes as often as once in 24 hours, while at other times it is the same for six days or more.

William E. Foss is director and chief engineer of the Water Division, Metropolitan District Commission, and Frank S. Hart is superintendent of the Sudbury Division.

Attitude of British Toward Concrete Road Construction

(London Correspondence)

THE attitude in Great Britain toward concrete roads is one of increasing interest. Two paving outfits have been supplied by the Allied Machinery Corporation to the Middlesex County Council for use on the new north circular road. This road, beginning at the west side of London, in the suburb of Ealing, is to pass through Willesden, Edmonton, skirting the northern and northeastern districts, and making again for the Thames on the east side of London, terminating at Southend on the river. This road will relieve the heavy traffic which has, by lack of good roads, to pass right through London and thus increase the congestion on the main city roads. Road transport vehicles will, then, use this road when proceeding from the west of London to the east.

The entire road will be built half-width, i.e., 24 ft. at first. The new north circular road was undertaken also to relieve the prevailing unemployment, the government paying one-half the cost and the Middlesex County Council the other half.

Another complete paving outfit has been supplied to the Northumberland County Council, which is rebuilding with concrete a ¾-mile stretch of the great north road between Newcastle-upon-Tyne and Morpeth. This road is also being built one half at a time, a width of 14 ft., as the present traffic over it could not be diverted. The full labor-saving outfit was not used, owing to the unemployment, but the road was laid, levelled and finished mechanically, 13 men laying 180 cu.yd. of concrete per day. Eleven of the 13 men were unskilled workmen.

The other pavers used for road work were supplied to the Marylebone Borough Council for laying foundations for wood paving in Oxford Street which, at present, carries the major part of the traffic proceeding across the north side of London.

Concrete roads in Britain are, so to speak, on trial, and should the new north circular road, especially, prove a success, there is no doubt but that the use of concrete for the main highways will rapidly extend.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

A Siamese Dredging Record

Sir — The following dredging record may interest your readers.

A 2½-yd. all-steel dipper dredge designed by the writer has been working in Siam on irrigation work, and has made a record of 1,115,000 cu.yd. in 2 years and 9 months without stoppage for repairs of any sort except the renewal of wire ropes.

The cost of labor, fuel, stores and repairs, but not including interest, depreciation or supervision, was 4.8c. per yd.

This output is not remarkable in itself, except having been made in a tropical country remote from base of repairs, and in freedom from breakdowns and repairs.

The dredge is fitted with Robinson's patent solid laminated dipper arm and duplex parallel hoisting ropes. The hoisting ropes run one year without renewal, and the dipper arm has never been taken out of the saddle-block and is apparently as good as new, nor has a shaft been lifted in three years. Working single shift 9 hours; material, clay; deposit on bank.

This dredge is in line with the recommendations made by the writer in a recent paper read before the American Society of Civil Engineers advocating better dredges that would not break down, and is an answer to the criticism that it cannot be done. A. W. ROBINSON.

Hongkong, China, May 4.

Design Considerations in Mixed Steel nd Concrete Construction

Sir—In regard to the letter of R. E. W. Haggerty, in *Engineering News-Record*, May 12, 1921, relative to so-called mixed construction, it is interesting to note the peculiar failure to which he refers as the basis of his conclusions, in questioning the propriety of using structural steel and reinforced concrete on the same job.

It is common practice to use a straight line instead of a parabolic stress deformation curve in concrete, also to ignore the fact that the modulus of elasticity of concrete generally increases with age, and with this increase comes a change in the position of the neutral axis, which affects the lever arm to a smaller extent. Assumptions as to the width of slab to be considered as part of the compression flange of T-beams, are in general practice, of a conservative nature. Tests show that concentrated loads placed in mid-span of one-way reinforced panels, not to mention multiple-way, are so distributed in effect that instead of very high local values, we get lesser values spread laterally over a much wider zone than the area actually loaded. In addition, we have at times, arching, also to a limited extent, tension in concrete, not to mention benefits accruing from the monolithic nature of reinforced-concrete construction as generally used.

Treating all the above effects as being on the safe side, and acting cumulatively however, would hardly justify the most ardent advocate of reinforced concrete to believe it possible for a 7-story building to stand after the failure of two important first-floor [illegible] cracks around said columns. Concrete is only able to follow the steel in tension for small values, before it cracks. This frequently occurs at from [illegible] the cracks become visible [illegible] at from 10,000 to 16,000 lb. [illegible] tion of load, such as [illegible] accentuates this condition. [illegible] condition reported, tends to make the [illegible] the failure quoted [illegible]

A more detailed report of the failed structure would be very interesting, not necessarily to act as a precedent or excuse for less conservative design, but to illustrate to what extent a kind Providence at times, does, apparently, stay the law of gravitation. This undoubtedly is the real point Mr. Haggerty had in mind, rather than laying stress on the lack of effectiveness of subsequent repairs.

As to the references made to the so-called mixed construction, in referring to the United States Bank Bldg. at Denver, described by Mr. Wheeler in a previous issue, it must be admitted that while reinforced-concrete buildings are generally constructed so that the concrete frame gets the load direct, it is likewise general practice in steel buildings, to use some other material, frequently concrete, to carry floor loads to the steelwork. Steel beams are frequently used to carry loads to supports of various materials, and surely load can be transmitted to structural steel by concrete members. In the practice of engineering, it is constantly necessary to make use of different combinations of different materials, each of which has its own distinct physical properties. Among these combinations, is that of structural steel and reinforced concrete which can be successfully used jointly in the hands of competent designers, and such was the case in the Denver building above referrd to. V. D. FIXEN.

Chicago, Ill., June 12.

How Strong Should a Dam Be?—Reduced Factors of Safety Commonly Used

Sir—The editorial entitled "How Strong Should a Dam Be?" in your issue of June 16, p. 1017, recalled to me forcibly the amazement I have always felt at the methods of handling factors of safety in engineering design. The point I desire to make is this: While a bridge, building or other structure will be designed so that all its component parts will have a factor of safety of four and sometimes six in resisting stresses due to *maximum loads* to be imposed on them, dams and other retaining structures, in fact the very foundations on which these bridges or other structures depend for their stability, are designed with much reduced factors of safety.

For instance, retaining structures are designed first, against overturning with either the limitation that the resultant be inside of the "middle third" or that the toe pressure be within the allowable maximum soil pressure. In the first case, with the center of gravity of the vertical load resisting overturning considerably removed from the center of base a resultant at the edge of the middle third provides a factor of safety rarely of more than two and often less. For the condition of maximum soil pressure, the assumptions are made that various soils will support loads of certain amounts per square foot which allow a factor of safety of about two as far as load bearing is concerned and of considerably less than one as far as settlement is concerned, unless rock foundations are available on the site.

In designing these structures against sliding the provision generally made is that the horizontal thrust be no greater than one-half the vertical weight-resisting movement, which again provides a scant factor of safety.

The remarkable part of this condition is that retaining structures for either earth or water are more likely to be subjected to overload than are other structures. A retaining wall may have its retained contents soaked with water, which, by its additional weight and the reduction of the "angle of repose" may cause considerable increase in the horizontal thrust; again it may be subject either to a surcharge, or if already surcharged to an increase in surcharge, a condition which rapidly cuts into the factor safety.

In the case of [illegible] in flood [illegible] in high winds.

The matter [illegible] and the expenditure of a greater amount of [illegible] work. M. HIRSCHTHAL.

[illegible], N. J., June [illegible]

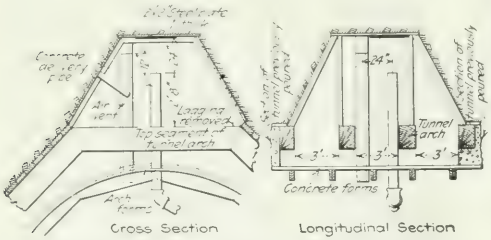
HINTS FOR THE CONTRACTOR

Careful Maintenance Reduces Mixer Delays

MIXER delays were largely eliminated in building the Butte-Anaconda concrete road in Montana by the following procedure: When the work stopped at noon and at night a number of 2-in. cast-iron balls were placed in the drum and the mixer operated for a minute or so. The balls loosened the concrete adhering to the inside and a stream of water washed out the loosened particles. Each morning before work was started the mixer was thoroughly gone over and each evening all repairs necessary were made. The mixer engineer came onto the work an hour ahead of time and remained overtime to overhaul and make repairs. During the season's operation the mixer was never shut down more than 30 min. at a time and lost time because of mixer troubles was negligible. Clifton, Applegate & Toole, Anaconda, Mont., were the contractors, with J. M. Hicks as superintendent.

Air Vent in Form for Tunnel Lining

Concrete lining in the San Fernando tunnel of the Southern Pacific Railroad is being placed by the pneumatic method, and due to the practice of lining sections in heavy ground first, it is occasionally necessary to make a closure or place concrete in a section between two adjoining sections that have already been lined. In these cases the concrete pipe enters the arch vertically from below and as the form is closed tight to prevent cement leakage, some outlet must be provided for the escape of the air used to blow the concrete in.



ARRANGEMENT OF VENT AND DELIVERY PIPE IN CLOSING SECTION

The arrangement of forms and delivery pipe in such a section has been worked out as follows:

Before placing the reinforcing steel in the closing section an excavation of 4 or 5 ft. more than the usual amount is made above the crown of the arch and in the top of this excavation a steel plate is fastened to serve as a buffer against which to blow the concrete. An air outlet is provided in the form of a vertical shaft or box made of 2 x 8-in. timbers (the box having an inside cross-section of 4 x 8 in.) extending to a height of 1 ft. above the top of the concrete delivery pipe.

For filling the wall forms and the lower parts of the arch, the delivery pipe is directed to the sides, as usual. After the concrete has filled the forms well up toward the center of the arch the last curve in the delivery pipe is removed and the concrete is delivered against the steel plate above. Delivery is continued in this direction until concrete overflows through the air vent. The last section of the 6-in. pipe through which the concrete was delivered is left in place until the concrete has set and is then cut off at arch level with a chisel.

A "Home-Made" Foot Brake for Muck Cars

In enlarging the section of Southern Pacific tunnels on the Tehachapi grade in California, muck is brought out of the tunnels in ½-cu.yd. dump cars. The cars are taken upgrade (2.2 per cent) by hand and when filled are allowed to roll out of the tunnel by gravity, the operator riding on the car and controlling its speed by means of a foot brake.

Ordinary half-yard dump cars were adapted for this service by the attachment of a foot brake consisting

FOOT BRAKE MADE OF PIPE ON MUCK CAR

of a 3-ft. length of old iron pipe fastened at one end to the frame of the car between the two wheels, the other end of the pipe extending to the rear and projecting below the body of the car so the operator can readily press on it with his foot when standing on the car frame. With the pipe bearing on the tread of the wheel, it was found that the operator could control the speed of the car within the desired limit.

Dynamite for Drainage Ditching

To form a ditch 1,500 ft. long for draining 20 acres of swampy land near Millen, Ga., sticks of dynamite were placed in holes 24 in. deep with an average spacing of 12 in. The resulting ditch was about 7½ ft. wide on top, 2½ ft. at bottom and 3½ ft. deep, the material removed being approximately 970 cu.yd. No hand trimming was required. With 1,000 lb. of dynamite at 25½c., 44 man-hours at 20c., and $6.20 for incidentals, the total cost was $270, or a unit cost of 27.8c. per yd. and 18c. per lin.ft. Blowing out ing would have cost 40 to 50c. per lin.ft., according to a report in the Georgia *Public Health Reports.* stumps represented 25 per cent of the cost. Hand ditch-

NEWS OF THE WEEK

New York, June 30, 1921

Ready to Pour Concrete at Hetch Hetchy Dam

After 20 Months of Work Foundation Excavation Is Completed to 85-Ft. Depth

After 20 months of continuous work excavation for the foundation of the Hetch Hetchy dam has been practically completed, and will be ready for pouring concrete early in July. When concreting starts it is hoped to pour at the rate of 1,000 cu.yd. per day. The maximum depth of bedrock, which was uncovered over the entire area on which concrete is to be poured, is 85 ft. below the bed of the stream with the exception of a few potholes which reach a depth of approximately 100 ft. in some places.

By the successful unwatering of the lowest excavation without caissons, which were at first considered, it is believed that the work has been so expedited that the structure can be carried above the danger line of next season's flood before the high water arrives. The Utah Construction Co., which has the contract for the construction of the dam, had considered the advisability of flooding the excavation for a while during the extreme high water period to avoid a possible mishap due to scour on the inner slopes of the excavation. As the work progressed, however, the excavation was kept dry so successfully that it was decided not to flood it, thus saving considerable time.

FLOOD FLOW

The discharge capacity of the diversion tunnel, 23 x 25 ft. in cross-section, had been carefully computed, taking into consideration the crest elevation of the upstream diverting dam and the downstream back-water dam. Provision was made for taking care of 13,000 sec.-ft., which was the maximum flow measured in previous peak floods

The peak flow occurred on June 12, when it was estimated that 11,000 sec.-ft. was carried through the diversion tunnel. The actual runoff was in excess of this, it is believed, as there is a considerable amount of storage developed by this diversion dam on the valley above and which was effective in smoothing out the peak. Under this condition of maximum stream flow the water level was 4 ft. below the crest of the diversion dam or 136 ft. above the bottom of the excavation. The leakage into the excavation was [illegible] handled by the pumping equipment installed. This consists of one 14-in., one 8-in. and three 6-in. centrifugal pumps. A 12-in. pump held in reserve was not used.

New Southwark Bridge Opened

On June 6 the new Southwark bridge over the Thames, at London, was formally opened. The new structure replaces what was the largest and one of the earliest cast-iron arch bridges in existence. Steel arches have replaced the cast-iron work; their spans vary from 123 to 140½ ft. clear. The bridge is 55 ft. wide. Sir William Arrol & Co., Glasgow, were contractors. Traffic was handled on temporary footbridges during the reconstruction.

Oil Insulation of Subgrades Used in California Experiments

The California State Highway Commission is carrying on with the approval of the U. S. Bureau of Roads extensive experiments in an effort to overcome the effects of adobe and alkaline soil upon the state highway pavements. The experiments on the road between Mojave and Lancaster in Kern and Los Angeles counties include the treatment of the subgrade or earth foundation under the concrete slab by the oil penetration method with a view of insulating the concrete from the alkali in the soil. On another section of the highway, the commission's engineers are placing a 4-in. cushion of gravel over the adobe subgrade. Similiar experiments are being conducted west of Lemoore in Kings County.

A modern theory of highway construction, the commission explains in a recent statement, is that permanency of concrete road slabs depends largely upon the subgrade—if the subgrade is adequate and there is no separation between it and the concrete slab, the massive concrete slab is not necessary. Experiments conducted by the U. S. Bureau of Roads are cited to indicate that much money may be wasted in constructing heavy concrete slabs. If permanency of the earth foundation can be obtained, heavy traffic may be maintained upon comparatively thin concrete roads. The California experiments are being conducted upon federal-aid projects.

Experimental reconstruction is to be undertaken by the state highway commission engineers upon some portions of the county-built oil-macadam highways in San Joaquin County north of Tracy by the installation of concrete shoulders on each side of the present paved road. The shoulders will be 30 in. wide and approximately 8 in. thick.

The roadway between the shoulders, after scarifying and rerolling, is to be [illegible] with [illegible] concrete to an approximate thickness of 24 in. The commission will spend not more than $20,000 on this experiment.

Committee Reports on N. Y. Waste Disposal

Recommendations Favor Municipal as Against Contract Work—Reclamation Stations Suggested—Program Outlined

Municipal instead of contract collection and disposal of wastes and establishment of reclamation stations where rubbish will be burned in furnaces are among recommendations submitted to the Mayor of New York in a report on the collection and disposal of solid wastes by a committee headed by Chief John Kenlon, of the Fire Department, and including Edward A. Byrne, Royal S. Copeland, Philip P. Farley, L. F. Haffen, Murray Hulbert, John P. Leo, Merritt H. Smith, Amos Schaeffer, and Arthur S. Tuttle. It is recommended by the foregoing committee that the following program be adopted for the disposal of New York's solid wastes:

1. That the city ordinances and the rules and regulations of the street cleaning and health departments requiring separation of all wastes by the householder be rigidly enforced.

2. That collection of ashes, rubbish, garbage and street sweepings be made separately.

3. That as soon as practicable the collection and final disposition of all wastes be made directly by the city without the intervention of contractors.

4. That ashes entirely free from rubbish, from street sweepings and from garbage be used for filling low lands and that, wherever possible, city owned lands be used for this purpose, and that the necessary legislation to permit of this be obtained.

RECLAMATION STATIONS RECOMMENDED

5. That reclamation stations be established at suitable locations where the more valuable materials may be picked out of the rubbish and the residue burned in furnaces operated at a sufficiently high temperature to prevent possible nuisance.

6. That all street sweepings be burned at the reclamation stations.

7. That garbage be taken to sea until experiments now under way can be completed.

8. That in case the experiments now in progress are unsatisfactory, or the processes be found too costly, the city should adopt some other method of final disposition of garbage.

9. That a reduction plant for the final disposal of dead animals and offal be immediately constructed.

10. That a special study be made by the street cleaning department of the problem of collection and transportation of all kinds of waste to reduce costs.

11. That the question of transportation by water and waterfront dumps be given similar study so as to develop a type of scow which will permit the economical filling of low lands as recommended.

12. That property be selected and acquired, where not already owned, at suitable locations for the purpose of constructing waterfront dumps or inland transfer stations so as not to be dependent on contractors.

13. That the city adopt the foregoing program as its general policy and proceed to work out the details as fast as the means at its disposal will permit.

14. That the street cleaning commissioner be authorized to secure the services of men equipped by training and experience to prepare detailed working plans and estimates of cost for all necessary equipment and plant to carry out this program.

15. That any immediate expenditures be confined to the purchase of motor trailer and floating equipment, to the purchase of sites and the construction of waterfront and inland reclamation stations; and reduction works for dead animals and offal.

The city waste disposal commitee explains that its report is incomplete as to the final disposition of garbage as well as with respect to the development of the remainder of the plan, but desires to state that it will hold itself in readiness to confer with the commissioner of street cleaning from time to time during the preparation of the final plans by the experts to be employed, and to review and report upon these plans, to the end that they may be harmonized with the general procedure herein outlined.

Surveys on Columbia Basin

Further examination and study of data compiled in connection with surveys of the Columbia Basin project in the state of Washington are being continued, including diamond drilling at a proposed dam site on the Columbia River. The project, proposing the irrigation of 1,753,000 acres, was described in *Engineering News-Record*, Nov. 11, 1920, p. 944. The designs and cost estimates on the entire project are being revised and it is expected that the later figures will place the total cost well below the $300,000 which was calculated at the peak of 1920 prices.

Ten Per Cent Rate Reduction on Eastern Canadian Lines

A reduction of 10 per cent in rates on the railroads of eastern Canada has been ordered by the Dominion Board of Railway Commissioners. Western rates will remain unchanged. This reduction establishes a return to the rates prevailing before Sept. 1, 1920, when a 20-per cent increase was granted with the understanding that rates would be reduced 10 per cent Jan. 1, 1921, and 10 per cent July 1, 1921.

Pennsylvania R.R. to Tear Down Old Trainshed

Announcement has been made by the Pennsylvania R.R. of its intention to begin work early in July tearing down the trainshed of its old passenger terminal in Jersey City. It will be replaced by a low shed of the longitudinal smoke-duct type.

Construction of the old shed was begun in 1890 and when it was completed was the largest high arch passenger trainshed in the country. Since the opening of the New York passenger terminal of the Pennsylvania R.R., the old Jersey City terminal has been used almost entirely to handle suburban traffic transferring to the ferries and the Hudson tunnels. The contract for removing the old shed has been let to Henry A. Hitner's Sons Co., contractors, Philadelphia.

Discuss Location of New Viaduct for Atlanta, Ga.

The location of a roadway viaduct across railroad tracks in the heart of the city at Atlanta, Ga., is under discussion between C. E. Kauffman, city engineer of bridges and estimates, and the chief engineers of the railroads. The city has reported in favor of a viaduct at Spring St. and engineers representing the railroads have submitted a report recommending that the northerly terminus of the viaduct be Cone St. It is stated that this location would permit the viaduct to cross the railroad tracks in a direction more nearly at right angles.

In March, 1921, the City of Atlanta approved at a special election a bond issue of $750,000 for the construction of a viaduct across the railroad tracks in the heart of the city with its northerly terminus at Spring St. This viaduct is needed to relieve traffic congestion in the heart of the business district by providing a through route bypassing the congested area on its westerly side. One of the plans for the Spring St. viaduct submitted by the city necessitates the crossing of railroad tracks for a distance of about 1,200 ft. The location recommended by H. L. Collier, chief of construction, and C. E. Kauffman, engineer of bridges and estimates, and tentatively approved by the city planning commission, reduces the distance the viaduct will extend over the railroad tracks by about 50 per cent.

Robert H. Whitten, consultant to the planning commission, submitted a report on viaducts in the congested section, recommending that the present viaduct be constructed to Spring St. but that the Cone st. route be left open for the construction of a future viaduct. He stated that the present traffic requirements also demand the elimination of the grade crossings at Prior St. and Central Ave. through the construction of viaducts. C. E. Kauffman is now taking up with the engineers for the railroads the details of the location of the Spring St. viaduct.

To Use Canal Bed for Highway

The application of Ira and Boston, two surburbs of Akron, Ohio, to utilize the Ohio Canal bed as a boulevard entrance into the city so as to avoid the necessity of climbing out of the steep Cuyahoga River Valley has been authorized by legislation. The bill also provides for the use of the canal bed as a right-of-way for a sewer. The county commissioners assume responsibility for flood damage, must build and maintain culverts, and must commence work within a reasonable time.

Commission Approves Report on Philadelphia-Camden Bridge

On June 23 the Delaware River Bridge Commission, composed of the interstate bridge commissions of Pennsylvania and New Jersey, approved the recommendations made by the board of engineers on June 9, fully abstracted in *Engineering News-Record* of June 23, p. 1086. The commission adopted the Franklin Square location, as against the Spring Garden St. and Washington Square locations that continued to be advocated by various interests in the public hearings preceding the commission's decision. It also approved the adoption of the suspension bridge design, and continued the enginering organization of the board of engineers for the immediate preparation of contract plans.

Action by the city council of Philadelphia on the necessary appropriation of money for construction has been deferred. This appropriation is necessary to legalize further steps in construction. The two states have appropriated sums to cover their contributions to the cost of the bridge, but they are contingent on the city's appropriation being made. It is generally expected that council will act favorably within the next few weeks.

Contract plans for the foundation work may be completed by fall, ready for calling for bids on this part of the work. The necessary surveys for the condemnation or purchase of lands required for the bridge have already been begun.

Kansas City to Meter Water

All new water service connections will be metered at Kansas City, Kan., and meters will be installed as rapidly as possible on old connections.

Governors Would Discuss Waterway and Power Development

Following the suggestion of Governor Sproul of Pennsylvania, Governor Edwards of New Jersey has subscribed to the proposal for a joint conference among the Governors of New York, Pennsylvania, and New Jersey for the development and utilization of rivers and streams in the two states. It is proposed to initiate joint discussions of flood control, water power development and the general economic importance of the rivers of the three states.

Phipps Road Bill Passes House

The Phipps highway bill, with the Dowell bill added, passed the House of Representatives June 27 by a vote of 266 to 77. The action was taken under suspension of the rules which precluded any amendments on the floor of the House. An effort was made by the opponents of the legislation to force the bill to a vote without debate. Finally, however, it was arranged that each side was to be allowed twenty minutes to be used in arguments for or against the measure. The debate was very acrimonious, despite the time limitation.

Senator Townsend stated on June 27 that he would move the following day to refer the bill as it passed the House to his committee. If his motion should be lost the measure then necessarily will go immediately to conference. The vote on the Townsend motion, however, will not be a test of strength as it is probable that some senators who favor the Dowell principles would be unwilling to have such important legislation go to conference without the Senate having had an opportunity to consider it. After the Senate has had a chance to debate the Townsend bill, it then will be possible to move at any time to substitute the House bill and pass it.

While there is no certainty that a federal highway commission will be set up, there already is speculation as to whom the President might chose for such a commission, if by any chance it were authorized. These names include those of George Deihl of Buffalo, president of the American Automobile Association, Samuel M. Williams, of the Highway Industries Association, and Roy Chapin, of the Hudson Motor Car Co.

Federal Reclassification Report

The Federal Council, representing government employees who are members of the American Association of Engineers, has recently submitted to the Joint Congressional Committee which has the subject under consideration, a report on various reclassification bills now pending at Washington, D. C., especially with regard to the status of technical and scientific employees. The report is accompanied by a chart illustrating the salary curves of the various bills pertaining to the technical and scientific groups of the federal service.

It is not feasible to attract young men into the service, the report states, at a salary less than the minimum shown on the A. A. E. curve. It is held necessary to make a sufficient range in the sub-professional grades to create an incentive to these employees, many of whom would be ineligible to enter the full professional grade without years of experience. In positions carrying yearly salaries of $1,800, it is pointed out, are included the bulk of the professional and scientific personnel. A wider range of salaries in this grade is urged. The A. A. E. curve provides for this condition by extending the upper limit to $2,760, embracing four movies within the grade at intervals of $240 each.

The Federal Council believes that any bill concerning reclassification should contain provision for an executive agency under the control of the President to harmonize all questions regarding allocations and which should function as a board of appeal for employees.

Bill for Regulating London Traffic

The new bill introduced in Parliament by London members for the better regulation of traffic has for its object the improvement of the Home Office by-laws. These by-laws will be drafted by a committee composed of a representative each from the London County Council, the borough councils, Greater London, the London members of Parliament and the Ministry of Transport. The by-laws will deal chiefly with the position in the streets of slow- and fast-moving traffic, with the regulation of certain classes of traffic to specific thoroughfares; with frontage obstruction by the loading and stationing of vehicles; with the parking of cars in squares, and with obstructions generally.

Urge Revision of Government's Employment Policy

A complete revision of the employment policy of the national government is recommended by the Chamber of Commerce of the United States. This action is taken as a result of a referendum vote on the subject just completed among the 1,400 business organizations within the chamber's membership. The chamber's position is that the recasting of the system is necessary as a means of obtaining efficiency in the government service. The recommendations are:

1. Recasting of the present system under which personnel for the federal civil service is secured and managed. 2. Adequate and uniform pay under essentially like conditions for the federal civil service through reclassification and regrading. 3. Reclassification by statute based upon investigations already made and further investigation by the U. S. Civil Service Commission. 4. Reclassification by the commission and the budget bureau and current correction made by Congress, aided by these agencies. 5. Promotion through statutory recognition as the preferred method for filling vacancies. 6. Inclusion of all administrative officers not responsible for determining policies under civil service rules. 7. Transfers between departments to be regulated by executive orders consistent with the civil service law. 8. Efficiency records to be developed by the civil service commission. 9. Removal of an employee to be possible upon a written statement of the reasons to the employee with opportunity for a written reply, but without right of appeal above the head of the department.

Deliver First 1,500-Ton Barge for New York Canal Service

The first of five barges with a cargo capacity each of 1,500 gross tons and 10-ft. draft has arrived at New York City, via the New York State Barge Canal, loaded with 83,000 bu. of oats. The five barges for operation on the canal have been ordered from the McDougall-Duluth Shipbuilding Co. of New York and Duluth. They are 254 ft. long, with 36-ft. beam and 14-ft. depth, having a cargo capacity of 1,500 gross tons at a 10-ft. draft and 1,750 gross tons at 11-ft. draft. They are driven by Diesel oil engines. A company is being organized to operate the barges and maintain a regular service between New York and Buffalo, largely devoted to the grain carrying business. Julius H. Barnes, formerly president, United States Food Administration Grain Corp., and Capt. A. Miller McDougall, of the shipbuilding company, are joint owners of the barges.

A £11,281,000 Water Loan Proposed for London, England

A bill authorizing the Metropolitan Water Board of London, England, to expend £11,281,000 during the next fifteen years for extensions to its works has been approved by a committee of the House of Commons and is now before a joint comittee of the Commons and Lords. The outstanding feature of the scheme is the enlargement of the Littleton Reservoir on the north side of London. This reservoir now holds 6½ billion Imperial gallons, or about 24 days' supply for London. By increasing the capacity of this reservoir, the western and northern areas can be supplied therefrom, while those supplies for the eastern area can be conserved for its own needs.

H. E Stilgoe, chief engineer to the Metropolitan Water Board, says that the London supply is at the rate of 39 Imp. gal. per head per day which is larger than that of any other city or town in England, and that he sees no way by which this rate can be reduced. If this scheme is carried through the available supply will be 42 Imp. gal. per head. Of the present consumption of 39 Imp. gal. a day, 9 gal. is for trade purposes. The consumption of other large cities in Britain is estimated at 22.8 Imp. gal. per head per day for Leeds, 22 for Birmingham, and 12.4 for Sheffield.

The bill is being opposed by the London Chamber of Commerce and by the Associated London Manufacturers' Committee. The Chamber urges against the bill the present high cost of labor and material and contends that by saving 1 Imp. gal. a day, which it says could be easily done, the scheme could be postponed a year. The Manufacturers' Committee opposes the bill because it would increase the water charges for trade purposes from the present 6½d. to 2s. per 1000 Imp. gallons or from about 11 to 39c. per 1000 U. S. gallons.

Filters for Milwaukee Now Are Urged in Report

Following laboratory experiments of chemists of the Milwaukee Sewerage Commission and a report of the local section of the American Chemical Society calling on the city of Milwaukee to delay water filter construction to await the outcome of impending discoveries in both water and sewage treatment, Harrison P. Eddy, consulting engineer of the firm of Metcalf & Eddy, of Boston, was called in to report on the need of filters. His report, presented June 6 to Mayor D. W. Hoan, indicates that filters should be built and the construction should not be delayed. Since it will take a year to perfect the designs, experiments on the effect of the accurate control of the electrically determined acidity (hydrogenion concentration) upon the process of coagulation and filtration can be obtained. If successful methods in the laboratory are found large-scale tests at the existing experimental plant should be made. If this experimental work demonstrates the desirability of adopting new methods, Mr. Eddy is of the opinion that the filter designs can be easily modified accordingly. He recommends placing the investigation under the joint direction of a recognized expert in colloidal chemistry and a water-works engineer.

California Commission Answers Automobile Association

Charges of wastefulness in day labor highway construction work, made by the California State Automobile Association in bulletins recently published, have been answered in a statement issued recently by the California Highway Commission, which claims that material and vital facts relating to the highway program have been deliberately concealed by the automobile interests. In a number of instances it is pointed out, the automobile association has quoted estimated costs on one type of road construction and final costs on an entirely different type, failing to note that the type of construction was changed.

Bids on nineteen contracts which exceeded the estimates have been rejected by the highway commission since August, 1915. These rejected bids, it is stated, exceeded the engineers' estimates by an average of 41.2 per cent. Twelve of these sections were later constructed by day labor. Of the 165 contracts for which bids have been received by the commission since 1915, only twelve have been constructed by day labor. It is charged by the commission that the automobile interests would have all work done by contract without regard to whether bids of contractors are resonable or excessively high.

By those familiar with local conditions the automobile association's attack on the highway commission's policy is belived to be losing favor with a considerable number of organizations and individuals, but some of the representatives of automobile manufacturers are considering the tentative organization of a campaign to declare war on the automobile association and withdraw support from it as long as it persists in what is characterized as a destructive policy with regard to the state highway program. The automobile association, it is realized, has gained strong following by reason of the active publicity campaign which it has conducted since the start of its attack on the highway commission.

Fix Date for Lyons Fair

The Lyons Fair, for the promotion of international trade, will be held in Lyons, France, Oct. 1-15. American manufacturers may secure further details from Emile Garden, 150 Nassau St., New York City.

New Haven Rejects and New London Adopts City Manager Plan

New London, Conn., voted 2,744 to 1,644 for a council-manager charter on June 6. A council of seven members, elected at large, will appoint a city manager, at a salary of $5,000 a year. The councilmen will receive $300 a year. Heretofore New London has been governed by a mayor and council for the city and a board of selectmen for the town, the three selectmen sitting as members of the City Council and bringing its membership to 18. At New Haven, on June 14, a city manager charter was defeated by a vote of 18,717 against, and 7,909 for, out of a possible 45,687 votes.

Defer British Registration Bill

The Institution of Civil Engineers of Great Britain has informed the council of the Institution of Municipal and County Engineers during the course of the year that it had been decided not to proceed with the proposed bill for the registration of engineers, but to substitute for it an application for an alteration in the charter to obtain the power of conferring the title "chartered engineer." In view of the increasing number of countries in which registration of engineers is becoming an accomplished fact the postponement of registration, according to the recently published annual report of the council of the municipal and county organizations, is to be regretted. The report says, in part:

"Registration is neccessary if the engineering profession as a whole is to attain the highest possible standard and if the public is to be guaranteed a regular standard of efficiency such as is already provided in the medical profession. Engineering work involves the safety, health and comfort of the whole community, but there is also the question of economy; true economy is always the result of the highest skill, and the money spent in improving engineering education training, which is returned a thousandfold, is largely wasted unless there is some provision for ensuring the utilization of the required knowledge.

To Rebuild South Street Bridge Over Schuylkill River

Plans are being made by the Department of Public Works, Bureau of Surveys, of Philadelphia for immediate reconstruction of the South St. bridge over the Schuylkill River. The present wrought-iron pin-connected drawbridge, operated by hand was built in 1878 and reinforced in 1895. A 576-ft. length of the present structure is to be replaced by five plate-girder spans, the central one to be a double-leaf trunnion bascule giving 100-ft. clear channel.

In contrast to other Schuylkill River bridges, the new structure has received special attention with regard to architecture. The design has received the approval of the Art Jury. The piers supporting the bascule leaves will be of massive concrete construction, surmonted by copper-covered houses for the operating machinery. Careful study has been given to the problem of concealing the machinery and counterweights, which render most bascule bridges unsightly.

Traffic will have to be interrupted during a large period of the reconstruction and diverted temporarily to the Gray's Ave. and Walnut St. bridges. To minimize the interruptions, however, the foundations (to rock) will be constructed as far as possible before closing the old structure. A temporary run-around bridge is out of the question at present prices.

Bids are now being asked for the removal of the old bridge and construction of the new foundations. It is anticipated by Charles Frommer, acting chief engineer of the department, that bids for the new superstructure can be called for within a few months.

During the period of construction of the new river bridge another contract will be let for the reconstruction of the old truss spans on South St. over the tracks of the Philadelphia, Baltimore & Washington R.R.

New Illinois Legislation

Bills passed by the Illinois legislature which adjourned June 18 include the following which have some bearing on engineering work:

The Sanitary District of Chicago may construct controlling works on the Great Lakes and may build garbage reduction plants. The Sanitary District or the city of Chicago may construct a deep-water harbor in Lake Calumet. City councils may create zoning commissions, and cities and villages of less than 5,000 may adopt the manager form of goverment. The bond issue of $20,000,000 for the Illinois waterway is approved The Illinois Commerce Commission is created to supersede the public utilities commission. The state highway act is revised; a patrol maintenance system is authorized, counties may bid on state road construction and the State is given power to construct material plants. A commission to promote the St. Lawrence waterway is authorized.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Grand Rapids Engineering Society recently appointed a committee to investigate and report on methods of improving gravel streets with permanent surface top. The committee, consisting of H. H. Turner, Purritt A. Parks, Byron E. Parks, Theodore O. Williams, John F. Nellist, C. A. Paige, A. H. Apted and C. J. Wagner, has recommended the use of sheet asphalt or a bituminous pentration top.

The Engineers' Society of Pennsylvania, at its annual meeting, June 13, at Harrisburg, elected the following officers: President, Richard V. McKay; first vice-president, Theodore E. Seelye; second vice-president, Crosby Tappan; secretary, Howard E. Moses; treasurer, Harry T. Neale.

The Portland (Ore.) Post, Society of American Military Engineers, at its annual meeting June 13, elected the following officers: President, F. S. Cook; vice-president, P. Hetherton; secretary, E. B. Thompson; treasurer, S. C. Schubert; assistant treasurer, A. D. Montieth.

The Engineering Society of Akron has elected the following officers: President, J. H. Vance; vice-president, L. G. Tighe; directors, R. R. Metheany and H. G. McGee. Mr. McGee is also secretary-treasurer.

PERSONAL NOTES

PROF. CHARLES A. ELLIS of the University of Illinois has resigned, effective at the end of the present school year, to become vice-president of the Strauss Bascule Bridge Co. of Chicago. He is a graduate of Wesleyan University, A.B. 1900. For two years he was assistant to the city engineer at Middletown, Conn. From 1902 to 1908 he was employed by the American Bridge Co. as draftsman checker, squad foreman, and designer on many large railway structures. From 1908 to 1912 he was assistant professor of civil engineering at the University of Michigan, and from 1912 to 1914 designing engineer for the Dominion Bridge Co. In 1914 he was made assistant professor of civil engineering at the University of Illinois and since 1915 has been professor in charge of all courses in bridge and structural engineering. He has been a constant contributor to the technical press, and is now completing the manuscript for a text book on framed structures which will go to press this autumn. He has recently been appointed one of the associate editors for a large and comprehensive library of hand books in structural engineering.

L. H. WHEATON, consulting engineer, Halifax, N. S., has been appointed commissioner for the County of Cape Breton, with headquarters at Sydney, B. C. He will make reports to the joint expenditure board in matters relating to public works and expenditure for the county.

COLONEL GEORGE M. HOFFMAN, Corps of Engineers, U. S. A., has been designated as a member of the board which is to prepare a detailed plan for marking American battlefields in Europe.

COLONEL GEORGE P. HOWELL, Corps of Engineers, U. S. A., has been appointed to the army retiring board for the Fourth Corps Area.

W. O. MCCLUSKEY, JR., has resigned as county road engineer, Ohio County, W. Va., to become assistant division engineer for the third district of the State Road Commission.

ALEXANDER G. HOFFMAN, assistant county road engineer, Ohio County, W. Va., has been appointed county road engineer, Ohio County.

COLONEL J. A. WOODRUFF has been designated as senior instructor of the Engineer Reserve Officers Training Corps class assembled at Camp Humphreys, Va., near Washington, from June 16 to July 27. The camp will be organized into a battalion of four companies.

E. R. RODENBERG, for ten years assistant city engineer of East St. Louis, Ill., has been appointed chief engineer of the East Side Levee and Sanitary District, East St. Louis, Ill.

THE NATIONAL ENGINEERING CO. has been organized by I. Muschel, formerly inspector of construction, Navy stations, Pensacola, Fla., and Norfolk, Va., to specialize in the design, erection and construction of structural steel and reinforced concrete buildings.

B. M. HALL, of B. M. Hall & Sons, engineers, Atlanta, Ga., has been awarded the honorary degree of Doctor of Science by the University of Georgia.

CLARENCE M. BROOKS has been appointed deputy commissioner of highways with headquarters at Montpelier, Vt., by the new Vermont state highway board and will be directly in charge of road maintenance work.

BERTON SMITH, for several years chief engineer of the Oakdale (Cal.) irrigation district, has resigned to become superintendent and chief engineer of the Merced irrigation district.

ALBERT GIVAN has been appointed city engineer of Sacramento, Cal., to take office July 1, when the new city-manager plan goes into effect.

GIBBONS & BROWN is a firm of consulting engineers recently organized by J. O. G. Gibbons, formerly with Westinghouse, Church, Kerr & Co. and recently in private practice, and by C. E. Brown, for the past few years a U. S. ordnance engineer. The firm will specialize in power plants and industrial problems and will be located in Newark, N. J.

F. H. SHAW of Lancaster, Pa., has been chosen engineer for the Borough of Lewistown on the construction of the South Main St. bridge over Kishacoquillas Creek.

ELLIOTT E. NASH, formerly general manager of the Minneapolis & St. Louis R.R., with headquarters at Minneapolis, has been appointed vice-president and general manager.

GEORGE T. DONOGHUE has resigned as chief engineer of the Lincoln Park Commission, Chicago. He has negotiations under way for further engagement, regarding which announcement will be made shortly.

RUSSELL H. CHITTENDEN, director of the Sheffield Scientific School, Yale University, for 21 years, will retire from this office next June.

W. D. MAXWELL has been reappointed engineer of Sac County, Iowa.

FRED S. MORSE has been appointed city engineer of Springfield, Ill.

CHARLES M. SCHWAB has received the degree of Doctor of Engineering from Stevens Institute of Technology.

GEORGE S. COWDERY, JR., for the last two years with the Royal D. Salisbury Co., engineers, Denver, Col., has been appointed district engineer of the Chadron, Neb., office of that company.

COLONEL J. C. ROPP, of the engineering organization of the J. G. White Management Corp. has been appointed by Director Charles G. Dawes as one of four assitants in directing and organizing the work of the new Federal Budget Bureau.

ALBERT H. RHETT, formerly engineer of structures, New York, Westchester & Boston Ry., and recently engineer for Toch Bros., New York, manufacturers of technical paints and varnishes, has been appointed sales manager of this firm.

C. E. PAUL, consulting engineer National Lumber Manufacturers Association, at its Chicago office, has resigned effective July 1, and after a brief vacation will resume his former private consulting practice specializing in construction and materials. He has been connected with the lumber associations for six years and has had a large part in the development of its technical work.

Business Side of Construction

Facts and Events that Affect Cost and Volume

International Statistical Bureau on Construction Proposed

Delegates of the Associated General Contractors of America will present a plan for an international statistical and informational bureau on construction at the first annual meeting of the International Chamber of Commerce at London, June 27-July 1. The functions of such a bureau would be to furnish information on the following subjects: (1) Raw materials—prices, sources, and general data; (2) manufactured materials and machinery—sources and supply; (3) demand for raw materials, manufactured supplies and machinery; (4) character and amount of construction progress throughout the world; (5) labor—demand and supply, skilled and unskilled; (6) latest discoveries and methods in construction throughout the world; (7) transportation; (8) finance, including methods of financing construction and review of present conditions; (9) import and export tariff data; (10) government control of construction, materials, labor, transportation, credit, and mass production methods; (11) dumping possibilities; (12) agencies and associations in construction; (13) technical schools and journals; (14) new market opportunities.

The A. G. C. will be represented at the International Chamber meeting by Noble Foster Hoggson, of Hoggson Bros., New York City, and John R. Wiggins, the John R. Wiggins Co., Inc., Philadelphia.

Report on Car Loadings

An increase of 82,489 in the number of cars loaded with revenue freight on American railroads during the week which ended on June 11, compared with the previous week was shown by reports just received by the car service division of the American Railway Association. The total for the week was 788,997 cars which was, however, 141,979 cars below that for the corresponding week in 1920 and 18,208 cars under that for the corresponding week in 1919. In making comparisons with the previous week, consideration must be given to the fact that observance of Decoration Day on May 30 resulted in a reduction of the total for the week.

With the exception of grain and grain products which showed a slight reduction, the loading of all other classes of commodities was larger than the preceding week, the largest gains being in merchandise and miscellaneous freight which includes manufactured products, and in coal. The total for the first named class was 469,295 cars or an increase of 52,074 over the previous week. Coal loadings totaled 163,088 cars which was an increase of 20,414 over the previous week but 28,400 cars under the corresponding week last year.

Building Situation Analyzed in Questionnaire

That the country is not industrially overbuilt; that building should be undertaken now; and that labor costs and material prices are the principal deterrents to building, are facts revealed in a questionnaire recently sent out by the Detroit Steel Products Co. The Detroit company circularized more than 200 architects, engineers, and contractors with a view to seeking a nationwide opinion upon industrial construction work. One hundred and seventeen replies were to the effect that building should be done now and 136 replies were to the effect that the country was not over built industrially. In answer to the question, "What do you think is needed to make prospective builders go ahead with plans?" Eighty-three replied that lower material prices were necessary and eighty-three also that lower labor costs were needed. Considerations next in order of importance were stabilization of prices, easier credit, settlement of labor disputes, increased confidence in building, lower freight rates, and better general business conditions. Three-fourths of the replies received indicated that builders felt there would be a further reduction in both prices of building materials and cost of building labor.

There was wide variation in the opinion as to upon what basis prices would be stabilized, answers being received stating that the basis of stabilization would be all the way from 10 to 100 per cent above the 1913 level and all the way from 10 to 50 per cent below present prices.

Government Soon to Act in Building Investigation

According to a recent announcement made by Attorney-General Daugherty, one of the open price associations of New York City whose activities were under scrutiny by the Lockwood joint commitee on housing is soon to be the defendant in a suit instituted by the government. It was intimated that suit might be started simultaneously against this national association in several cities.

Factory Wages Decrease

Factory workers in New York State received an average of 34c. less a week in May than in April according to figures compiled by the State Department of Labor. The average weekly wage of a factory worker for May was $25.86. The average earning in New York City was $27.45, or 39c. less than in April, while in up-state factories the average was $24.85—33c. less than in April.

Further Wage Adjustments Made

Adjustment of wage disputes in the building industry on a basis of reduced pay has been accomplished in several cities during the past week. A tie-up in building work which had been current since Apr. 1 in and near Davenport, Iowa, ended a few days ago, when agreements were signed with the employers by the unions, a separate one being signed by each craft, providing for a 12½c per hour reduction for all crafts. This amounts to a decrease of $1 per day with a general scale of 87½c per hour.

In Tulsa, Okla., where building conditions have been unsettled for a couple of months, bricklayers and hod carriers have consented to a reduction in pay, the new wage scale being $11 per day, whereas the old one was $12. The decision to impose the $1 a day decrease was arrived at after a lengthy conference on the part of the arbitration board.

Press dispatches indicate that the building strike in Springfield, Mass., is also ended. The carpenters union and the building trades employers association agreed on a wage cut of 10c. an hour. Carpenters are to receive 85c. an hour; bricklayers, 95; plasterers, 95c.; electricians, lathers and painters, 85c.; hoisting engineers, 90c.; sheet metal workers, 85c.; masons' tenders, 65c.; steamfitters' helpers, 55c.; and electricians' helpers, 35c. The highest wage in the new schedule is that for structural iron-workers—96¾c. an hour.

For the purpose of stimulating building operations in Hartford, Conn., the structural building trades alliance made a voluntary offer of a flat 10 per cent reduction in wages to a committee representing the building employers association. The offer affects carpenters, plumbers, steamfitters, electricians, painters, sheet metal workers, iron workers, stationary engineers, and lathers. Masons and masons' tenders are not included, for the former have already accepted a decrease and the rate for the latter is still being debated.

A partial settlement of the wage differences in Newark has been made. Carpenters, bricklayers, iron workers, hoisting engineers, and laborers have returned to work, the resumption following the signing of an agreement between a committee from the General Contractors Association and the executive committee of the bricklayers.

West Coast Lumber Production

For the week ending June 11, 114 mills reporting to the West Coast Lumberman's Association reported a production of approximately 58,000,000 ft. b.m., which is 30 per cent below normal. New business totaled 51,000,000 ft. b.m. and shipments 61,500,000 ft. b.m.

Output of Contractors' Machinery for 1919 Valued at $186,000,000

A preliminary statement of the general results of the 1920 census of manufacturers has been issued by the Bureau of the Census, Department of Commerce, furnishing statistics concerning the value of various kinds of machinery manufactured during the year 1919. According to the tabulation, the value of the total production of contractors' equipment and machinery amounted to approximately $186,000,000. The largest valuation placed upon the manufacture of a single line of equipment was for pumps and pumping machinery, the output of which was estimated in value at $65,360,000. The following list showing production valuations has been taken from the general list of machinery as compiled by the Bureau of the Census; air compressors, $13,960,000; brick, pottery, and other clay working machinery, $5,371,000; concrete mixers, $9,579,000; cranes, electric, $25,865,000; cranes, steam and hydraulic, $13,515,000; cranes other than electric, steam and hydraulic, $9,568,000; dredging machinery, $1,939,000; excavating machinery, $6,641,000; gas machines and apparatus, $7,898,000; hydraulic rams, $1,369,000; pumps and pumping machinery, $65,360,000; roadmaking machines, $13,915,000; steam shovels, $9,654,000; and well drilling machinery other than oil well, $1,663,000. This makes a total of $186,297,000. The figures for 1919 are only preliminary and may be subject to such changes as are necessary in a further examination of the reports submitted to the Bureau of the Census.

Retail Food Prices Drop

According to a recent bulletin issued by the Bureau of Labor Statistics, the retail food index issued by the United States Department of Labor shows a decline of 4.8 per cent in the retail cost of food to the average family in May as compared with April. Prices of thirty-five of the forty-three articles of food reported to the Bureau of Labor Statistics each month, and which are the basis for the index figure, decreased during the month from April 15 to May 15. The general level of wholesale prices was only slightly lower in May than in April, the weighted index number dropping from 154 to 151.

Bids on Bridge Repair Drop 50 Per Cent in Nine Months

A repair job on the Lincoln Highway bridge over the Hackensack River will be contracted for at one-half the price bid nine months ago if the low bidder in the recent bid opening gets the contract. The work consists of repairs to the hand rail and bids for the repair work were first opened in September 1920, when the low bid was found to be $14,751. The lowest bid received last week for the same work was $7,197. The highest bid received last week was $2,251 under the low bid received nine months ago.

Portable Power Plant for the Contractor

(Berlin Correspondence)

To furnish power required for the performance of various duties in building construction a unique plant has been designed by an Austrian engineer, Dr. Merkl. The power plant, shown in an accompanying photograph, has so been arranged that not only is the gasoline engine—which was selected as the prime mover—available for its usual uses, but it drives a compressor for pneumatic tools and carries a small electric generator set to provide electric power for lighting purposes and for the propulsion of machinery. The whole outfit is capable of performing the following operations:

1. Piledriving with a weight of ram of 370 kg. of fifteen to sixteen full strokes, 1.9 per minute. With an extension ram bringing the weight up

AUSTRIAN PORTABLE POWER PLANT

to 600 kg., ten to eleven strokes per minute are produced.

2. Electric power for lighting and for driving drilling machines.

3. Slotting and drilling of wood and iron by means of portable electric drilling machines.

4. Driving a circular saw by belt or universal joint.

5. Acting as a blower for a forge.

6. Driving a centrifugal pump and a concrete mixer.

7. Providing compressed air for a caisson at moderate depth and for pneumatic rock drills and riveting hammers.

The power plant forms a small, compact unit, can be easily moved and placed in any desired spot, and requires but little space. The gasoline motor produces from 14 to 16 hp. In the smaller outfit two of the four cylinders are adapted for acting as compressors, while in the larger outfit a special two-cylinder compressor is provided for directly coupled to the four-cylinder motor.

The piledriver, the most substantial part of the outfit, contains several novel features. It consists of the base placed on three wheels with two runners which can be erected upright or put in an inclined position, two braces, and lastly the ramming mechanism. The three former parts are of channel iron and the base consists of six channel irons put together by screw bolts. The two runners and the braces are held rigidly in position by cast steel cross pieces, of which the runners have three, one each at the bottom and top ends and one in the upper half. The bottom pieces carry the trunnions upon which the runners are hinged for hoisting or lowering them. The windlass for hoisting and keeping in position the pneumatic hammer is mounted on the braces. This is worked by hand in the case of the smaller outfit and by compressed air in the larger outfit.

Contract for Tile-Concrete Smelter Stack Let

A contract was recently let to the Wiederholt Construction Co., St. Louis, for the erection of a stack 24 ft. inside diameter at the top, 450 ft. high above foundations, and a foundation octagonal in shape 87 ft. between parallel sides. The stack is to be located at the Midvale smelter plant of the United States Smelting, Refining & Mining Co., about seven miles south of Salt Lake City, Utah. The construction is to be of Wiederholt patented hollow tile with steel reinforcement in both vertical and circumferential directions, the interstices of the tiling being filled with concrete. A 4-in acid-proof lining is provided with a 3-in. air space between the inner and the outer shells. The foundation rests upon a subsoil of sand and clay, free of surface water. The engineer in charge of construction is L. D. Anderson, chief metallurgical engineer for the U. S. Smelting, Refining & Mining Co.

Building Trades Wages in Various Countries

According to a pamphlet embodying tariff information for the use of the committee on ways and means of the United States House of Representatives, the greatest per cent increase in the wages of building labor in the interim 1914-1920 was experienced in Japan. Wages of bricklayers, common laborers and carpenters rose 228 per cent, 346 per cent, and 226 per cent, respectively in that six-year period. In Germany the wages of bricklayers and painters decreased from 1914-1920, 17 and 23 per cent respectively, through there was a much higher rate existing between 1914 and 1920. In England the per cent increases resemble those of the United States quite closely, the increases in the United States being: Bricklayers, 72 per cent; laborers, 123 per cent; carpenters, 91 per cent; painters, 100 per cent; plasterers, 69 per cent. In England the per cent increase were: Bricklayers, 91 per cent; laborers, 160

per cent; carpenters, 104 per cent; painters, 117 per cent, and plasterers, 103 per cent.

The information from which this digest was made for the Congressional committee was taken from various sources. For the United States the average rates for May of each year are given, the figures being supplied by the *Monthly Labor Review*. In Germany the rates are the quoted rates for the district of Stettin, taken from the German industrial inspector's report. The monthly journal of Yokohama's Chamber of Commerce and the Department of Agriculture and Commerce for Japan furnished the figures for that country and the wages quoted are for all Japan for 1914, and the wages per day in Yokohama in 1920. The *British Labor Gazette* supplied the figures for England.

Imports and Exports

According to announcement recently made by the Bureau of Foreign and Domestic Commerce, the total imports for the month of May, 1921, were approximately $205,000,000 and the total exports approximated $300,000,000. The imports for May, 1920, were $431,000,000 and the exports, $745,500,000. For the eleven months ended in May the total imports amounted to $3,468,787,153 and the exports, $6,179,360,357. For the eleven months ended May, 1920, the imports were $4,685,846,580 and the exports, $7,479,611,906.

Philadelphia Plans Sewer Work

The city of Philadelphia will receive bids during late July for the construction of a 6 ft. 6 in. concrete sewer in various streets. The total estimated cost is $1,300,000 and the length of sewer to be built is 63,000 lin.ft.

Road Bonds Sell at Par

Bonds of Pennsylvania's 5 per cent Series C highway construction issue, amounting to $8,805,000, were sold recently at par and accrued interest, a syndicate of Philadelphia, Pittsburgh and New York bankers making the offer on condition that all other bids be rejected and that the bonds not be put out until October.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 2, the next, on July 7.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	—$3.23	$4.00	$4.50	—$3.13	$3.51	$4.65	$4.35	$4.60	$5.00
Structural rivets, 100 lb	4.85	5.25	—5.75	4.88	5.30	—6.00	6.40	5.50	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	—3.13	3.25	3.75	—3.00	3.53½	4.32½	2.35	4.00	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	47½%	5%
Cast-iron pipe, 6 in. and over, ton	54.00	59.22	65.00	54.10	62.80	70.00	85.90	65.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80(del.)	2.60	+2.80	2.17	2.46	3.10	3.09	3.10	3.40
Gravel, ¾ in., cu.yd	2.50	—2.35	—3.00	2.25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	—1.40	—2.50	2.25	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	—2.25	2.80	2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	43.00	40.00	—35.00	55.00	36.00	47.00	27.00	28.50	110.00
Lime, finishing, hydrated, ton	21.00	21.00	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.50	2.75	1.65	1.50	3.10	2.25	2.75	1.00
Common brick, delivered, 1,000	18.40	—11.00	12.50	12.00	17.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	.092	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	.1345	.15	.13	.096	.092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	.80	.98	.88	.91	.95	.96	.79	.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.35@.45	.45	.50	.37½@.50	.50@.55	.50	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quote at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

A warehouse decrease on steel has just been announced in New York. Structural shapes are now selling for $3.23 delivered, as against $3.33 formerly. Reinforcing bars now sell for $3.13, uncut, and $3.28 cut to 2-ft. and over. The Pittsburgh mills are reporting to be operating at about 25 per cent capacity. There is practically no inquiry for billets, bars, plates or rods.

The brick market is much firmer in New York, with $15 the general price alongside dock, although sales have been made at $16. Elsewhere, also the market is firm. Atlanta, quoting $11 as against $11.50 last week, reports the only change during the week.

The lumber market is holding fairly firm, although Southern pine is down $1 in New York. Dallas shows a rather sharp decline, without explanation.

As to labor, it is expected that Judge Landis' decision on the Chicago labor controversy will attempt to end jurisdictional disputes as well as settle the local difficulty. Work is proceeding satisfactorily in Chicago, and permits issued last week totalled 195, at a value of $3,194,250. In Minneapolis the unions have not officially recognized the May 1 cut of 20 per cent but the employers' association reports plenty of labor available at the new scale.

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